Received: 14 January 2022 | Accepted: 14 March 2023

DOI: 10.1002/pan3.10479

PEOPLE AND NATURE | BRITISH ECOLOGICAL SOCIETY

RESEARCH ARTICLE

Nature interactions and their associations with connection to nature and well-being varies between different types of green spaces

Whitney Fleming[1,2] | Assaf Shwartz[1]

[1]Faculty of Architecture and Town Planning, Human and Biodiversity Research Lab, Technion-Israel Institute of Technology, Haifa, Israel

[2]Biology and Chemistry Department, Queens University of Charlotte, Charlotte, North Carolina, USA

Correspondence
Whitney Fleming
Email: whitney.fleming92@gmail.com

Funding information
European Union's Horizon 2020 Research and Innovation Program, Grant/Award Number: 852633-ERC; Zuckerman STEM Leadership Program

Handling Editor: Kathryn Williams

Abstract

1. Increasing urbanization leads to greater loss of interaction with nature over time in a process described as the extinction of experience. Urban green spaces are some of the most prominent sites where individuals can access and interact with nature in urban areas. There is currently a gap in research around how different types of urban green spaces influence nature interactions, their relationships with human well-being, and what influences these relationships. Greater knowledge of these connections can aid in the design of green spaces that can increase human well-being and mitigate the extinction of experience.
2. We conducted a visitor survey in an urban nature site in Israel, which consists of both a garden and protected nature area dominated by natural Mediterranean vegetation. We aimed to understand how visitors interacted with nature at the site and how the interactions differed between the protected nature area and the garden. Both frequency of interactions and number of total interactions were measured. We also investigated the extent to which these interactions associated with nature relatedness (using the NRS scale), well-being (using overall happiness and psychological well-being) and the variables that influence nature interactions and well-being outcomes.
3. Visitors who visited the protected nature area were more likely to interact with nature than those who only visited the garden. Nature interactions were significantly associated with an individual's nature relatedness and their perception of whether the site functioned more similarly to an urban park or a protected nature area. Living nearby was associated with greater attachment to and identity with the site, but also lower frequency of nature interactions. Nature interactions were associated with measures of well-being, including overall happiness, attachment, identity and reflection, but varied depending on well-being measures.
4. Interactions with nature, and their benefits, are not equal based on both actual opportunity for interaction and perceptions of green spaces. Incorporating user preferences of urban green spaces for more wild nature that individuals also

perceive as wilder may allow for greater interaction. Developing urban nature sites that allow for greater interaction can promote human well-being associated with interactions and combat extinction of experience.

KEYWORDS
green space, nature interactions, nature relatedness, subjective well-being, urbanization

1 | INTRODUCTION

More and more people worldwide are losing contact with nature in a process described as the extinction of experience (Pyle, 1979; Soga & Gaston, 2016). The extinction of experience relates to reduction in individuals' interactions with nature, which in turn can impact their affinity toward nature and their willingness to protect it, but also the provision of a variety of health and well-being benefits delivered by these interactions (Cox et al., 2018; Keniger et al., 2013). With increasing urbanization worldwide individuals may have reduced access to nature interactions and therefore to these benefits delivered by nature. Gaston et al. (2018) answers the question of what nature interactions are by defining them as individual interactions where a person resides in the same physical space as nature or perceives it through a stimulus. Examples of nature interactions include visiting urban green spaces or national parks, viewing trees through a window, listening to bird song, or walking your dog in the park (Colléony et al., 2019; Gaston et al., 2018; Soga & Gaston, 2020). Nature interactions are considered rich in their ability to engage multiple senses, notably smells, and tangible sensations that are greater compared to interactions in human-built contexts (Kaplan & Kaplan, 1989). Nature interactions vary in their type (such as conscious interaction and unconscious interaction or positive and negative interaction), as well as are influenced by spatial, temporal and socio-economic dynamics (Soga & Gaston, 2020). Understanding the extent to which individuals can access nature interactions in different urban settings and how they benefit from these interactions is key to identify solutions that can mitigate the extinction of experience.

Mounting empirical evidence demonstrates that interacting with nature delivers a range of measurable benefits to humans such as positive effects on physical health and psychological well-being (reviewed by Keniger et al., 2013). For instance, a study in England showed that people who visited green spaces frequently had greater social, mental and physical health benefits (Cox, Hudson, et al., 2017). Barton and Pretty (2010) found that people who made long visits and practiced exercise in green spaces reported higher self-esteem and mood. Nature interactions can also improve cognition and affect for those experiencing depression (Berman et al., 2012). Additionally, interacting with nature was found to improve psychological health through decreased stress (Van den Berg et al., 2010), increase in social cohesion (Hartig et al., 2014), higher life satisfaction (Chang et al., 2020), and improving general psychological well-being (Annerstedt et al., 2013). These benefits are inherently linked to individuals' access to nature. A dose response can exist between the amount of nature present in built environments and well-being indicators (Shanahan et al., 2015). Cox et al. (2018) demonstrated that individuals in neighbourhoods with less nature had higher incidence of poor mental health, lower social cohesion, and were also prone to less beneficial physical activity. Different types of nature experiences may also affect the mental benefits, or internal dose, an individual receives through differing levels of attention, perceptions, and connectedness to nature (Bratman et al., 2019). Identifying the relationships between these benefits and individuals' interactions with nature may help to reduce the well-being consequences of the extinction of experience.

Additional consequence of the extinction of experience is an increase in alienation from nature which reduces individual's connection and affinity to nature (i.e. orientation toward nature; Soga & Gaston, 2016). There is increasing research on an individual's opportunity for nature interactions but still a gap in how interactions are shaped by opportunity for interactions and how it relates to their connection to nature more broadly (Soga & Gaston, 2020). Interacting with nature on a regular basis can strengthen one's emotional connection to nature (Ballew & Omoto, 2018; Rosa et al., 2018; Zylstra, 2014). People who have a stronger connection to nature are more likely to interact with it regularly and this relationship is also related to positive environmental attitudes (Colléony et al., 2020; Lin et al., 2014; Rosa & Collado, 2019). Further, connectedness or relatedness to nature has been shown as a significant predictor of happiness indicators (Zelenski & Nisbet, 2014), including psychological well-being (Cervinka et al., 2012; Cox, Hudson, et al., 2017). Therefore, better understanding of how interactions with nature are related to an individual's connection with nature also has implications for their well-being. One of the primary drivers of extinction of experience is the loss of opportunity due to urbanization (Soga & Gaston, 2016), so linking well-being benefits for the users of natural areas may be able to inform urban design that most benefits people.

Although urbanization is associated with a lower dose of nature exposure, heavily urbanized areas also represent the places with the greatest potential gain in well-being for individuals if their frequency of nature interactions can be increased (Cox et al., 2018). People interact, perceive and benefit from nature in varied ways (e.g. Faehnle et al., 2014; Tyrväinen et al., 2003) and distinct urban green spaces could influence individuals differently (Ojala et al., 2019). Thus, understanding how different types of urban green spaces are associated with nature interactions is of interest. Even when people set out and spend time in urban green spaces, most of them do not directly seek to interact with nature (e.g. Irvine

et al., 2013), and this, in turn can affect the outcomes of the those interactions (Colléony et al., 2020; Prévot et al., 2018). Some of the daily routine interactions with nature in urban green spaces are not regarded as meaningful nature interaction that strengthen people's connection to nature (Colléony et al., 2019). We thus need to better understand how people interact with nature in varied urban green spaces to examine their potential to foster nature interaction and deliver well-being outcomes. For example, urban nature reserves, characterized by a wild appearance (Pieterse et al., 2010), are one type of green space that provide opportunity to interact with more complex nature than traditional urban parks because urban nature reserves host richer biodiversity than urban green spaces (Alvey, 2006). They may offer similar benefits to visiting an urban park (Özgüner & Kendle, 2006) but also may provide opportunities for activities not well served by urban parks (Thompson, 2002) because of their potential for more profound interactions (Cleary et al., 2020; Van den Berg et al., 2010). These differences may lead to divergent outcomes depending on their ability to foster nature interactions.

Here, we aim to characterize interactions with nature during a visit to an urban protected nature area and garden, identify the variables that associate with those interactions, and understand the outcomes of visiting. Such knowledge can help inform the design of urban green spaces and parks that offer meaningful opportunities to interact with nature and can help mitigate the extinction of experience. We studied a unique site is comprised of both a protected nature area and memorial gardens, which more closely resemble a traditional urban park allowing for comparison between two management types of an urban green space where visitors can have varied interactions with nature. We conducted a visitor survey to specifically answer the following questions: (1) What are the differences in visitors' interactions with nature based on visiting the protected nature area versus garden? (2) How do visitors interact with nature during their visit and which variables determine this interaction? and (3) How do nature interactions associate with well-being? Research design around human well-being and the environment should consider understanding local context, picking tools that are culturally appropriate and measure accurately and, in enough detail (Woodhouse et al., 2015). For this study, we consider well-being related to place-based measures because of urban nature sites are places. Specifically, these relationships are represented in a conceptual framework (Figure 1).

Place-based measures around well-being come from the idea of sense of place which concerns attachment and identity related to place satisfaction (Stedman, 2002). Theory and research on place has shown measuring identity, attachment and reflection as valid measures of well-being in place-based studies (Fuller et al., 2007; Manzo, 2003).

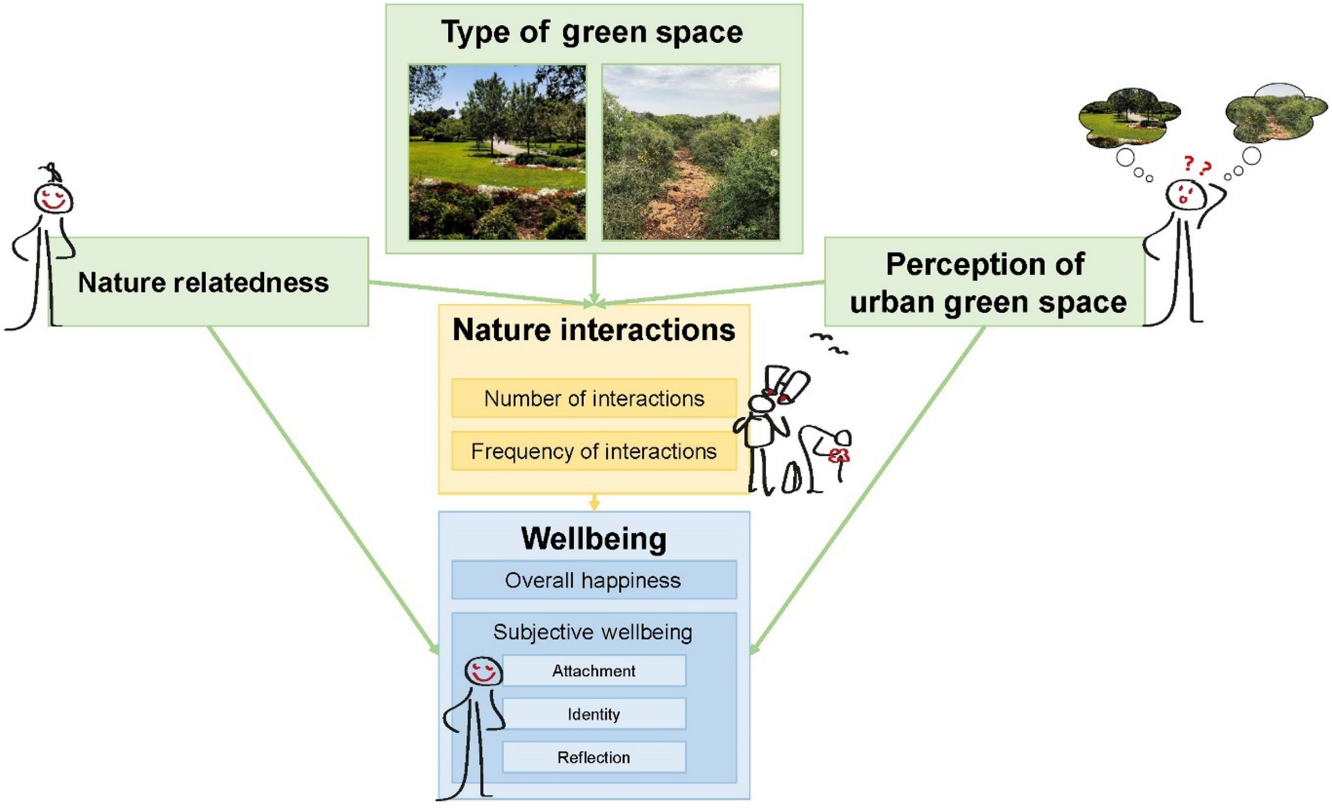

FIGURE 1 Conceptual framework depicting the hypothesized relationships between type of green space, nature relatedness, perception of green space, nature interactions and well-being.

2 | METHODS

2.1 | Study site

We conducted the study in Ramat HaNadiv, a publicly accessible protected nature area and garden in Israel, located in the southern part of Mt. Carmel. Ramat HaNadiv consists of a memorial garden (ca. 7 ha), an intensively managed botanical garden, and a protected nature area comprising approximately 455 ha of natural Mediterranean vegetation with planted pine and cypress groves (Bashan & Bar-Massada, 2017). The park is surrounded by urban areas, and it also hosts one of the Long-Term Socio-Ecological Research (LTSER) stations, as part of the global and Israel LTSER network. Annually, it attracts over half million visitors and promotes education and environmental knowledge with an emphasis on emotional connection to nature. Therefore, Ramat HaNadiv offers a unique opportunity to explore human nature interactions and their outcomes in one site, which consists of both intensively managed garden and natural Mediterranean protected area that hosts diverse visitors from nearby urban areas and across the country.

2.2 | Study design

During Passover vacation 2018 (April), a survey was conducted where 596 questionnaires were distributed to visitors of Ramat HaNadiv (hereafter referred as RH). Two surveys were developed where 299 participants answered the questionnaire before their visit, and 297 after their visit. For two reasons, the questionnaire from before the visit was not used in this study. First, the questionnaires were broad with intent for collection for multiple studies, and this study was interested specifically in the interactions individuals had with nature during the visit and their outcomes at the different parts of RH, and the before questionnaire inherently does not measure interaction. Second, a number of methodological challenges including inconsistency of questions on the before/after instrument, different participants in the before/after groups, and challenges in intercepting individuals before their visit (i.e. there is no clear entrance, and so some before visitors were already within the park) led to a lack of robustness and feasible comparison.

Below we detail the scales and measures used in the analysis. The 'after visit' survey included questions on: (1) the perception of RH (values and its function), (2) connection to nature, (3) whether respondents live nearby, (4) demographic variables, (5) types of nature interactions during the visit, (6) frequency of nature interactions, (7) subjective well-being and (8) overall happiness. The development of the questionnaires was conducted in collaboration with RH management. A focus group was conducted with the management team of RH to decide on the scales and variables that were used in the survey. The questionnaire was administered in Hebrew, but the questionnaire can be found in the Supporting Information in English and Hebrew (Text S1).

Participants signed an informed consent form before answering the questionnaire. They were also offered small gifts (plant seeds) in exchange for participation. Permission for this study was granted by the Technion Social and Behavioural Sciences Institutional Review Board (approval number: 2018-024), and the research was performed in accordance with relevant guidelines and regulations.

2.3 | Data collection & preparation

To measure nature interactions (NI), we used a tool developed by Colléony et al. (2020) to assess nature interactions including the extent to which participants interacted with nature during their visit. Respondents were provided with a list of 35 specific nature interactions mainly related to seeing, smelling, hearing, touching and taking pictures. They were asked whether they did or did not do each behaviour (yes/no) during the visit. For instance, 'did you see a bird?', 'did you touch leaves?', 'did you smell pine trees?' and 'did you take a picture of landscape?'. This list contained other behaviours, not related to nature (e.g. 'did you smell car pollution?', or 'Did you hear cars?'). While these items were considered beyond the scope of this study, they were modelled exploratorily as independent variables, and found overall not to be related to nature relatedness or well-being outcomes, and not used in further analyses (Text S2). Items were presented in a random order. Score of nature interactions was derived for each participant by summing the number of positive answers (answered "yes") for a total combined score for overall nature interaction (NI) (Cronbach Alpha = 0.84). Nature interactions were also measured as the frequency with which participants interacted with nature by answering nine questions about specific nature interactions on a 5-point scale on the frequency with which they interacted during their visit from 1 (not at all) to 5 (throughout the visit). Based on satisfactory internal consistency (Cronbach alpha = 0.75), we derived a single measure of nature interaction frequency by averaging scores of the nine items for analyses.

Respondents were also asked to report whether they think RH functions more as an urban park or a protected nature area on a continuous scale from 0 (urban park) to 10 (protected nature area). To measure connection to nature (NR), we used the 6-item version of the Nature Relatedness scale (Nisbet & Zelenski, 2013). Participants rated their level of agreement to each statement on a 5-point scale, from 1(strongly disagree) to 5 (strongly agree). Based on satisfactory internal consistency (Cronbach alpha = 0.81), we derived a single measure of NR by averaging scores of the six items for analyses. While there are many scales to understand connection to nature, a comprehensive review of scales confirmed strong convergent validity among measures included NR, because of how similar the different scale are (Restall & Conrad, 2015). Subjective well-being was measured using Fuller et al.'s (2007) scale that explores attachment (Cronbach alpha = 0.87), identify (Cronbach alpha = 0.77), and reflection (Cronbach alpha = 0.74).[1] Additionally, we measured how happy visitors were after their visit using the Overall Happiness Scale (OHS; Hartig et al., 2003),

a thermometer-like scale ranging from 0 (not happy at all) to 10 (very happy). Finally, we asked respondents to provide information regarding the places in RH they visited (the protected nature area, memorial gardens or both places), their gender, year of birth, number of children, average income (on a scale from 0 below average to 10 above average; they were told average household income is 15,400 NIS), and education level (below high school, high school, bachelor degree, second degree, third degree). We also asked them whether they live nearby RH (yes/no), and the urbanization level of their current place of residence and childhood place of residence (large city, medium sized city, rural settlement).

2.4 | Data analyses

Statistical analyses were conducted in RStudio (version 1.1.456; R Core Team, 2014). Difference in average nature interaction, as measured by the total number of interaction and frequency of interaction, by place(s) visited (garden, protected nature area or both) were plotted and tested with ANOVA for significant difference between groups (Ahlmann-Eltze & Patil, 2021, function *ggsignif*). Thirty-five generalized linear models with binomial error structures were built to explore how individual nature interactions (e.g. see a bird) were associated with the place respondents visited (i.e. garden, nature park or both). Two linear models were built to test the relationship between NI (both frequency and number of interactions) and individuals' view on the function of the site, nature relatedness, living nearby and demographics. Four additional linear models were built to explore the relationships between well-being variables (three components of subjective well-being, and one for overall happiness) and nature interactions, as well as individuals' view on the function of the site, nature relatedness, living nearby and demographics. Correlations between independent variables were tested, and all correlations were <0.6. A variance inflation factor was calculated between all independent variables, which showed no concerning multicollinearity between variables with factors ranging from 1.03 to 1.74.

3 | RESULTS

The majority of survey respondents were urban dwellers (77%), female (56%), highly educated (61% holding a bachelor degree or higher), married (69%), did not live near Ramat Hanadiv (67%) and generally grew up in urban areas (75%). On average respondents were around 44 years old (50% between the ages of 32 and 57), had two children (50% between two and three children), and had a household income slightly above the average for Israel (mean = 5.9, while 5.0 represents the average income per household in Israel 15,400 NIS). The frequency with which visitors interacted with nature and the number of interactions (NI) had a correlation of 0.5. Analysis of individual statements of NI reveal that the top five nature interactions were: smelled herbs, smelled flowers, saw a bird, photographed scenery, and heard birds singing (Table 1). The percentage of participants who engaged in a nature activity ranged from 80% (smelled herbs) to 3% (saw a hedgehog) with an average engagement of 41% across all activities (Table 1). This equates to an average of around 15 interactions per person, with a reported minimum of zero and maximum of 35. A summary of engagement in non-nature activities can be found in supplemental material (Text S3).

The mean score for frequency of nature interactions was a 3.5, indicating individuals felt they interacted with nature somewhere between half of the time and all the time throughout their visit. On average, visitors interacted more with nature when they visited the protected nature area compared to the memorial gardens (Figure 2), regardless of the type of measure used to explore nature interactions (i.e. number of distinct interactions, or the frequency of interactions). While responders reported all types of interactions in both the park and the garden, the frequencies differed between the two areas (Table 1). Out of the 35 interactions eight were mentioned more frequently by garden compared to nature park visitors (Table 1). We found that for 13 nature interactions the number of times an interaction was mentioned by garden or nature park visitors were significant at the 0.05 level (Table 1). Among those interactions only three were higher for the garden visitors (i.e. smelled herbs, grass and heard water) and the reset (e.g. saw a bird, photographed scenery and touched rock) were more frequently mentioned by nature park visitors (Table 1). The distribution of the different types of nature interactions between the garden and the nature park (or both) by visitors can be found in Supporting Information (Text S4).

The first model predicting nature interaction explained 17% of the variation in responses to how frequently people interacted with nature throughout their visit. Overall nature relatedness and how individuals perceived the site (urban park versus protected nature area) exhibited a significant positive association with how frequently people interacted with nature (Figure 3). Whether individuals lived near Ramat Hanadiv exhibited a significant negative association with how frequently people interacted with nature (Figure 3). Gender, age, education level, income, civil status, childhood residence and current residence were not significantly associated with how frequently people interacted with nature in the model (Table 2).

Similarly, the second model predicting nature interaction explained 17% of the variation in responses to how many types of interactions people had with nature throughout their visit. Overall nature relatedness and how individuals perceived the site (urban park versus protected nature area) exhibited a significant positive association with how many types of interactions people had with nature (Table 2; Figure 4). Age exhibited a significant negative association with how many types of interactions people had with nature (Figure 4). Childhood residence, a variable coded as a factor from rural to urban, also exhibited a significant negative association with number of interactions, suggesting fewer interactions for those that grew up in a small or medium city (Figure 4). Gender, age, education level, income, civil status and current residence were not significantly associated with the number of nature interactions people experienced in the model.

TABLE 1 Number of times and percentage (in brackets) each nature interaction was mentioned by visitors to Ramat HaNadiv. The percentage of times each nature interaction was mentioned by respondents who visited the nature park or the garden, as well as, the results of 35 generalized linear models with binomial error structure flagging statistical significance for each nature interactions. Coefficient (β), standard errors (*SE*) and *p*-values are presented, for the differences between garden and park (garden as reference).

Type of nature interaction	Time mentioned (%)	Park	Garden	β	*SE*	*p*-value
Smelled Herbs	237 (81%)	70%	90%	−1.34	0.35	**<0.001**
Saw a bird	229 (77%)	83%	72%	−1.06	0.33	0.069
Smelled flowers	228 (79%)	73%	83%	−0.59	0.33	0.071
Photographed scenery	227 (76%)	83%	71%	0.67	0.33	**0.045**
Heard birds chirping	222 (76%)	71%	77%	−0.32	0.31	0.288
Photographed flowers	192 (65%)	71%	65%	0.27	0.29	0.349
Touched a rock	192 (67%)	71%	57%	0.65	0.29	**0.026**
Heard water flow	192 (68%)	54%	80%	−1.25	0.30	**<0.001**
Touched a tree	189 (66%)	79%	61%	0.87	0.31	**0.005**
Saw a butterfly	181 (61%)	74%	53%	0.92	0.30	**0.002**
Photographed trees	178 (60%)	67%	61%	0.26	0.28	0.353
Touched leaves	177 (62%)	64%	59%	0.20	0.28	0.468
Touched a flower	165 (58%)	57%	54%	0.14	0.27	0.600
Touched weeds	157 (53%)	60%	48%	0.49	0.27	0.073
Saw a bee	139 (47%)	52%	42%	0.39	0.27	0.148
Smelled grass	125 (42%)	36%	50%	−0.57	0.28	**0.040**
Saw a beetle	121 (41%)	55%	25%	1.33	0.28	**<0.001**
Touched the ground	121 (42%)	55%	34%	0.85	0.28	**0.002**
Smelled Soil	119 (40%)	44%	40%	0.16	0.27	0.550
Smelled pine trees	112 (38%)	43%	37%	0.21	0.27	0.435
Heard wildlife	103 (35%)	34%	33%	0.07	0.28	0.803
Heard the sounds of insects	91 (31%)	36%	26%	0.45	0.29	0.120
Touched the water	91 (32%)	27%	34%	−0.31	0.30	0.296
Followed animals	76 (27%)	29%	33%	0.31	0.31	0.317
Saw a lizard	65 (22%)	23%	16%	0.45	0.34	0.182
Photographed animals	65 (22%)	29%	14%	0.86	0.33	**0.009**
Photographed the sky	65 (22%)	29%	17%	0.68	0.32	**0.033**
Collected leaves or stones	52 (18%)	23%	13%	0.72	0.35	**0.039**
Took close-up pictures of insects	49 (16%)	26%	12%	0.98	0.35	**0.005**
Heard the croaking of a frog	49 (38%)	14%	16%	−0.18	0.38	0.639
Saw a frog	38 (13%)	13%	12%	0.04	0.40	0.916
Touched animals	18 (6%)	5%	4%	0.05	0.64	0.944
Saw a wild boar	16 (5%)	2%	4%	−0.51	0.83	0.537
Saw jackal	13 (14%)	3%	2%	0.60	0.83	0.469
Saw a hedgehog	10 (3%)	1%	3%	−0.80	1.13	0.479

Note: Bolded values indicates signfigant at the $p < 0.05$ level.

Models explaining variation in response to subjective well-being showed some consistency. In responses on overall happiness after the visit, the model explained 15% of the total variation. Nature relatedness and how individuals perceived the site exhibited a significant positive association, and number of nature interactions exhibited a significant negative association with overall happiness (Table 3). In responses on the attachment component of subjective well-being, the model explained 29% of the total variation, where frequency of nature interactions, nature relatedness, living nearby and how individuals perceived the site exhibited a significant positive association with attachment (Table 3). In responses on the identity component of subjective well-being, the model explained 32% of the total variation, where frequency of nature interactions, nature relatedness, living nearby and how individuals perceived the site (urban park versus protected nature area) exhibited a significant positive association with identity (Table 3). In responses on the reflection component

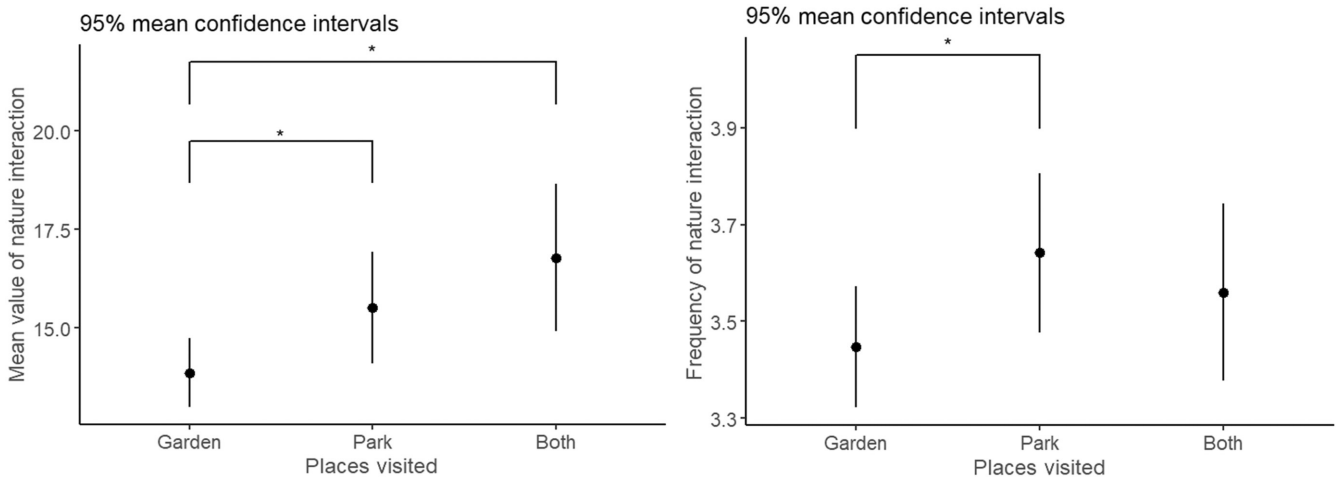

FIGURE 2 Average amount of nature interactions by number of activities (left) and frequency of interactions (right) per respondent by which area(s) of Ramat HaNadiv they visited. Statistically significant differences between groups (*) are indicated at the 0.05 level.

of subjective well-being, the model explained 32% of the total variation, where number of nature interactions, nature relatedness, and how individuals perceived the site exhibited a significant positive association, and education exhibited a significant negative association with reflection (Table 3). Gender, age, income, number of children, civil status, childhood residence and current residence were not significantly associated in any of the models of subjective well-being.

4 | DISCUSSION

Our study examined the relationships between nature connection, nature interactions and well-being outcomes in protected nature area versus garden, as a potential means of combating extinction of experience. Extinction of experience originating from reduction in nature interactions is related to individuals' connection to nature and has implications for the well-being benefits derived from these interactions (Cox et al., 2018; Keniger et al., 2013). Our results indicate that those with stronger connections to nature are more likely to interact with nature, and greater interactions with nature are associated with better well-being outcomes. Additionally, the type of nature site individuals visit, a garden or a protected nature area, is significantly related to their interaction where more wild nature promotes greater interaction. Not only does the actual nature site relate to interaction, but how people perceive the site is also significantly related to interactions where perceptions of more wild nature also promote greater interaction.

The type of urban site, protected nature area versus garden, mattered for individual's nature interactions. By examining nature interactions in cities with disparate urban planning, previous research has found total interaction time varies depending on access to different types of green spaces (Oh et al., 2021). In our study individuals were more likely to interact with nature in both frequency and number of unique interactions if they visited the protected nature area portion of the site compared to just the memorial garden. While all types of nature interactions were mentioned by both garden and nature park visitors, their prevalence varied between the two types of green spaces. For instance, visitors to the gardens mentioned smelled herbs, heard water and smelled grass more frequently than the ones of visited the nature park. These results coincide with the design of the garden, which contain a fragrance garden, a small ecological pond with a fountain that strengthen the sound of water, and vast lawns. Thus, introducing water bodies and other elements that facilitate sensing-based interaction with nature in urban parks and garden can strengthen nature interaction (Xiao et al., 2017), aesthetic appeal (Lindemann-Matthies & Köhler, 2019), contribute to the connection of people to nature (Fischer & Kowarik, 2020) and also enhance urban biodiversity (e.g. Shwartz et al., 2008, 2013).

On the other hand, interactions with more pristine nature such as, touching a rock, tree, the ground, seeing and taking photos of wildlife (butterfly, bird, lizard and beetle) the sky and scenery were more frequently reported among visitors to the nature park, as expected. The characteristics of more wild nature, therefore, may give individuals the opportunity to have more profound, varied and more frequent interactions with nature. Other studies have found that the type of nature matters for individual connectedness to nature and frequency of visitation (Colléony et al., 2017), as well as finding that individuals express preferences for more of specific natural elements in urban green spaces such as trees (Talal et al., 2021). While urban nature areas in general are important to address the extinction of experience (Shanahan et al., 2015), specific types of nature sites can increase opportunity for meaningful interactions. As an alternative explanation, it may also be the case that the interactions listed on the questionnaire may be more suited to the protected nature area compared to the garden (e.g. if individuals are encouraged not to touch plants in the garden). So rather than specifically promoting more interaction, the instruments used could show a bias toward one of the study sites. However, in this study we also found that nature relatedness, perceptual and socio-demographic variables influenced nature interactions. Thus, one size may not fit all, and considering a

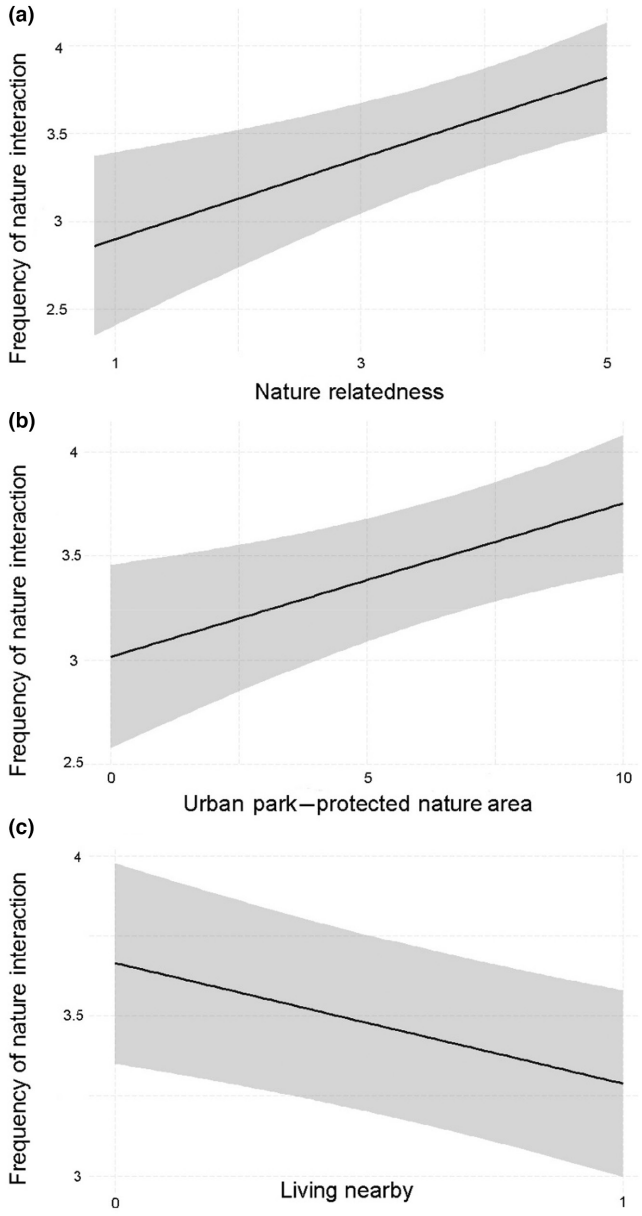

FIGURE 3 Effects of variables significantly ($p < 0.05$) associated—(a) nature relatedness, (b) perceived function of the site and (c) living nearby—in the linear model predicting how frequently people interacted with nature throughout their visit to Ramat HaNadiv.

variety of nature sites may be important to provide different nature interaction opportunities for various individuals.

Overall, individuals who visited Ramat HaNadiv indicated on average they engaged with nature in just under half of the ways in which we measured interaction. Individuals also indicated they felt that the frequency with which they interacted with nature was high. Specific types of interactions were more common than others, such as smelling herbs and seeing a bird, where others were quite rare, such as seeing a jackal or a hedgehog (as expected since these species are active at night). These results are somewhat intuitive as specific types of interactions would expectedly be more commonplace (especially given the site has a dedicated "fragrance garden"). Interactions with nature also increased in both number and frequency for participants when participants had higher nature relatedness. This is in-line with previous research demonstrating that while the opportunity for nature interaction is important, an individual's orientation toward nature may be a more important driver of visiting parks and meaningful nature interactions (Colléony et al., 2020; Lin et al., 2014). Thus, accommodating people's connection to nature is equally as important as providing access to it.

Living nearby was associated in a decrease in how frequently individuals interacted with nature throughout their visit. This could be due to a lack of novelty inducing fewer interactions, such as not taking pictures of a place frequently visited. Previous research on novelty seeking has indicated that novelty has a moderating effect on both past visitation to a site and an individual's place attachment, and between their place attachment and intention to revisit (George & George, 2004). Living nearby may also decrease interaction because individual's have knowledge that an opportunity is available, even if they do not act on that opportunity (Kaplan, 1992), where the opportunity would not be available living farther away. Childhood residence was also a significant predictor of total number of interactions, where living in a rural settlement was associated with more interaction compared with living in a city. Previous research has shown a significant association between childhood recreation behaviour and adult recreation behaviour, but not necessarily childhood residence (Yoesting & Burkhead, 1973). Childhood residence in more rural areas was found to be positively correlated to the proximity of urban residence to green spaces at adulthood (Colléony et al., 2020), and childhood residence in cities was negatively correlated to the level of engagements in conservation education activities and the number of plant species people wanted to have in gardens (Shwartz et al., 2013). Extinction of experience related to loss of nature interactions of children can influence their nature relatedness, and therefore their nature interactions as adults (Chawla, 2020). As urbanization increases, childhood residence and extinction of experience for children may play a larger role in nature interactions in the future.

Interestingly, individuals who viewed the park more as a protected nature area had higher nature interactions and all well-being measure scores on average, implying that perceptions of naturalness of the site can influence interactions with nature and their outcomes. Other studies have already found that perceptions of greater biodiversity and more wild nature are related to greater restorative outcomes and therefore improved well-being (Fisher et al., 2009), whether or not those areas are actually higher in biodiversity and wild nature (Dallimer et al., 2012; Shwartz et al., 2014). For instance, in Southern England perceived species richness, and not actual richness, was related to site satisfaction and nature connectedness in experimentally manipulated flower meadows (Southon et al., 2018). Altogether these results highlight that examining the determinants of why individuals perceive a given site as more natural or biodiverse can be important for promoting nature interactions and well-being benefits that can help mitigate extinction of experience. We therefore suggest that future research should aim to disentangle the

TABLE 2 Results of two linear models exploring the variables the influence nature interactions in Ramat HaNadiv measured using the frequency of nature interactions and total number of nature interactions.

	Frequency of nature interactions			Total number of interactions		
	β	*SE*	R^2/adj R^2	*β*	*SE*	R^2/adj R^2
			0.17/0.11			0.18/0.12
Urban park/protected nature area	**0.07****	0.03		**0.73*****	0.20	
Nature relatedness	**0.23****	0.07		**1.98*****	0.53	
Gender[a]	0.09	0.11		−0.17	0.86	
Age	−0.00	0.00		**−0.08***	0.04	
Education[b]	0.06	0.05		0.46	0.41	
Income[c]	0.01	0.03		0.09	0.21	
Civil status[d]	−0.17	0.15		−1.00	1.16	
Childhood residence[e]						
[1]	−0.25	0.17		**−2.67***	1.31	
[2]	−0.13	0.15		−1.88	1.16	
Current residence[e]						
[1]	0.17	0.16		0.79	1.21	
[2]	0.08	0.16		1.40	1.25	
Children	0.06	0.05		0.48	0.41	
Live nearby[f]	**−0.38****	0.13		−0.92	0.97	

Note: Bolded values indicates signfigant at the $p < 0.05$ level.

[a]Dummy variable where women are "0" and men are "1".

[b]Item coded from 0 "elementary" to 4 "masters or higher".

[c]Item coded from 0 "below average" to 4 "above average".

[d]Dummy variable where married is "0" and not married is "1".

[e]Factor where community, rural settlement, is "0," medium or small city is "1," and large city is "2".

[f]Dummy variable where no is "0" and yes is "1".

*Significant at $p < 0.05$; **Significant at $p < 0.01$; ***Significant at $p < 0.001$.

complexities and inconsistencies in the relationships between perceived and actual biodiversity, nature interactions and well-being, so as to design environments that encourage nature experience.

Interacting with nature was also related to the outcomes of subjective well-being, as were how individuals viewed the park, and their nature relatedness. Previous research has indicated aspects of well-being including psychological well-being, meaningfulness, and vitality are significantly correlated with an individual's connection to nature (Cervinka et al., 2012), and even that sustainable behaviours significantly influence happiness (Corral-Verdugo et al., 2011). Our results support these findings that perceptions of and connection with nature are positively related to well-being. Individuals' frequency of nature interactions throughout the visit was positively associated with both attachment and identity. The number of nature interactions was positively associated with reflection and negatively with overall happiness. The latter contradicts previous studies demonstrating a positive relation between several measures of psychological well-being and nature interactions (Duvall, 2011). This result should be considered with caution, as the effect size here was rather low. However, it is important to note that nature interactions are not always positive (Soga & Gaston, 2022) and they vary between individuals and contexts as we showed here (e.g. age, childhood residence and nature relatedness). Future research would benefit from a better understanding on how unique nature interactions associate with measures of well-being including the number of interactions and type of interactions. Living nearby was also positively associated in attachment and identity. These findings may be supported by literature on sense of place, where specific characteristics of natural places are related to an individual's place attachment and identity (Masterson et al., 2017; Stedman, 2003). Living near a nature site may contribute to well-being because it may provide both real opportunities to interact with nature, but also individual knowledge of "thereness" where benefits are derived knowing the nature is there (Kaplan, 1992).

4.1 | Limitations and future directions

An important limitation of this study is that it does not compare the effect of nature interactions in terms of those who experience them and those who do not. Certain interactions with nature, such as seeing large trees, or just being physically present in nature were

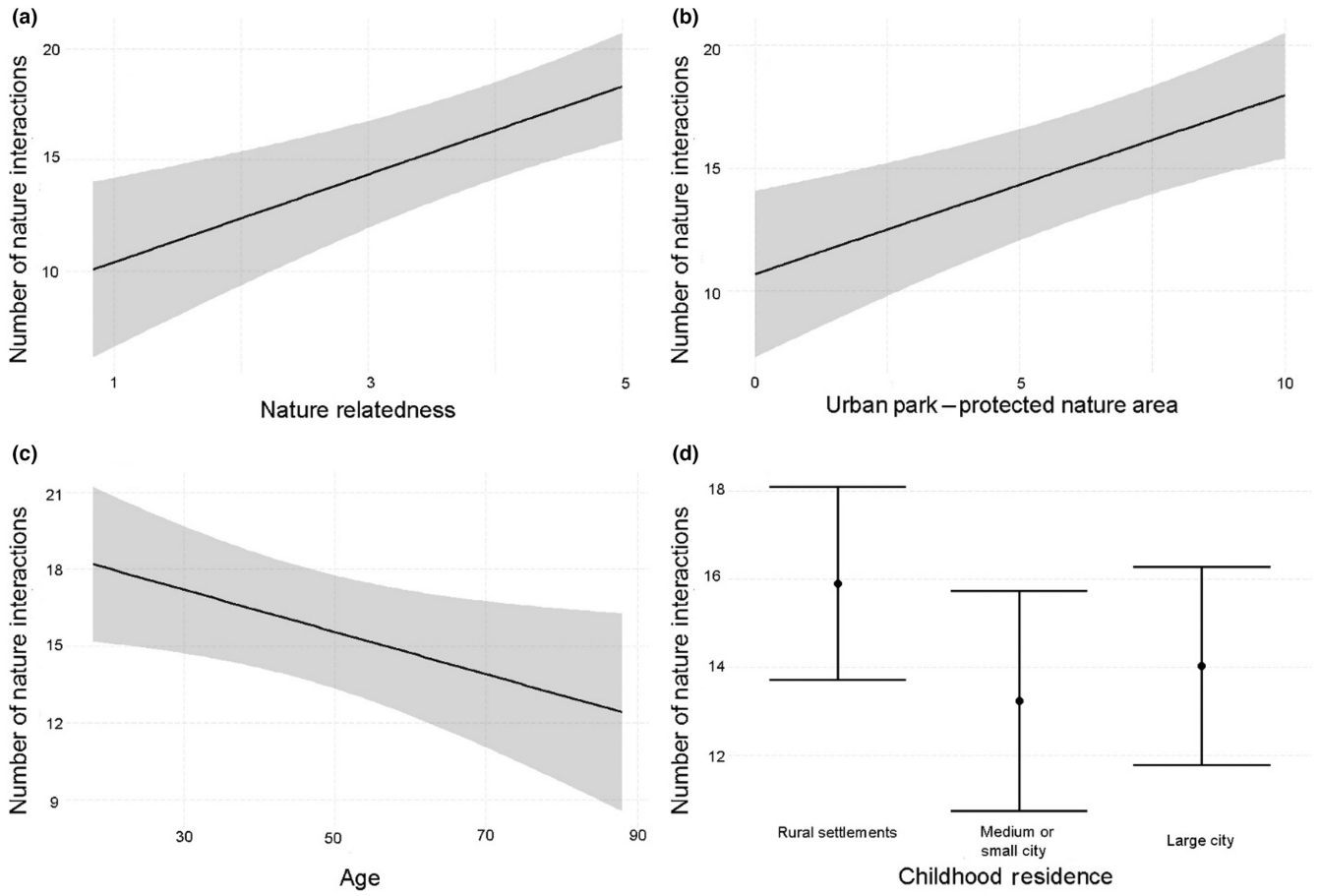

FIGURE 4 Effects of variables significantly ($p < 0.05$) associated—(a) nature relatedness, (b) perceived function of the site, (c) age and (d) childhood residence with standard error—in the linear model of predicted how many types of interactions people had with nature throughout their visit to Ramat HaNadiv.

not measured because all individuals would have had this experience during their visit (at least non consciously). Simply visiting the park therefore may have effects that are not captured here. So even though meaningful nature experiences are more highly related to well-being outcomes (Colléony et al., 2020), the most common nature interactions people have in general are experiences where they are not actually present in nature (Cox, Shanahan, et al., 2017) and simply experiencing nature may effect individual well-being. Additional comparative studies related to nature interactions versus non-nature interactions that contribute to human well-being, and how meaningful those interactions are, would add to this dialogue. Furthermore, this study was based on a convenience sample and those visiting the park may also already be inclined to seek out nature interactions, which could influence the effect of nature interactions on well-being. A cross-sectional survey design that measured well-being before and after visiting the park was not utilized, which also could have contributed to better understanding the relationship with nature interactions.

In this study we did not measure the time spent in nature adequately. While the original questionnaire had a question to gauge the amount of time individuals spent in different parts of the park, the phrasing of the question and substantial lack of response (~50%) means this study cannot understand the potentially confounding factor of time spent in a place. Of those who did answer our time question, the average duration individuals spent in the park was about twice as long (90 min) as they spent in the garden (45 min). Future research would benefit from further exploring the relationship between interaction, time spent, and well-being outcomes. It is worth noting, however, studies have shown well-being from nature is more greatly derived from the engagement individuals have with nature rather than the time an individual spends in nature (Richardson et al., 2021). Finally, this study only measured nearby as a subjective concept, and nearby could mean very different things to different individuals. As there is little literature on what constitutes nearby and what is nearby nature, we suggest additional studies to clarify this concept. Our study also did not measure well-being related to all components of experiencing nature. Russell et al. (2013) describes experiencing nature as knowing, perceiving, interacting, and living within nature. Under this framework, our study only focused on direct interactions with nature (and to an extent perceiving), and so may have missed aspects of experience that may be important to well-being. Future research would benefit from understanding what the determinants of nature are experience wholistically and its implications for well-being outcomes.

TABLE 3 Regression analysis results of linear model for subjective well-being in Ramat HaNadiv.

	Overall happiness			Subjective well-being—attachment			Subjective well-being—identity			Subjective well-being—reflection		
	β	*SE*	R^2/adj R^2	β	*SE*	R^2/adj R^2	β	*SE*	R^2/adj R^2	β	*SE*	R^2/adj R^2
			0.15/0.08			0.29/0.23			0.32/0.26			0.32/0.26
Urban park/protected nature area	**0.14****	0.05		**0.06****	0.02		**0.03***	0.01		**0.08****	0.03	
Nature Relatedness	**0.36****	0.12		**0.20*****	0.05		**0.12****	0.03		**0.33*****	0.07	
Gender[a]	−0.11	0.19		0.10	0.08		−0.00	0.05		0.12	0.11	
Age	−0.01	0.01		0.00	0.00		−0.00	0.00		−0.00	0.01	
Education[b]	−0.06	0.09		−0.01	0.04		−0.01	0.02		**−0.12***	0.05	
Income[c]	−0.00	0.05		0.00	0.02		0.01	0.01		−0.00	0.03	
Civil status[d]	0.30	0.26		−0.02	0.11		0.04	0.07		0.03	0.15	
Childhood residence[e]												
[1]	−0.09	0.29		−0.15	0.13		−0.04	0.08		−0.20	0.17	
[2]	0.03	0.26		−0.10	0.11		−0.02	0.07		−0.09	0.15	
Current residence[e]												
[1]	−0.00	0.27		0.21	0.12		0.13	0.07		0.29	0.16	
[2]	0.16	0.28		0.08	0.12		0.07	0.07		0.08	0.16	
Children	0.08	0.09		0.03	0.04		0.04	0.02		0.01	0.05	
Live Nearby[f]	−0.12	0.22		**0.20***	0.10		**0.14***	0.06		−0.08	0.13	
Frequency of nature interaction	0.21	0.14		**0.21****	0.06		**0.15*****	0.04		0.07	0.08	
Number of nature interactions	**−0.05***	0.02		−0.00	0.01		0.00	0.00		**0.02***	0.01	

Note: Bolded values indicates signfigant at the $p < 0.05$ level.

[a]Dummy variable where women are "0" and men are "1".

[b]Item coded from 0 "elementary" to 4 "masters or higher".

[c]Item coded from 0 "below average" to 4 "above average".

[d]Dummy variable where married is "0" and not married is "1".

[e]Factor where community, rural settlement is "0," medium or small city is "1," and large city is "2".

[f]Dummy variable where no is "0" and yes is "1".

*Significant at $p < 0.05$; **Significant at $p < 0.01$; ***Significant at $p < 0.001$.

5 | CONCLUSIONS AND IMPLICATIONS

Urban nature areas have the potential to address the extinction of experience and subsequently contribute to human well-being. Our study indicates different types of green spaces will provide different opportunity for nature interactions and that stronger connections to nature are more likely to induce nature interactions, and greater interactions subsequently are related to well-being outcomes. Additionally people differ in the type of nature interaction they seek depending on if they live nearby (Ayala-Azcárraga et al., 2019). Different planning solutions are required to account for the variety of people accessing them to both encourage those with low affinity to nature to interact with nature, but also provide opportunity for those with high affinity to nature with spaces they can benefit from. Connecting people to nature is key for both well-being and nature interactions. This has implications for urban planning and policy in terms of the design of urban nature areas to promote human well-being because the perception of these spaces is related to their use and user experience (Ayala-Azcárraga et al., 2019).Taking green space user preferences into account can improve planning as they are the end users of these spaces (Özgüner, 2011). Creating opportunity for more wild nature is more likely to induce individuals to interact with nature, as are perceptions of wild nature. Therefore, both the realized and perceived opportunity to access natural areas influence nature interactions and experience.

AUTHOR CONTRIBUTIONS

Assaf Shwartz conceived the idea for the paper and collected the data; Whitney Fleming analysed the data and wrote the manuscript; and both authors contributed substantially to revisions.

ACKNOWLEDGEMENTS

The authors thank Ramat HaNadiv for their support and cooperation that made this project possible. They also thank Danielle Bashan for managing the survey.

FUNDING INFORMATION

This project has received funding from the European Union's Horizon 2020 Research and Innovation Program under grant No. 852633-ERC—Beyond assuming co-benefits in Nature-based Solutions: Applying the niche concept for optimizing social and ecological outcomes (Niche4NBS). The corresponding author was also supported by a Zuckerman Fellowship.

CONFLICT OF INTEREST STATEMENT

Assaf is an Associate Editor for People and Nature, but was not involved in the peer review and decision making process.

DATA AVAILABILITY STATEMENT

The data are archived at: Fleming & Swartz (2023), Nature interactions and their associations with connection to nature and well-being varies between different types of green spaces data, Dryad, Dataset, https://doi.org/10.5061/dryad.w0vt4b8x2.

ORCID

Whitney Fleming https://orcid.org/0000-0001-6381-240X

ENDNOTE

[1] Confirmatory factor analysis and reliability revealed the item "I am not satisfied with RH" associated with the identity item should be removed, and was therefore removed from subsequent analyses.

REFERENCES

Ahlmann-Eltze, C., & Patil, I. (2021). *Ggsignif*. https://cran.r-project.org/web/packages/ggsignif/vignettes/intro.html

Alvey, A. A. (2006). Promoting and preserving biodiversity in the urban forest. *Urban Forestry & Urban Greening*, *5*(4), 195–201. https://doi.org/10.1016/j.ufug.2006.09.003

Annerstedt, M., Jönsson, P., Wallergård, M., Johansson, G., Karlson, B., Grahn, P., Hansen, Å. M., & Währborg, P. (2013). Inducing physiological stress recovery with sounds of nature in a virtual reality forest—Results from a pilot study. *Physiology & Behavior*, *118*, 240–250. https://doi.org/10.1016/j.physbeh.2013.05.023

Ayala-Azcárraga, C., Diaz, D., & Zambrano, L. (2019). Characteristics of urban parks and their relation to user well-being. *Landscape and Urban Planning*, *189*, 27–35. https://doi.org/10.1016/j.landurbplan.2019.04.005

Ballew, M. T., & Omoto, A. M. (2018). Absorption: How nature experiences promote awe and other positive emotions. *Ecopsychology*, *10*(1), 26–35. https://doi.org/10.1089/eco.2017.0044

Barton, J., & Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environmental Science & Technology*, *44*(10), 3947–3955. https://doi.org/10.1021/es903183r

Bashan, D., & Bar-Massada, A. (2017). Regeneration dynamics of woody vegetation in a Mediterranean landscape under different disturbance-based management treatments. *Applied Vegetation Science*, *20*(1), 106–114.

Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., Kaplan, S., Sherdell, L., Gotlib, I. H., & Jonides, J. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of Affective Disorders*, *140*(3), 300–305. https://doi.org/10.1016/j.jad.2012.03.012

Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., de Vries, S., Flanders, J., Folke, C., Frumkin, H., Gross, J. J., Hartig, T., Kahn, P. H., Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., … Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, *5*(7), eaax0903. https://doi.org/10.1126/sciadv.aax0903

Cervinka, R., Röderer, K., & Hefler, E. (2012). Are nature lovers happy? On various indicators of well-being and connectedness with nature. *Journal of Health Psychology*, *17*(3), 379–388. https://doi.org/10.1177/1359105311416873

Chang, C., Oh, R. R. Y., Nghiem, T. P. L., Zhang, Y., Tan, C. L. Y., Lin, B. B., Gaston, K. J., Fuller, R. A., & Carrasco, L. R. (2020). Life satisfaction linked to the diversity of nature experiences and nature views from the window. *Landscape and Urban Planning*, *202*, 103874. https://doi.org/10.1016/j.landurbplan.2020.103874

Chawla, L. (2020). Childhood nature connection and constructive hope: A review of research on connecting with nature and coping with environmental loss. *People and Nature*, *2*(3), 619–642. https://doi.org/10.1002/pan3.10128

Cleary, A., Fielding, K. S., Murray, Z., & Roiko, A. (2020). Predictors of nature connection among urban residents: Assessing the role of childhood and adult nature experiences. *Environment and Behavior*, *52*(6), 579–610. https://doi.org/10.1177/0013916518811431

Colléony, A., Levontin, L., & Shwartz, A. (2020). Promoting meaningful and positive nature interactions for visitors to green spaces. *Conservation Biology*, *34*, 1373–1382.

Colléony, A., Prévot, A.-C., Saint Jalme, M., & Clayton, S. (2017). What kind of landscape management can counteract the extinction of experience? *Landscape and Urban Planning*, *159*, 23–31. https://doi.org/10.1016/j.landurbplan.2016.11.010

Colléony, A., White, R., & Shwartz, A. (2019). The influence of spending time outside on experience of nature and environmental attitudes. *Landscape and Urban Planning*, *187*, 96–104. https://doi.org/10.1016/j.landurbplan.2019.03.010

Corral-Verdugo, V., Mireles-Acosta, J. F., Tapia-Fonllem, C., & Fraijo-Sing, B. (2011). Happiness as correlate of sustainable behavior: A study of pro-ecological, frugal, equitable and altruistic actions that promote subjective wellbeing. *Human Ecology Review*, *18*(2), 95–104.

Cox, D., Shanahan, D., Hudson, H., Fuller, R., Anderson, K., Hancock, S., & Gaston, K. (2017). Doses of nearby nature simultaneously associated with multiple health benefits. *International Journal of Environmental Research and Public Health*, *14*(2), 172. https://doi.org/10.3390/ijerph14020172

Cox, D. T., Shanahan, D. F., Hudson, H. L., Fuller, R. A., & Gaston, K. J. (2018). The impact of urbanisation on nature dose and the implications for human health. *Landscape and Urban Planning*, *179*, 72–80.

Cox, D. T. C., Hudson, H. L., Shanahan, D. F., Fuller, R. A., & Gaston, K. J. (2017). The rarity of direct experiences of nature in an urban population. *Landscape and Urban Planning*, *160*, 79–84. https://doi.org/10.1016/j.landurbplan.2016.12.006

Dallimer, M., Irvine, K. N., Skinner, A. M. J., Davies, Z. G., Rouquette, J. R., Maltby, L. L., Warren, P. H., Armsworth, P. R., & Gaston, K. J. (2012). Biodiversity and the feel-good factor: Understanding associations between self-reported human well-being and species richness. *Bioscience*, *62*(1), 47–55. https://doi.org/10.1525/bio.2012.62.1.9

Duvall, J. (2011). Enhancing the benefits of outdoor walking with cognitive engagement strategies. *Journal of Environmental Psychology*, *31*(1), 27–35. https://doi.org/10.1016/j.jenvp.2010.09.003

Faehnle, M., Bäcklund, P., Tyrväinen, L., Niemelä, J., & Yli-Pelkonen, V. (2014). How can residents' experiences inform planning of urban green infrastructure? Case Finland. *Landscape and Urban Planning*, *130*, 171–183.

Fischer, L. K., & Kowarik, I. (2020). Connecting people to biodiversity in cities of tomorrow: Is urban foraging a powerful tool? *Ecological Indicators*, *112*, 106087. https://doi.org/10.1016/j.ecolind.2020.106087

Fisher, B., Turner, R. K., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics*, *68*(3), 643–653. https://doi.org/10.1016/j.ecolecon.2008.09.014

Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters*, *3*(4), 390–394. https://doi.org/10.1098/rsbl.2007.0149

Gaston, K. J., Soga, M., Duffy, J. P., Garrett, J. K., Gaston, S., & Cox, D. T. C. (2018). Personalised ecology. *Trends in Ecology & Evolution*, *33*(12), 916–925. https://doi.org/10.1016/j.tree.2018.09.012

George, B. P., & George, B. P. (2004). Past visits and the intention to revisit a destination: Place attachment as the mediator and novelty seeking as the moderator. *Journal of Tourism Studies*, *15*(2), 51–66. https://doi.org/10.3316/ielapa.200501358

Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology*, *23*(2), 109–123. https://doi.org/10.1016/S0272-4944(02)00109-3

Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, *35*(1), 207–228. https://doi.org/10.1146/annurev-publhealth-032013-182443

Irvine, K., Warber, S., Devine-Wright, P., & Gaston, K. (2013). Understanding urban green space as a health resource: A qualitative comparison of visit motivation and derived effects among park users in Sheffield, UK. *International Journal of Environmental Research and Public Health*, *10*(1), 417–442. https://doi.org/10.3390/ijerph10010417

Kaplan, R. (1992). *The psychological benefits of nearby nature*. Timber Press. http://deepblue.lib.umich.edu/handle/2027.42/148476

Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. CUP Archive. https://www.google.com/books?hl=en&lr=&id=7I80AAAAIAAJ&oi=fnd&pg=PR7&dq=The+Experience+of+Nature:+A+Psychological+Perspective&ots=ToPWVIpbZe&sig=1fJaOSa2QLw3nvde4ep1b0eMy9U

Keniger, L., Gaston, K., Irvine, K., & Fuller, R. (2013). What are the benefits of interacting with nature? *International Journal of Environmental Research and Public Health*, *10*(3), 913–935. https://doi.org/10.3390/ijerph10030913

Lin, B. B., Fuller, R. A., Bush, R., Gaston, K. J., & Shanahan, D. F. (2014). Opportunity or orientation? Who uses urban parks and why. *PLoS ONE*, *9*(1), e87422. https://doi.org/10.1371/journal.pone.0087422

Lindemann-Matthies, P., & Köhler, K. (2019). Naturalized versus traditional school grounds: Which elements do students prefer and why? *Urban Forestry & Urban Greening*, *46*, 126475. https://doi.org/10.1016/j.ufug.2019.126475

Manzo, L. C. (2003). Beyond house and haven: Toward a revisioning of emotional relationships with places. *Journal of Environmental Psychology*, *23*(1), 47–61. https://doi.org/10.1016/S0272-4944(02)00074-9

Masterson, V., Stedman, R., Enqvist, J., Tengö, M., Giusti, M., Wahl, D., & Svedin, U. (2017). The contribution of sense of place to social-ecological systems research: A review and research agenda. *Ecology and Society*, *22*(1), 49. https://doi.org/10.5751/ES-08872-220149

Nisbet, E. K., & Zelenski, J. M. (2013). The NR-6: A new brief measure of nature relatedness. *Frontiers in Psychology*, *4*, 813. https://doi.org/10.3389/fpsyg.2013.00813

Oh, R. Y. R., Fielding, K. S., Nghiem, T. P. L., Chang, C.-C., Shanahan, D. F., Gaston, K. J., Carrasco, R. L., & Fuller, R. A. (2021). Factors influencing nature interactions vary between cities and types of nature interactions. *People and Nature*, *3*(2), 405–417. https://doi.org/10.1002/pan3.10181

Ojala, A., Korpela, K., Tyrväinen, L., Tiittanen, P., & Lanki, T. (2019). Restorative effects of urban green environments and the role of urban-nature orientedness and noise sensitivity: A field experiment. *Health & Place*, *55*, 59–70. https://doi.org/10.1016/j.healthplace.2018.11.004

Özgüner, H. (2011). Cultural differences in attitudes towards urban parks and green spaces. *Landscape Research*, *36*(5), 599–620. https://doi.org/10.1080/01426397.2011.560474

Özgüner, H., & Kendle, A. D. (2006). Public attitudes towards naturalistic versus designed landscapes in the city of Sheffield (UK). *Landscape and Urban Planning*, *74*(2), 139–157. https://doi.org/10.1016/j.landurbplan.2004.10.003

Pieterse, G. M., Marchand, M. J., Dyk, J. C. V., & Barnhoorn, I. E. J. (2010). Histological alterations in the testes and ovaries of the sharptooth catfish (*Clarias gariepinus*) from an urban nature reserve in South Africa. *Journal of Applied Ichthyology*, *26*(5), 789–793. https://doi.org/10.1111/j.1439-0426.2010.01557.x

Prévot, A.-C., Cheval, H., Raymond, R., & Cosquer, A. (2018). Routine experiences of nature in cities can increase personal commitment toward biodiversity conservation. *Biological Conservation*, *226*, 1–8. https://doi.org/10.1016/j.biocon.2018.07.008

Pyle, R. M. (1979). The extinction of experience. *Horticulture*, *56*, 64–67.

R Core Team. (2014). *R: A language and environment for statistical computing*. [3.5.0]. R Foundation for Statistical Computing. http://www.R-project.org/

Restall, B., & Conrad, E. (2015). A literature review of connectedness to nature and its potential for environmental management. *Journal of Environmental Management*, *159*, 264–278. https://doi.org/10.1016/j.jenvman.2015.05.022

Richardson, M., Passmore, H.-A., Lumber, R., Thomas, R., & Hunt, A. (2021). Moments, not minutes: The nature-wellbeing relationship. *International Journal of Wellbeing*, *11*(1), Article 1. https://doi.org/10.5502/ijw.v11i1.1267

Rosa, C. D., & Collado, S. (2019). Experiences in nature and environmental attitudes and behaviors: Setting the ground for future research. *Frontiers in Psychology*, *10*, *763*. https://doi.org/10.3389/fpsyg.2019.00763

Rosa, C. D., Profice, C. C., & Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: The role of connectedness to nature and childhood nature experiences. *Frontiers in Psychology*, *9*, 1055.

Russell, R., Guerry, A. D., Balvanera, P., Gould, R. K., Basurto, X., Chan, K. M. A., Klain, S., Levine, J., & Tam, J. (2013). Humans and nature: How knowing and experiencing nature affect well-being. *Annual Review of Environment and Resources*, *38*(1), 473–502. https://doi.org/10.1146/annurev-environ-012312-110838

Shanahan, D. F., Fuller, R. A., Bush, R., Lin, B. B., & Gaston, K. J. (2015). The health benefits of urban nature: How much do we need? *Bioscience*, *65*(5), 476–485. https://doi.org/10.1093/biosci/biv032

Shwartz, A., Muratet, A., Simon, L., & Julliard, R. (2013). Local and management variables outweigh landscape effects in enhancing the diversity of different taxa in a big metropolis. *Biological Conservation*, *157*, 285–292. https://doi.org/10.1016/j.biocon.2012.09.009

Shwartz, A., Shirley, S., & Kark, S. (2008). How do habitat variability and management regime shape the spatial heterogeneity of birds within a large Mediterranean urban park? *Landscape and Urban Planning*, *84*(3), 219–229. https://doi.org/10.1016/j.landurbplan.2007.08.003

Shwartz, A., Turbé, A., Simon, L., & Julliard, R. (2014). Enhancing urban biodiversity and its influence on city-dwellers: An experiment. *Biological Conservation*, *171*, 82–90. https://doi.org/10.1016/j.biocon.2014.01.009

Soga, M., & Gaston, K. J. (2016). Extinction of experience: The loss of human–nature interactions. *Frontiers in Ecology and the Environment*, *14*(2), 94–101. https://doi.org/10.1002/fee.1225

Soga, M., & Gaston, K. J. (2020). The ecology of human–nature interactions. *Proceedings of the Royal Society B: Biological Sciences*, *287*(1918), 20191882. https://doi.org/10.1098/rspb.2019.1882

Soga, M., & Gaston, K. J. (2022). The dark side of nature experience: Typology, dynamics and implications of negative sensory interactions with nature. *People and Nature*, *4*, 1126–1140. https://doi.org/10.1002/pan3.10383

Southon, G. E., Jorgensen, A., Dunnett, N., Hoyle, H., & Evans, K. L. (2018). Perceived species-richness in urban green spaces: Cues, accuracy and well-being impacts. *Landscape and Urban Planning*, *172*, 1–10. https://doi.org/10.1016/j.landurbplan.2017.12.002

Stedman, R. C. (2002). Toward a social psychology of place: Predicting behavior from place-based cognitions, attitude, and identity. *Environment and Behavior*, *34*(5), 561–581. https://doi.org/10.1177/0013916502034005001

Stedman, R. C. (2003). Is it really just a social construction?: The contribution of the physical environment to sense of place. *Society & Natural Resources*, *16*(8), 671–685. https://doi.org/10.1080/08941920309189

Talal, M. L., Santelmann, M. V., & Tilt, J. H. (2021). Urban park visitor preferences for vegetation—An on-site qualitative research study. *Plants, People, Planet*, *3*(4), 375–388. https://doi.org/10.1002/ppp3.10188

Thompson, C. W. (2002). Urban open space in the 21st century. *Landscape and Urban Planning*, *60*(2), 59–72.

Tyrväinen, L., Silvennoinen, H., & Kolehmainen, O. (2003). Ecological and aesthetic values in urban forest management. *Urban Forestry & Urban Greening*, *1*(3), 135–149.

Van den Berg, A. E., Maas, J., Verheij, R. A., & Groenewegen, P. P. (2010). Green space as a buffer between stressful life events and health. *Social Science & Medicine*, *70*(8), 1203–1210.

Woodhouse, E., Homewood, K. M., Beauchamp, E., Clements, T., McCabe, J. T., David, W., & Milner-Gulland, E. J. (2015). Guiding principles for evaluating the impacts of conservation interventions on human well-being. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *370*(1681), 20150103. https://doi.org/10.1098/rstb.2015.0103

Xiao, J., Tait, M., & Kang, J. (2017). The design of urban smellscapes with fragrant plants and water features. In *Designing with Smell*. Routledge.

Yoesting, D. R., & Burkhead, D. L. (1973). Significance of childhood recreation experience on adult leisure behavior: An exploratory analysis. *Journal of Leisure Research*, *5*(1), 25–36. https://doi.org/10.1080/00222216.1973.11970109

Zelenski, J. M., & Nisbet, E. K. (2014). Happiness and feeling connected: The distinct role of nature relatedness. *Environment and Behavior*, *46*(1), 3–23. https://doi.org/10.1177/0013916512451901

Zylstra, M. J. (2014). *Exploring meaningful nature experience connectedness with nature and the revitalization of transformative education for sustainability*. Stellenbosch University.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Text S1. Questionnaire in English and Hebrew.

Text S2. Linear regression models for nature relatedness and well-being measures and non-nature-based interactions.

Text S3. Non-natural interaction frequency.

Text S4. Distribution of the different types of nature interactions between the garden and nature park by visitors.

How to cite this article: Fleming, W., & Shwartz, A. (2023). Nature interactions and their associations with connection to nature and well-being varies between different types of green spaces. *People and Nature*, *5*, 1160–1173. https://doi.org/10.1002/pan3.10479