

## **Nature connection in adulthood: The role of childhood nature experiences**

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**Abstract:**

- 1) Context: Nature connection describes our relationship with the rest of the natural world. Promoting nature connection in children and adults has been identified as a worthwhile focus for education and public health, given the positive associations between nature connection, wellbeing and pro-environmental behaviours. Prior research has looked at activities that promote an individual's connection to nature, reporting that a variety of interventions can be effective. Particular emphasis has been placed on positive childhood nature experiences due to their effects on adult nature connection. Research from varied places such as New Zealand, Australia, the USA and Brazil suggest that an individual's childhood nature experiences can play a positive role on their adult connection to nature.
- 2) Approach: This paper is the first of its kind to explore the associations between childhood nature activities, both their type and frequency, and adult nature connection in a Greek sample (n=401). We gathered the perspectives of Greek-speaking adults using quantitative measures in an online survey.
- 3) Results: Our results suggest that, in line with previous research, childhood nature experiences were significantly and positively correlated with adult nature connectedness. However, contrary to previous research, analysis suggested that adult nature experiences did not mediate the relationship between childhood nature experience and adult nature connection. Age was positively correlated with less structured childhood nature experiences such that older adults were more likely to have participated in unstructured outdoor activities like flower picking and general alone time outside during childhood.
- 4) Synthesis and applications: Capturing retrospective self-reports on the frequency and type of childhood nature experiences in this Greek sample helps us understand how

these experiences may predict engagement and relationships with nature in adulthood. In turn, these findings inform context-specific recommendations for encouraging nature contact in childhood. For instance, this may have implications for nature-based learning in Greece, as well as the provision of urban green and blue spaces.

**Keywords:** nature connection, childhood nature experiences, adult nature experiences, Greece, Nature Connection Index

## Introduction

In the face of increasing environmental degradation, motivating people to care about the environment and to behave accordingly is seen as a ‘wicked problem’ (Sun & Yang, 2016). Researchers across a range of disciplines have drawn upon theories commonly used in their respective fields to understand how to encourage more sustainable behaviour (e.g., Baxter & Pelletier, 2020; Eyster et al., 2022). Encouraging people to enact pro-environmental behaviours, or actions which aim to benefit the natural world, seems to be one important piece in addressing the challenge of action towards sustainability. Interventions towards this aim include education and awareness-raising activities, social influence and incentives. This range of approaches seems to be effective in encouraging pro-environmental behaviour; however, questions remain about the ability of such efforts to influence behaviour long-term (Grilli & Curtis, 2021).

One promising potential pathway for encouraging people to enact pro-environmental behaviour across the lifecourse is to promote relationships with nature, also called nature connection, early in life. Nature connection is associated with increased subjective wellbeing (Capaldi et al., 2014) and an increased likelihood to enact pro-environmental behaviours (Barragan-Jason et al., 2023). Given these associations, as well as the current climate and biodiversity crises and the global mental health crisis, increased nature connection has been seen as a worthwhile goal to promote for a variety of groups, including young children (Barrable, 2019), adolescents (Piccininni et al., 2018), adults (Sheffield et al., 2022) and older adults (Freeman et al., 2019). Additionally, the associations between nature connection and a range of outcomes have drawn interest from a variety of disciplines such as psychology, education, business, and geography (Ives et al., 2017).

There are several closely related constructs that describe a relationship to the natural world (Tam, 2013) such as inclusion of nature in self (Shultz, 2002), nature relatedness

(Nisbet et al., 2009) and connectedness to nature (Mayer & Frantz, 2004). The umbrella term of nature connection can be used to refer to all these constructs which capture a subjective feeling of closeness between humans and the rest of the natural world (Cleary et al., 2020). As it is a subjective construct, scales to measure it are largely self-report and include a variety of measures, such as the Nature Relatedness scale (Nisbet et al., 2009), the pictorial Inclusion of Nature in Self scale (Shultz, 2002; Kleepsies et al., 2021) and the more recently validated Nature Connection Index (Richardson et al., 2019).

Despite the known relationship between connection to nature and various positive outcomes, like improved wellbeing, Soga and Gaston (2016) suggest that the last several decades have seen an extinction of experience resulting from children spending less time in nature than ever before. This downturn has negatively impacted relationships with nature, decreasing the likelihood that young people will exhibit pro-environmental behaviour and experience associated benefits to wellbeing (Colléony et al., 2020). Given that this extinction of experience seems to be at least somewhat generational, with causes like urbanisation and land use changes (Colléony et al., 2020), and due to changing norms around experiences in nature, we might expect age to be related to certain types of experiences in nature. These different nature experiences might also have implications for how likely they are to facilitate a stronger connection to nature. Changing generational norms also reinforce the importance of understanding how we can promote connection to nature in diverse groups to address this decrease.

However, it is important to note that while there is some evidence of a negative downturn in nature-based experiences, there is considerable heterogeneity in the trends around different types of experiences in nature such that while some might be decreasing, others might be increasing or remaining steady (Cazalis et al., 2023). Additionally, this supposed extinction of experience could also be linked to biophobia, or a fear of nature,

which means people are less likely to seek out time in nature (and therefore become more afraid of nature due to lack of exposure, thus worsening the cycle; Soga et al., 2023). Related to this fear of nature is the urbanisation-disgust theory, which suggests that as societies become more urbanised, people encounter living things like insects more often, especially indoors, but have poorer knowledge about them; the level of disgust people feel towards living things like insects therefore has increased substantially in response to this more frequent interaction (Fukano & Soga, 2021). Fukano and Soga suggest that these negative feelings about nature (biophobia) could make people less likely to want to enact pro-environmental behaviour or spend time in nature, perpetuating another negative cycle. Therefore, it is currently difficult to make conclusions about global trends in nature-based experiences given this range of factors.

A host of studies have explored ways to promote nature connection, both in children (for a review see Barrable & Booth, 2020a) and in adults (for a review see Sheffield et al., 2022). Barrable and Booth (2020a) identified interventions designed to increase nature connection, which varied in their length, activities and focus, and in the age ranges included. The authors reported that younger children showed greater increases in nature connection post intervention and at follow-up; this underpins the importance of influential nature experiences early in childhood. In a systematic review and meta-analysis of 36 studies, Sheffield et al. (2022) found that most interventions had a significant medium effect, with type of contact, quality of engagement and timing failing to be significant predictors of the effect size observed. In general, more research is needed on the study of predictors and activities that may promote a positive relationship with the natural world.

As with other areas of development, childhood is a particularly important time for nurturing relationships with nature. Chawla (2020), in a comprehensive review of research on childhood nature connection, notes the wide variety of experiences in childhood which are

linked to greater connection to nature in childhood and later in life. Such experiences, drawn from the studies included in the review, include time in nature, specific parenting styles, family values and being female, amongst others. Chawla asserts that cultivating this relationship in childhood is particularly important considering increasingly urgent climate change and environmental degradation. Childhood nature experiences are also important for counteracting biophobia; Soga et al. (2020) report that more frequent nature experiences in childhood and knowledge of nature were associated with lower levels of biophobia. These findings indicate that more frequent childhood nature experiences could play an important role countering the ill effects of an extinction of experience.

The role of childhood experiences on adult environmental attitudes has also been explored previously in a variety of cultural contexts. In a US sample, childhood participation in *wild* (e.g., hiking, camping, and fishing), rather than *domesticated* (e.g., caring for plants and picking produce), nature activities was found to be a significant predictor of adult environmentalism (Wells & Lekies, 2006). Conversely, in a close look at childhood nature experiences and adult environmental attitudes and behaviours in a sample from New Zealand, van Heezik et al. (2021) found that there was no significant association between childhood nature experiences and time spent in nature or pro-environmental behaviours. The same study looked at nature connection as well and reported a significant positive association between childhood nature experiences and nature connection. In an urban Australian sample, Cleary et al. (2020) found that childhood nature experiences significantly predicted adult nature connection, but it was actually largely explained by the fact that adults with childhood nature experiences were also more likely to visit natural spaces in adulthood. A similar finding was reported in a Brazilian sample where greater contact with nature during childhood correlated with greater contact with nature as an adult and adult nature connection (Rosa et al., 2018).

To our knowledge, no research has yet been conducted on nature connection and childhood nature experiences in a Greek sample, though there have been studies on Greek adults' relationship with the landscape (Kyvelou & Gourgioutis, 2019), as well as country-level statistics on nature connection that highlight its importance as a key metric for a sustainable future (Gkargkavouzi et al., 2021; Richardson et al., 2022). A study on environmental awareness and nature experiences in an international context, including a Greek sample, found an association between a generally coded 'child nature/outdoors' and environmental concern (Palmer et al., 1998). Finally, a study undertaken and published in the Greek language examined nature activities and environmental concern in Greek adults and found a significant association between the two (Ζαφειρούδη & Χατζηγεωργιάδης, 2008). Given previous associations between environmental concern and nature connection, we can expect to find a possible relationship in the study.

Aside from the pressing need to examine human-nature relationships in cross-cultural contexts (Tam & Milfont, 2020) and the intrinsic value of looking at different country samples, it is also worthwhile to consider how Greece may present an interesting population to explore. This may be for a variety of reasons, including seeing Greece as a representative of newly urbanised countries, as well as within the broader recent socio-economic context of Southern Europe, within which countries have experienced a rapid and progressive delocalisation of population over the last fifty years, as well as pressing economic downturn (Vinci, et al., 2022). However, it is important to note that previous research on Greece has reported fluid urban-rural linkages, and that in the aftermath of the 2008 economic crisis in Greece, revitalised relationships with nature brought along a range of benefits and implications for how people used nature to cope with crises (Benessaiah & Chan, 2023). Thus, the present study draws upon this unique context by asking Greek-speaking adult participants to reflect on their childhood experiences in nature, which took place pre-

economic crisis, and their adulthood experiences and connection, most of which will have taken place during or after the economic crisis, to understand the links through a longitudinal lens.

### **The current study**

As previous research has highlighted the importance of childhood nature experiences for adult nature connection in a variety of samples, this study seeks to understand the role that the frequency and type of certain such experiences have in predicting connection to nature in a sample of Greek-speaking adults, as this is not a group that has been tested before in relation to nature connection. The research predictions were:

P1. Adult nature connection will be positively associated with frequency of participation in childhood nature experiences.

P2. Adult nature experiences will be positively associated with frequency of participation in childhood nature experiences.

We also had three exploratory research questions based on previous literature. Question 1 was based on previous research that has seen different experiences (e.g., environmental education lessons, summer camps, etc.) that had a different impact on children's nature connection (Barrable & Booth, 2020). Question 2 was based on two separate papers (Cleary et al., 2017; Rosa et al., 2018) which found that the relationship between childhood nature experiences and adult nature connection was mediated by adult nature experiences. As such, we wanted to see whether it was the childhood nature experiences that had a direct effect on adult nature connection, or whether, as seen in Cleary et al. (2017) and Rosa et al. (2018), the effect was explained by adults visiting nature more in adulthood. Finally, exploratory question 3 was based on Soga & Gaston's (2016) idea of extinction of experience, positing that older generations would have had a greater range of experiences in nature, including more time spent in nature unaccompanied. As such, the exploratory questions were:

- 1) What *types* of childhood nature experiences are better predictors of adult nature connection?
- 2) Do nature experiences in adulthood mediate the relationship between childhood nature experience and adult nature connection?
- 3) How does age relate to experiences of nature during childhood?

## **Methods**

### **Procedure**

A survey for Greek-speaking adults was administered through an online questionnaire platform (Online surveys, formerly BOS). We recruited participants through two posts on the first author's social media channels (i.e., Facebook, Twitter) in the period between June and July 2021; posts were then shared more widely by the first author's network. Four hundred and twenty-seven ( $n=427$ ) adults responded, with 401 full responses given. Responses with missing data were not used. Ethical approval for this research project was obtained through the School of Education at the University of Dundee (approval number E2020-127) prior to the collection of data. Informed consent was obtained for the use and storage of data by all participants prior to their completion of the survey.

### **Materials**

#### ***Nature Connection***

The Greek version of the Nature Connection Index was used (Barrable, Beloyianni, Gamble & Touloumakos, in preparation). The Nature Connection Index (Richardson et al., 2019) is a short (6-item) unidimensional measure of nature connection for adults and children. The original study with English data found good construct validity and internal consistency (Cronbach's  $\alpha = .92$ ). In this study, the internal consistency was calculated at  $\alpha = .87$ . The total score is calculated using the formula presented in the original paper,

taking into account different weightings for each question, with a total top score of 100 (Richardson et al., 2019).

### ***Adult nature experiences***

We asked participants to indicate the frequency of undertaking nature-based activities in the present. There were two questions enquiring about adult nature experiences: “How often do you spend time in nature (e.g. in a garden, beach, park or ‘wilderness’)?” and “How often do you tend your garden or your plants?”. A 4-Likert response was provided, indicating the frequency, from “Less than one time per week” to “More than three times per week”. A total score was calculated as the mean of all answers, which is presented as adult nature experiences. The two separate questions were also used as independent variables in later calculations.

### ***Child nature experiences***

Moreover, we used seven questions with a 4-Likert scale response, to assess the frequency of undertaking certain activities in and with nature during childhood. These included “As a child, I spent time in nature with my family” and “As a child, I looked after plants, trees or vegetables in a garden”. The responses ranged from “Very frequently” to “Never”. A total score was calculated as the mean of all the answers, which is presented as childhood nature experiences total. Separate questions were also used as independent variables in later calculations. Finally, demographics of current age and sex were also collected.

## **Participants**

The sample consisted of 401 adults with a mean age of 42.53 years old ( $SD = 14.47$ ) and included 297 females (74%) and 104 males (26%). An independent-sample t-test analysis demonstrated that there were statistically significant differences regarding the age of participants in terms of their gender ( $t(397) = -2.17, p < 0.05$ ). In particular, male participants

were found to be slightly older ( $M = 45.23$  years,  $SD = 13.22$ ) than female participants ( $M = 41.64$ ,  $SD = 14.82$ ).

## Analysis

Initially, descriptive statistics were calculated for all variables, to give the researchers an overview of the data and inform the rest of the analysis. We computed a correlation matrix to explore the relationships of the totals for adult and childhood nature experiences and nature connection, and to test the two predictions. In order to answer the first exploratory research question, we initially constructed a correlation matrix for each of the childhood nature experiences and nature connection, which were then used to inform our linear model construction. We also undertook a mediator analysis to answer our second exploratory question. All statistical analyses were undertaken using Jamovi Desktop version 2.3.26solid (The jamovi project, 2022).

## Results

Descriptive statistics were calculated for nature connection for all and by sex, and mean values and standard deviations are presented in Table 1.

**Table 1**

*Means (and standard deviations) of Nature Connection Index total score, age in years and childhood and adult nature experiences*

	<b>NCI total mean (SD)</b>	<b>Age in years</b>	<b>Childhood Nature Experiences total mean (SD)</b>	<b>Adult Nature Experiences total mean (SD)</b>
<b>Female (n=297)</b>	76.5 (21.6)	41.7 (14.8)	2.41 (.69)	2.63 (1.02)
<b>Male (n=104)</b>	77.7 (21.1)	45.2 (13.1)	2.26 (.65)	2.64 (1.01)
<b>Total (n=401)</b>	76.8 (21.5)	42.2 (14.2)	2.37 (.68)	2.63 (1.01)

To look at the two predictions, we calculated the correlations between all the main variables, presented in Table 2 below. Nature connection was significantly positively correlated

with frequency of childhood nature experiences ( $r=.449, p < .001$ ), and we also found that nature connection was very weakly, but significantly, correlated with frequency of adult nature experiences ( $r=.099, p=.049$ ). Finally, there was no significant correlation between adult and childhood nature experiences ( $r= .004, p=.936$ ).

**Table 2**

*Correlations between nature connection, adult nature experiences, and childhood nature experiences*

		<b>Nature connection</b>	<b>Adult nature experiences</b>	<b>Childhood nature experiences</b>
Nat. connect.	Pearson's r	—		
	p-value	—		
Adult nat. exp.	Pearson's r	.099	—	
	p-value	.049	—	
Chil. nat. exp.	Pearson's r	.449	.004	—
	p-value	< .001	.936	—
Age	Pearson's r	.417	.087	.132
	p-value	< .001	.083	.009

To answer some of our exploratory questions, a correlation matrix was used to look at the associations between all the different childhood nature experiences, namely picking flowers or vegetables, looking after flowers or vegetables, ‘wilderness’ experiences, such as hiking, camping or fishing, time spent in nature with family, friends or alone and outdoor learning experiences, and adult nature connection. This is presented in Table 3. As expected, the childhood nature experiences are correlated amongst themselves. They are also positively correlated with adult nature connection. When adjusting for multiple comparisons using the Bonferroni correction (Abdi, 2007) the level of significance was found to be  $p=.00143$ , which meant that all correlations were still found to be significant, with flower picking ( $r=.382$ ), time spent in ‘wilderness’ ( $r=.363$ ) and time spent alone in nature ( $r=.374$ ) presenting higher correlations than other activities.

**Table 3**

*Pearson's Correlation matrix between adult nature connection and different childhood nature experiences (\*\* $p < .001$ )*

	1	2	3	4	5	6	7	8
1. Nature connection	-							
2. Flower picking	.382**	-						
3. Gardening	.312**	.646**	-					
4. 'Wilderness'	.363**	.515**	.489**	-				
5. Family Nature time	.330**	.496**	.447**	.627**	-			
6. Friends nature time	.295**	.472**	.454**	.609**	.562**	-		
7. Alone nature time	.374**	.453**	.497**	.481**	.431**	.532**	-	
8. Outdoor learning	.240**	.326**	.352**	.331**	.271**	.357**	.382**	-

We undertook a stepwise regression with backwards elimination, with adult nature connection as the independent variable and starting with all dependent variables as predictors, removing potentially explanatory variables in the process. The final model was chosen to optimise  $R^2$  and  $F$ .

**Table 4**

*Stepwise regression with backwards elimination*

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	F	Overall model test		
					df1	df2	p
1	.578	.335	.328	495	4	394	<.001

The following model had the most explanatory power of those tested (Table 4). The results suggested that four variables, namely picking flowers, spending time in nature alone and with family and age, predicted 34% of the total variance ( $R^2=.335$ ,  $F(4, 394)=49.5$ ,  $p<.001$ ).

The model coefficient for all predictors can be seen in Table 5.

**Table 5**  
*Model coefficients – Nature connection*

<b>Predictor</b>	<b>Estimate</b>	<b>SE</b>	<b>T</b>	<b>P</b>
Intercept	24.254	3.993	6.0	<.001
Flower	3.445	1.1054	3.12	.002
Alone	4.213	1.0128	4.16	<.001
Family	3.736	1.2500	2.99	.003
Age	0.544	0.0628	8.66	<.001

We examined the relationship between age and different childhood nature experiences, namely picking flowers or vegetables, looking after flowers or vegetables, ‘wilderness’ experiences, such as hiking, camping or fishing, time spent in nature with family, friends or alone and outdoor learning experiences. Results (see Table 6) indicated that while some of the specific childhood nature experiences were significantly correlated with age (flower picking, ‘wilderness’, peer nature time, alone nature time), others were not (gardening, family nature time, outdoor learning).

**Table 6**  
*Pearson’s r correlations between age and a variety of childhood nature experiences*

	Flower picking	Gardenin g	‘Wilderness’	Family nature time	Peer nature time	Alone nature time	Outdoor learning
Age	0.18***	0.07	0.12*	0.05	0.11*	0.11*	0.03

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Finally, we undertook a mediation analysis (Baron & Kenny, 1986), in order to answer our second exploratory question, which was whether adult nature experiences mediated the relationship between childhood nature experiences and adult nature connection, as presented in previous research (e.g. Pensini et al., 2016; Rosa et al., 2018; van Heezik et al., 2021).

Our analysis, which can be seen in Tables 7 and 8, shows that there is no significant mediation between adult nature experiences and adult nature connection ( $z=-.015$ ,  $p=.988$ ), while the direct effect of childhood nature experiences and childhood nature connection was large ( $z=9.915$ ,  $p<.001$ ).

**Table 7**  
*Mediation estimates*

<b>Effect</b>	<b>Estimate</b>	<b>SE</b>	<b>95% Confidence Interval</b>		<b>Z</b>	<b>p</b>	<b>% Mediation</b>
			<b>Lower</b>	<b>Upper</b>			
Indirect	-.00247	.158	-0.312	0.307	-.015	.988	.0173
Direct	14.2573	1.438	11.439	17.076	9.915	<.001	99.9827
Total	14.2548	1.447	11.420	17.090	9.854	<.001	100.0000

**Table 8**  
*Path estimates*

				95% Confidence Interval		Z	p	
		Estimate	SE	Lower	Upper			
Childhood nature experiences	-	Adult nature experiences	-.00119	.0760	-.150	.148	-.0156	.988
Adult nature experiences	-	Nature connection	2.07527	.9526	.208	3.942	2.1786	.029
Childhood nature experiences	-	Nature connection	14.2573	1.438	11.439	17.076	9.9150	<.001

The relationship between age and different childhood nature experiences, namely picking flowers or vegetables, looking after flowers or vegetables, ‘wilderness’ experiences, such as hiking, camping or fishing, time spent in nature with family, friends or alone and outdoor learning experiences, were also examined. Results (see Table 9) indicated that while some of the specific childhood nature experiences were significantly correlated with age (flower picking, ‘wilderness’, peer nature time, alone nature time), others were not (gardening, family nature time, outdoor learning).

**Table 9**  
*Pearson’s r correlations between age and a variety of childhood nature experiences*

	Flower picking	Gardenin g	‘Wildern ess’	Family nature time	Peer nature time	Alone nature time	Outdoor learning
Age	0.18***	0.07	0.12*	0.05	0.11*	0.11*	0.03

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## Discussion

### *Main findings*

In line with the existing literature, and corresponding to prediction 1, results showed that various childhood nature experiences were significantly and positively correlated with

levels of adult nature connectedness (Asah et al., 2012; Cleary et al., 2020; van Heezik et al., 2021). In this study, picking flowers, spending time in nature alone or with family and age were the most predictive of adult nature connection, while outdoor learning was the least predictive. Overall, exposure to some childhood nature activities may enhance the feeling of being a part of the natural environment throughout the lifespan.

Results also showed that exposure to both structured and unstructured nature experiences during childhood may facilitate the development of nature connectedness throughout life (prediction 1), but the same childhood experiences could not significantly predict adult nature activities (prediction 2). Such a finding may be explained as a result of the limited opportunities for nature activities within the modern urban lifestyle, regardless of the subjective feeling of nature connection and the possible willingness to engage with nature. Moreover, lack of access may be of importance. Even so, we cannot determine the relationship between childhood nature activities and the challenges adults experience when trying to engage in nature-based activities within urban settings from the findings of the present study. Thus, future research needs to further investigate the role of early nature experiences on adults' abilities and willingness to confront barriers to engaging with nature in a more urban present-day context.

Although previous research has indicated that females tend to display higher nature connection and pro-ecological behaviours than males (Price et al., 2022; Whitburn et al., 2020), this finding did not seem to apply in our Greek sample. In the current study, males and females had similar levels of nature connectedness in adulthood replicating findings from Hughes et al. (2019). This might suggest that Greek males and females similarly engage and connect with nature. However, it is also likely that the overrepresentation of females within the sample, a limitation of our study, may have affected results to some extent.

Age was significantly and positively correlated to both childhood nature experiences and current nature connectedness. This is in line with findings from other populations (Reese et al., 2020; Richardson et al., 2019). This could, in part, be a result of younger age groups being likelier to use smartphones and other technology more regularly, a behaviour which is associated with lower nature connectedness (Richardson et al., 2022). Moreover, age was also found to be positively correlated to less structured childhood nature experiences, such as picking flowers and spending time in nature alone, as opposed to more structured experiences like outdoor learning. This finding may be explained as a result of the late rapid urbanisation that younger individuals have already experienced from childhood, which is linked to fewer nature activities and higher nature disconnection (Cox et al., 2018). The late 20<sup>th</sup> to 21<sup>st</sup>-century population movement from rural to urban settings has been widely considered a main cause of a decline in nature experiences and connectedness (Turner et al., 2004). That this extinction of experience may be paired with progressive disconnection between today's youth and the natural environment is especially worrying since it may lead to a lack of environmental sensitivity and less pro-ecological behaviours in the future (Barrable & Booth, 2022; Price et al., 2022; Sobel, 2017; Soga & Gaston, 2016). Yet, in this research, no data were collected regarding the participants' rural or urban places of origin or their access to the countryside. Future research needs to take into account further demographic characteristics of participants that may elucidate their ecological values, attitudes and behaviours.

Linking to our second exploratory question was an interesting divergence from previous literature. In our sample, adult nature experiences did not seem to mediate the relationship between childhood experiences and nature connection, suggesting that childhood nature experiences on their own, without adult nature experiences, may actually have a positive effect on adult nature connection. Prior research has suggested that one of the potential mechanisms for childhood nature experiences is that they 'prime' adults to seek them out throughout life.

Prior research by Cleary et al. (2018) in Australian urban residents found that current nature experiences were the most predictive of adult nature connection, even in adults who had few nature experiences in childhood. Rosa et al. (2018), looking at a sample of Brazilian adults, also suggest that adult nature experiences mediate the relationship between childhood experiences and current levels of nature connection. While we cannot offer a definitive explanation, we can hypothesise that spending time in nature in childhood may be enough to build a positive relationship with the natural world even in the absence of frequent contact in adulthood. We also propose that more research should be done to elucidate this relationship as presented in this sample, in light of access, barriers and motivations to visit natural spaces in adulthood.

A growing body of research has indicated that nature connection has multiple benefits for individuals, such as increased subjective wellbeing and happiness (Capaldi et al., 2014), improved health behaviours (Oh et al., 2021; Zelenski et al., 2023), greater stress relief (Egerer et al., 2022) and improved cognitive performance (Mason et al., 2022). Still, increasing nature connection in modern societies remains challenging. Previous literature has shown that both the quantity and quality of nature contact (and the extent to which the contact includes active nature engagement) may enhance the nature connectedness of both children and adults (Barrable & Booth, 2020; Sheffield et al., 2022). The role that connection to nature plays in promoting wellbeing might be particularly important for Greek adults given the recent history of economic crisis within the country and the way that going 'back to the land' supported some people navigating that tumultuous period (Benessaiah & Chan, 2023). Future research with Greek samples should investigate if those adults who are more connected to nature also experience greater wellbeing; if that is the case, subsequent work should then explore how childhood nature activities can be promoted more effectively in Greece to support life-long relationships with nature and improved wellbeing.

Many childhood nature experiences have been linked to a greater likelihood of being involved in ecological and nature-based activities in adulthood (Molinario et al., 2020; Rosa et al., 2018). Yet, the limited existing cross-cultural studies have demonstrated that the extent and the benefits of feeling connected with the natural environment seem to vary in terms of different cultural contexts and in light of different cultural perspectives on nature (Beery et al., 2023; Donell & Rinkoff, 2015). In this respect, the present study explored the relationship between childhood nature activities, adult nature experiences and adult nature connection in a Greek sample. All data were collected via well-designed online self-reported questionnaires. Further research can employ multiple methods to assess and describe the relationship between nature connection, childhood nature experiences and adult nature experiences.

Data in this study pertaining to childhood nature experiences were collected via retrospective self-report, which can be unreliable. Respondents' recall of their childhood nature experiences were dependent on the accuracy of their memories (which are not always reliable), and this can pose particular difficulties when asking participants to estimate the frequency with which they engaged in certain activities (Schwarz, 2007). Results should be interpreted with this potential bias and uncertainty in mind.

### **Conclusion**

In this study of 401 Greek adults, we examined the relationships between childhood nature experiences, adult nature experiences and current connection to nature to ascertain if similar associations held true in this sample compared to studies on other geographic locations. For this sample, various different childhood nature experiences were significantly and positively associated with current levels of nature connection. Despite this, childhood nature experiences did not significantly predict adult nature experiences, nor were adult nature experiences associated with current (adult) nature connection. Age was positively associated with less structured childhood nature experiences, and this could reflect

differences in attitudes and behaviours around how children are raised now compared to decades ago.

Understanding how childhood nature experiences might predict later contact with and connection to nature in this particular population can help inform context-specific recommendations for encouraging nature experiences amongst younger generations with an aim at dually addressing the mental health and climate crises and facilitating life-long relationships with nature. Future research should harness multiple methods to further explore how Greek-speaking adults feel their childhood nature experiences informed their relationships with nature in adulthood. Additionally, future research should also capture further demographic information to understand the role of these characteristics in childhood nature experiences, adult nature experiences and nature connection.

**Data availability statement:** Raw data are available on:

[https://figshare.com/articles/dataset/Childhood\\_nature\\_experiences\\_and\\_adult\\_nature\\_connection\\_in\\_Greek\\_adults/23703672](https://figshare.com/articles/dataset/Childhood_nature_experiences_and_adult_nature_connection_in_Greek_adults/23703672)

**Statement on inclusion:** Our study brings together authors from a number of different countries (UK, USA and Greece), including scientists based in the country where the study was carried out (Greece). Local authors were engaged early on with the research and study design to ensure that the diverse sets of perspectives they represent was considered from the onset, including on linguistic issues. Whenever relevant, literature published by scientists from the region was cited; efforts were made to consider relevant work published in the local language.

**Author contribution statement:** AB conceived and designed the study, planned and applied for ethics and undertook part of the data collection and data curation. VB translated all materials, assisted in data collection and undertook the analysis. SF undertook the writing of

the first draft and critically edited the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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