

Influences of Outdoor Experiences During Childhood on Time Spent in Nature as an Adult



Debra K. Kellstedt, DrPH,¹ Courtney S. Suess, PhD,² Jay E. Maddock, PhD³

Introduction: Time spent in nature provides myriad physical and mental health benefits for both adults and children. Despite these benefits, most people spend too little time in nature to realize the maximal effect. Different types of childhood experiences may have differential influence on adult time in nature. This study assessed the influences of different kinds of childhood outdoor experiences on time spent in nature as an adult. The first aim was to utilize 20 childhood nature experience items to construct summative scales. The second aim was to examine the influence of each scale and other factors on adult time in nature.

Methods: A 2-factor scale measuring wild and domesticated childhood nature experiences was developed using principal and confirmatory factor analyses. An online study of 2,109 American adults was conducted. Multiple linear regression examined the influences of the 2 childhood nature experiences scales, attitude and self-efficacy scales, and sex and age covariates on adult time spent in nature.

Results: Significant predictors of adult time in nature were wild childhood nature experiences ($\beta=0.279$, $p<0.001$), positive attitudes about nature ($\beta=0.12$, $p<0.05$), negative attitudes about nature ($\beta=-0.23$, $p<0.001$), and self-efficacy ($\beta=0.71$, $p<0.001$).

Conclusions: Wild childhood nature experiences (e.g., camping, hiking, and fishing) that include skill building, that are immersive and engaging, and that involve opportunity for social interaction may translate better into adult nature activities. Programs that introduce and support wild experiences may increase lifelong time spent in nature.

AJPM Focus 2024;3(4):100235. © 2024 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

INTRODUCTION

A wealth of research links positive health outcomes with being active and spending time outside in nature.^{1–4} Reviews have found links between exposure to nature and overall health and wellbeing through pathways such as harm reduction, restoration, and capacity building.² Studies have found that spending time in nature on a regular basis can specifically impact mental health by improving mood, attention, and social connections and reducing stress.^{2–6} In addition, spending time in nature can impact physical health by providing space and building capacity for physical activity (PA).⁷ Regular PA has been shown to protect

against chronic conditions such as diabetes, heart disease, high blood pressure, and some forms of cancer.^{8–10} PA

From the ¹Family & Community Health, Texas A&M AgriLife Extension Service, College Station, Texas; ²Department of Hospitality, Hotel Management and Tourism, College of Agricultural & Life Sciences, Texas A&M University, College Station, Texas; and ³Environmental and Occupational Health, Texas A&M University School of Public Health, College Station, Texas

Address correspondence to: Debra K. Kellstedt, DrPH, Family & Community Health, Texas A&M AgriLife Extension Service, 2137 TAMU, College Station TX 77843-2137. E-mail: Debra.kellstedt@ag.tamu.edu.

2773-0654/\$36.00

<https://doi.org/10.1016/j.focus.2024.100235>

that occurs in greenspaces appears to be especially beneficial, and most child PA takes place outside.¹¹

In a cross-sectional study with a representative sample of more than 19,000 adults in England, a self-reported dose of 2 hours per week directly exposed to nature was correlated with improved mental and physical health; health benefits increased when spending up to 5 hours a week outside.¹² Similar to PA guidelines, most U.S. adults do not achieve these nature health goals. In a representative sample of U.S. adults, 56% of Americans were spending 5 hours or less a week outside, and of those, 25% spent less than 2 hours outside.¹³

Many factors at multiple levels influence adults' decisions and abilities to spend a healthy amount of time in nature and to be sufficiently active. Although supports for PA have been well researched over the decades, less is understood about the factors and conditions that influence adult time spent in nature.¹⁴ Given the variety of health benefits and links to PA, it is important to understand how to predict and promote spending time outside.

A variety of variables may influence adult time in nature. The opportunity theory of outdoor recreation explains that participation in outside experiences may be influenced by opportunity and access rather than just by income.¹⁵ In contrast, a recent U.S. qualitative study of antecedents to adult nature engagement found that early exposure to nature, mentorship, and membership in nature-based organizations such as Scouts or church camps influenced later nature engagement but that time and money and concerns about safety were barriers.¹⁶ Cleland et al.¹⁷ in a longitudinal study examined the predictors of spending time outside during childhood and found that social predictors such as lack of adult supervision for play outside and parental encouragement predicted time outdoors for children aged 10–12 years. Sociocultural theories, such as the Cultural History Activity Theory,¹⁸ recognize that behaviors may be influenced by outside influences such as the sociohistorical context. For example, the social and physical environment—which includes SES, cultural preferences, and racial discrimination barriers—in which a child develops will impact their current and future attitudes and capacity toward being in nature. Socialization theories postulate that experiences during childhood can be internalized and shape adult values, attitudes, and behaviors.¹⁹ The significant life experience literature indicates that childhood experiences—both adverse and positive—have long-lasting impacts on adult attitudes and behaviors.^{20,21} Social cognitive theory hypothesizes that both internal and external factors like all of these can influence behavior by increasing self-efficacy.²² Childhood experiences, the sociocultural environment,

and socialization may all build (or inhibit) capacity for individuals to be in nature throughout adulthood.

A body of literature has examined the influence of significant positive nature experiences in childhood on adult connections to the natural world and environmentalist beliefs and behaviors.^{23–28} These studies find that not all experiences outside are the same. For example, there are surface-level qualitative and quantitative differences between camping in the woods and kicking a ball in a backyard. A study of pathways from childhood nature experiences to adult environmentalism found that experiences such as playing, camping, hunting, or fishing in wild nature had a slightly greater impact on future environmentalism than experiences such as gardening and picking flowers in domesticated nature.²⁹ Bixler and colleagues³⁰ explored the relationship between different childhood outdoor play experiences (wildland, urban, and yard adventurers) and environmental preferences later in life and found that the wildland adventures supported future environmentalism. Some work has studied how varying childhood experiences influence simply spending time in nature on a regular basis into adulthood, and evidence is mixed. One recent study based in New Zealand found that time spent in nature as a child did not predict adult time spent in nature,³¹ and other less recent studies conducted outside of the U.S. found that the quantity of nature experiences as a child was related to adult time spent in nature.^{32–34} One more recent study by Izenstark and Middaugh found that the frequency of time families spent outside together across all developmental periods—especially during middle adolescence—was associated with frequency of time spent outside and a preference for outdoor versus indoor spaces in early adulthood.³⁵

Children spend time outside in a variety of ways (e.g., playing with friends in the neighborhood, competing in sports, overnight camping trips). Childhood connections to nature have changed in quantity and quality over the years. Louv discusses the growing problems associated with children spending less and less time in nature.³⁶ Children who spend less time in nature may grow into adults with little affinity for and experience with nature. Learning about nature in a classroom is not the same as getting outside and immersing oneself in nature. One study in the United Kingdom explored the relationship between adults' access to green space after significant childhood experiences and coined the term the childhood factor, where not visiting greenspace and woodlands in childhood predicted lack of interest in spending time in greenspace as an adult.³⁴ Another study acknowledged that there are different factors that qualify as significant nature situations for children.²⁸ An area that needs more exploration is how different types of

childhood experiences in nature—whether they be everyday or domesticated experiences or more substantial wild types of experiences—carry over into the amount of time spent in nature during adulthood.

The purpose of this study was to explore the influences of different kinds of nature experiences in childhood on adult time spent in nature. The first aim, after creating childhood experiences in nature items, was to construct summative scales. The second aim was to use data from a nationwide sample to examine the influence of each scale on time spent in nature as an adult.

METHODS

Study Sample

Data were drawn from a nationwide sample of adults obtained in summer 2021 from a Qualtrics survey panel representing general population respondents from across the U.S. To minimize self-selection bias, participants were enrolled without knowing the survey content, ensuring that nonresponse was a random event rather than systematic. Participants received an electronic informed consent/informational sheet and indicated consent electronically. All procedures were approved by the Texas A&M University IRB.

Measures

The team developed the childhood experiences in nature items using a comprehensive 9-step approach following the recommendations of Boateng et al.³⁷ These methods follow a 9-step procedure: (1) domain identification and item generation, (2) content validity, (3) pretesting questions, (4) survey administration, (5) item reduction, (6) factor extraction, (7) tests of dimensionality, (8) tests of reliability, and (9) tests of validity. A complete description of measurement development procedures are reported elsewhere and summarized in this study.^{38,39}

Item generation was conducted following structure measurement development protocols. The 14-member multidisciplinary investigative team individually generated items about childhood time spent in nature for the prompt, *When you were a child, up to about the age of 12, how often did you do the following things?* The lead investigator reviewed all generated items and eliminated duplicates. Then, all items were reviewed and rated individually by the research team using a Qualtrics survey. Items were first rated on relevance to the construct of childhood time spent in nature on a 4-point Likert scale ranging from not relevant to very relevant. Next, thematic subsets were rank ordered on the basis of their importance to spending time in nature. Items that had means <2.5 on relevance and scored in the bottom quartile of importance were removed. After this phase, all

items were assessed in a cognitive interview with community members to assess comprehension, and poorly performing items were removed.⁴⁰

Once the items were developed, a nationwide sample of participants was surveyed through a panel from Qualtrics of U.S. adult residents aged ≥ 18 years. Data collection was completed in the summer of 2021, and respondents were stratified by age, sex, and region within the U.S. to be nationally representative. Participants completed informed consent electronically. After the data were collected, factor structures were explored and confirmed using split half methods, with the sample randomly split into 2 halves for analyses. The first half of the sample was subjected to a principal factor analysis (PFA) for exploring the correlations among the observed variables that align well with theories of domestic and wild childhood experiences in nature. To validate the latent constructs, a confirmatory factor analysis (CFA) was conducted using the second half of the sample.

Independent variables include childhood experiences in nature, attitudes toward nature, and self-efficacy for spending time in nature.

The 2-factor childhood experiences in nature scale, developed using the steps described earlier, was used. Responses were on a 5-point scale from never to always and assessed childhood outdoor experiences up until about age 12 years. The scale contains 2 subscales: 1 measuring domestic experiences such as riding a bike and 1 measuring wild experiences such as camping.

An 18-item, 3-factor scale measuring attitudes toward spending time in nature was assessed. The items started with the phrase *When I am in nature...* and included attitudes such as boredom, awe, happiness, and worry. Attitudes were assessed on a 5-point Likert scale (1=strongly disagree, 5=strongly agree). The 3 factors measured positive and negative attitudes and concerns about spending time in nature.³⁸

A single-factor scale, including 14-items measuring self-efficacy to be in nature, was also administered.³⁹ The items started with the phrase *How confident are you right now that could spend at least 2 hours per week in green or natural spaces if...* and included scenarios such as when it is hot outside or when you are busy. Self-efficacy was assessed on a 5-point Likert scale (1=not at all confident, 5=extremely confident).

The dependent variable, adult time spent in nature, was assessed with a validated average length per week spent outdoors in nature scale.⁴¹ The scale defined green and natural spaces and asked, *In the typical week, when the weather allows, about how long on average do you spend outdoors in nature?* Response options included *none, some but <30 minutes, 30 minutes to an hour,*

between 1 and 2 hours, 2–3 hours, 3–4 hours, 4–5 hours, 5–7 hours, and >7 hours.

The model controlled for 2 demographic variables: sex (male/female) and age (18–29, 30–39, 40–49, 50–59, 60–69, and ≥70 years).

Statistical Analysis

Means from 1 to 5 for each childhood experience scale were calculated to determine which type of experiences happened more frequently in the sample, and cross-tabulations were run on means of the 2 types of childhood experience scales by levels of adult time spent in nature. One-way ANOVA and correlations assessed bivariate relationships between scales. Multiple linear regression examined the influences of each of the 2 childhood experiences in nature scales, the 3 attitudes scales, and the self-efficacy scale, along with sex and age covariates, on adult time spent in nature.

RESULTS

The final sample included 2,109 participants (49.7% female; mean age=58.1; 59.8% non-Hispanic White, 18.4% Hispanic, 13.3% Black). Over 30% of the sample spent time in nature every day (Table 1).

For the childhood experiences in nature scale development, the research team generated 33 unique items. This was reduced to 23 items during expert review. Twelve participants pretested items during cognitive interviews (Phase 3), further reducing the number of items to 20, which were included in the Qualtrics survey.

In an initial exploratory phase, principle factor method was used to extract 2 latent factors from the set of 20 childhood experience items before proceeding to the second CFA stage. PFA was selected as the technique given the theoretical basis for expecting that the observed variables were characterized by either more domesticated or more wild childhood experiences. These types of childhood experiences were theorized and named to align with previous research by Wells and Lekies.²⁹ The PFA analysis showed 2 eigenvalues (6.7 and 1.6) >1. The 2-factor solution with orthogonal varimax rotation produced subsets of items. On the basis of theoretical insights, 7 items loading on to the first factor included childhood experiences that were characterized by domesticated nature, whereas 10 items loading on to the second factor included experiences characterized by wild nature. Three items did not load on either factor (cut off score was set to 0.50) and were removed (i.e., went to a body of water, went to a park, and did yard work or gardening). Reliability tests indicated that the scale reliability coefficients were above the 0.70 threshold indicated by Anderson and Gerbing⁴² (domestic nature

Table 1. Sample Demographics (N=2,109)

Variable	Mean (SD) or %
Sex (% female)	49.7
Age, years	58.1 (17.1)
18–29	9.1
30–39	9.3
40–49	9.5
50–59	12.8
60–69	30.8
≥70	28.5
Education	
High school or less	21.7
Some of community college	36.8
Graduate or professional degree	17.5
Household income	
<\$30,000	27.7
\$30,000–\$49,999	21.5
\$50,000–\$69,999	16.6
\$70,000–\$99,999	16.9
≥\$100,000	17.3
Race/ethnicity	
White, non-Hispanic	59.8
Black, non-Hispanic	13.3
Hispanic	18.4
Other	8.0
Adult time spent in nature	
Every day	30.5
More than twice a week but not everyday	28.8
Twice a week	8.8
Once a week	9.3
Once or twice a month	6.6
Once every 2–3 months	2.5
Less often	4.9
Almost never	8.6

Cronbach's $\alpha=0.82$, wild nature Cronbach's $\alpha=0.87$), indicating high internal consistency. Each of the observed variable subsets from the PFA were then tested in CFA. In the CFA model for domesticated nature, all 7 item loadings were high and significant ($p<0.001$), with coefficients above 0.50, demonstrating sufficient convergent validity and thus confirming the factor structure. In the second CFA model for wild nature, 10 items were high and significant ($p<0.001$), and only 1 item (enjoyed flowers and botanical gardens) had a loading below 0.40, mostly upholding convergent validity. Both constructs demonstrated discriminant validity; the square root of the average variance extracted for each exceeded the bivariate correlation between the constructs (average variances extracted ranged from 0.511 to 0.576). The chi-square, normed chi-square (χ^2/df), comparative fit index (CFI), Tucker–Lewis index (TLI), standardized

root mean square residual (SRMR), and root mean square error of approximation (RMSEA) assessed the fit for the CFA models as suggested by Hair et al.⁴³ and Byrne.⁴⁴ The CFA for the domestic nature experiences indicated a fit to the data ($\chi^2/df=9.69$, CFI=0.900, TLI=0.989, RMSEA=0.092, SRMR=0.055). The CFA for wild nature experiences indicated an excellent fit to the data ($\chi^2/df=5.061$, CFI=0.961, TLI=0.959, RMSEA=0.062, SRMR=0.037). Table 2 shows the items for each of the 2 childhood experience scales and their factor loadings. After the CFA, the relationships between the 2 constructs of childhood experiences and adult time spent in nature were tested through structural equation modeling. A maximum likelihood test was used. The structural model indicated an acceptable fit to the data despite the significant chi-square result ($p<0.001$): CFI=0.861, TLI=0.839, SRMR=0.072, RMSEA=0.087. Overall results shown in Table 3 (Figure 1) indicate that the wild nature experiences as a child derived from the childhood experiences framework have a significant direct impact on adult time spent in nature.

The results of the prediction analysis found that domesticated experiences in childhood (mean=3.64, SD=0.77) were reported more often than wild experiences (mean=2.60, SD=0.86). The scales were moderately correlated with each other ($r=0.59$, $p<0.001$). Age was slightly positively correlated with domesticated nature ($r=0.10$, $p<0.05$) and negatively correlated with wild nature ($r=-0.10$, $p<0.05$). Race/ethnicity was not significantly related to wild childhood experiences in nature but was significantly related to domesticated experiences in nature ($p<0.001$). Non-Hispanic White respondents (mean=3.75) reported significantly higher time spent in domesticated nature than Black (mean=3.48), Hispanic (mean=3.44), and other (mean=3.43) respondents. Both domesticated and wild childhood experiences were significantly related to time spent in nature as an adult ($p<0.001$). Table 4 shows time spent in nature per week during adulthood by the 2 types of childhood experiences.

The overall regression was statistically significant ($R^2=0.22$, $F[8, 1961]=67.38$, $p<0.001$). In the overall model, there was a significant relationship between wild childhood experiences ($\beta=0.279$, $p<0.001$), positive

Table 2. Childhood Experience Items

Item description	PFA factor loading	CFA factor loading
Scale 1: Domesticated nature		
Swam outside	0.54	0.58
Played outside unsupervised	0.65	0.66
Spent time outside with friends	0.70	0.70
Rode a bike	0.67	0.67
Played on an outdoor playground	0.56	0.55
Climbed trees	0.51	0.52
Lay in the grass	0.52	0.63
Scale 2: Wild nature		
Went camping	0.61	0.66
Went hiking	0.68	0.72
Played in the woods	0.55	0.70
Played in a treehouse or fort	0.56	0.68
Walked or jogged on trails	0.58	0.59
Went fishing	0.63	0.85
Found tadpoles or frogs	0.61	0.71
Went birding	0.71	0.61
Enjoyed flowers or botanical gardens ¹	0.51	0.46
Went hunting	0.61	0.57

CFA, confirmatory factor analysis; PFA, principal factor analysis.

attitudes ($\beta=0.12$, $p<0.05$), negative attitudes ($\beta=-0.23$, $p<0.001$), and self-efficacy ($\beta=0.71$, $p<0.001$) and adult time spent in nature, whereas there was no significant relationship between concerns ($\beta=-0.01$, $p=0.94$) and domesticated childhood experiences ($\beta=-0.05$, $p=0.50$) and adult time spent in nature (Table 5).

DISCUSSION

This study developed a valid and reliable instrument measuring both wild and domesticated childhood experiences in nature. Both types of childhood experiences predicted time spent in nature as an adult in bivariate analyses. However, in multivariate analysis, when

Table 3. Main Model (Figure 1): SEM Results

Structural path	Unstandardized estimate	Critical ratio	p-value
Wild nature experiences as a child → adult time spent in nature	0.894	8.72	***
Domesticated experiences as a child → adult time spent in nature	-0.166	-1.61	ns

Note: *** indicates significance at $p<0.001$; ns indicates no significance at $p>0.05$. The amount of variance explained (squared multiple correlations) in the final dependent construct (adult time spent in nature) was determined using Cohen's f^2 , a measure of effect size. The overall model was $R^2=0.10$.

SEM, structural equation model.

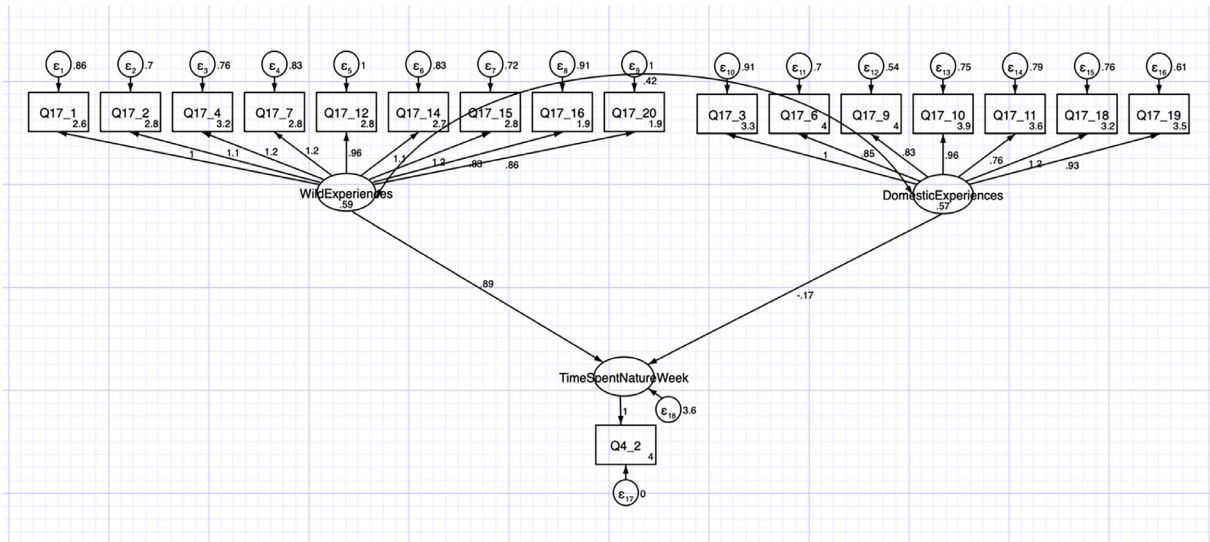


Figure 1. Main model: SEM results. SEM, structural equation model.

Table 4. Adult Time in Nature per Week by 2 Types of Childhood Experiences

Nature experiences	n	Mean	SD
Wild nature experiences as a child: F(8,2070)=26.56, p<0.001, eta ² =0.093			
Adult time spent in nature per week			
>7 hours	96	3.05	0.76
5–7 hours	61	2.83	0.92
4–5 hours	115	3.02	0.87
3–4 hours	131	2.94	0.89
2–3 hours	227	2.78	0.79
1–2 hours	462	2.63	0.83
30 minutes to an hour	517	2.56	0.82
Some but <30 minutes	350	2.27	0.78
None	112	2.01	0.87
Domesticated nature experiences as a child: F(8,2077)=5.54, p<0.001, eta ² =0.036			
Adult time spent in nature per week			
>7 hours	96	3.95	0.73
5–7 hours	62	3.78	0.76
4–5 hours	115	3.84	0.65
3–4 hours	133	3.84	0.73
2–3 hours	228	3.69	0.75
1–2 hours	465	3.65	0.77
30 minutes to an hour	515	3.66	0.72
Some but <30 minutes	349	3.43	0.82
None	115	3.37	0.82

controlling for other variables, domesticated experiences were no longer a significant predictor. Similar to Wells and Lekies,²⁹ this study found better prediction from

Table 5. Regression Results for Adult Time Spent in Nature

Variable	Coefficient	SE	t	p-value
Constant	2.1	0.40	5.07	0.001
Sex	-0.12	0.08	-1.42	0.157
Age	-0.08	0.03	-3.00	0.005
Positive attitudes	0.12	0.06	1.84	0.06
Negative attitudes	-0.23	0.07	-3.40	0.001
Concerns about nature	-0.01	0.06	-0.08	0.93
Self-efficacy	0.71	0.05	14.17	0.001
Domesticated childhood outdoor experiences	-0.05	0.07	-0.68	0.31
Wild childhood outdoor experiences	0.28	0.06	4.37	0.001

Note: n=1,970, R²=0.21, and adjusted R²=0.21.

wild nature experiences than from domesticated nature experiences during childhood. Regular, everyday experiences such as riding a bike or playing on a playground, although reported to happen more frequently, seemed to have limited impact on adult time in nature or may be mediated by attitudes and self-efficacy. It was more adventurous experiences in the wild such as camping, hiking, and fishing that were found to be significantly associated with adult time spent in nature.

Giusti and colleagues²⁸ explain that children’s connections to nature may depend on the qualities of their significant nature situations. Qualities of nature situations included things such as environmental epiphanies, restorative experiences, and nature free play.²⁸ They assert that for children to connect to nature over time,

they need routinization and progression in their nature experiences.²⁸ That is, to be comfortable in nature, children need to actually be in nature on a regular basis, and they may need to do so at times under the guidance of a trusted adult. In wild experiences, as opposed to domesticated experiences, children may experience more of these qualities such as awe, restoration, and full sensory engagement. If children are exposed to wild experiences at an early age where they can try new things and practice skills, their capacity to be comfortable in significant nature situations is being built. This kind of exposure could shape attitudes and increase self-efficacy to be in nature as an adult.

These findings have significant implications for health promotion and disease prevention. Domesticated experiences such as riding bikes and outdoor time with friends are certainly healthy and important activities. However, supplementing domesticated experiences with programs to introduce wild childhood experiences may have long-term benefits. Importantly, in a systematic review, Gill found that the most beneficial way to engage children with nature was through playfulness.²³ Even though wild experiences require structure and planning by adults on the front end, allowing children time for free play in nature can have immediate benefits as well.

How these wild experiences are introduced should be considered. Although youth development programs such as 4-H and Scouting and State and National Park outdoor programs provide incredible opportunities to regularly connect with nature, not all families have perceived or actual access to such programs. In the past, school physical education programs focused on teaching life skills.⁴⁵ Perhaps significant nature experiences could be incorporated into physical education curricula to introduce key life skills for being in nature. In addition, caregivers or trusted adults can introduce children to wild childhood experiences and mentor them. Sofranko and Nolan found that it was parental introduction to the sports of fishing and hunting that led to future adult participation.⁴⁶ There are a wide variety of wild outdoor experiences, and family access to this breadth of experiences may vary by family SES and proximity to wild nature. Therefore, programming to introduce children to these types of experiences may be even more effective if it is developed to be family based.

It is important to note that introductory experiences in nature can occur outside of childhood. Personal community plays an important role in how adults spend their time.⁴⁷ Certainly, parents and teachers and other role models (e.g., camp counselors) shape children's behavior, but college roommates, friends, and mentors could be influencers of adult behavior too. A recent study in Australia found that both childhood and adult

nature experiences predicted adult connection to nature.⁴⁸ Future research could explore the impact of the timing of exposure to wild nature experiences throughout the life course.

Limitations

There are several limitations in this study. First, it is a cross-sectional study, so childhood experiences are remembered as adults and may be subject to recall bias and social desirability; reported time spent in nature may differ from actual time in natured spaces. The respondent average age in this sample was skewed slightly older. As pointed out by Louv, older generations of Americans had more immersive and autonomous childhood experiences in nature than younger generations, and, therefore, results may vary with those of a younger average age even though age was not a significant factor in the regressions.³⁶ Items were developed and the study was conducted in the U.S. The scale should be pretested and reviewed before use in other countries. Given the length of the survey and the number of items, the study team did not assess who the activities were performed with. Future research should examine the effect of adult and peer involvement in nature activities and how it may influence subsequent behavior.

CONCLUSIONS

This article reports the influences of different kinds of outdoor experiences in childhood on time spent in nature as an adult by first constructing childhood experiences in nature summative scales and next examining the influence of each scale on time spent in nature as an adult. Two types of childhood experiences emerged: wild and domesticated. It was the wild childhood experiences in nature along with attitudes and self-efficacy that significantly predicted time in nature as an adult. Perhaps experiences in childhood that include more skill building, are immersive and engage more senses, and involve more opportunity for social interaction will translate better into adult activities in nature. Programs for children may need to switch focus from just teaching them about nature to actually allowing them to experience nature, and everyday domesticated experiences for children may need to be supplemented with regular opportunities to engage with wild nature. School- and family-based programs may have potential for increasing time in nature from childhood all the way through to adulthood.

ACKNOWLEDGMENTS

The IRB at Texas A&M University approved data collection procedures in 2021 (Number IRB2021-0556M). DKK and JEM

conceptualized the idea for the study. DKK and JEM collected data for the project. CSR and JEM developed the scales, and DKK, CSR, and JEM analyzed data. DKK prepared the manuscript, and all authors edited and revised the final version.

The results of this study were presented at the 22nd annual meeting of the International Society of Behavioral Nutrition and Physical Activity.

Declaration of interest: none.

CREDIT AUTHOR STATEMENT

Debra K. Kellstedt: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization, Project administration. Courtney S. Suess: Methodology, Formal analysis, Writing – review & editing. Jay E. Maddock: Conceptualization, Methodology, Formal analysis, Investigation, Writing – review & editing, Supervision.

REFERENCES

- Frumkin H, Bratman GN, Breslow SJ, et al. Nature contact and human health: a research agenda. *Environ Health Perspect*. 2017;125(7):075001. <https://DOI.ORG/10.1289/EHP1663>.
- Markevych I, Schoierer J, Hartig T, et al. Exploring pathways linking greenspace to health: theoretical and methodological guidance. *Environ Res*. 2017;158:301–317. <https://doi.org/10.1016/j.envres.2017.06.028>.
- Cain KL, Millstein RA, Sallis JF, et al. Contribution of streetscape audits to explanation of physical activity in four age groups based on the Microscale Audit of Pedestrian Streetscapes (MAPS). *Soc Sci Med*. 2014;116:82–92. <https://doi.org/10.1016/j.socscimed.2014.06.042>.
- Bowler DE, Buyung-Ali LM, Knight TM, Pullin AS. A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*. 2010;10:456. <https://doi.org/10.1186/1471-2458-10-456>.
- Hartig T, Mitchell R, de Vries S, Frumkin H. Nature and health. *Annu Rev Public Health*. 2014;35(35):207–228. <https://doi.org/10.1146/annurev-publhealth-032013-182443>.
- Barton J, Pretty J. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environ Sci Technol*. 2010;44(10):3947–3955. <https://doi.org/10.1021/es903183r>.
- Sugiyama T, Leslie E, Giles-Corti B, Owen N. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships? *J Epidemiol Community Health*. 2008;62(5):e9. <https://doi.org/10.1136/jech.2007.064287>.
- Benefits of physical activity | Physical activity. Centers for Disease Control and Prevention. <https://www.cdc.gov/physicalactivity/basics/pa-health/index.htm>. Updated April 17, 2024. Accessed June 18, 2024.
- Piercy KL, Troiano RP, Ballard RM, et al. The physical activity guidelines for Americans. *JAMA*. 2018;320(19):2020–2028. <https://doi.org/10.1001/jama.2018.14854>.
- HHS. Physical Activity guidelines for Americans. 2nd edition Washington, DC: HHS; 2018. https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf. Accessed September 10, 2023.
- Christiana RW, Besenyi GM, Gustat J, Horton TH, Penbrooke TL, Schultz CL. A Scoping Review of the Health Benefits of Nature-Based Physical Activity. *JHEAL*. 2021;1(3):142–160. <https://doi.org/10.51250/jheal.v1i3.25>.
- White MP, Alcock I, Grellier J, et al. Spending at least 120 minutes a week in nature is associated with good health and wellbeing. *Sci Rep*. 2019;9(1):7730. <https://doi.org/10.1038/s41598-019-44097-3>.
- The Nature of Americans. <https://natureofamericans.org/>. Accessed November 3, 2022.
- Telama R, Yang X, Viikari J, Välimäki I, Wanne O, Raitakari O. Physical activity from childhood to adulthood: a 21-year tracking study. *Am J Prev Med*. 2005;28(3):267–273. <https://doi.org/10.1016/j.amepre.2004.12.003>.
- Lindsay JJ, Ogle RA. Socioeconomic patterns of outdoor recreation use near urban areas. *J Leis Res*. 1972;4(1):19–24. <https://doi.org/10.1080/00222216.1972.11970053>.
- Tomasso LP, Cedeño Laurent JG, Chen JT, Spengler JD. Implications of disparities in social and built environment antecedents to adult nature engagement. *PLoS One*. 2022;17(9):e0274948. <https://doi.org/10.1371/journal.pone.0274948>.
- Cleland V, Timperio A, Salmon J, Hume C, Baur LA, Crawford D. Predictors of time spent outdoors among children: 5-year longitudinal findings. *J Epidemiol Community Health*. 2010;64(5):400–406. <https://doi.org/10.1136/jech.2009.087460>.
- Yamagata-Lynch LC. Understanding cultural historical activity theory. In: Yamagata-Lynch LC, editor. *Activity Systems Analysis Methods*. Cham, Switzerland: Springer, 2010:13–26. <https://doi.org/10.1007/978-1-4419-6321-5>.
- Grusec JE, Hastings PD. *Handbook of Socialization: Theory and Research*. New York, NY: Guilford Publications; 2014. https://books.google.com/books?hl=en&lr=&id=vTRFBQAAQBA-J&oi=fnd&pg=PP1&dq=Handbook+of+Socialization:+Theory+and+Research&ots=XW7RChvV_O&sig=1_cMMzzLq-XlfemNyCEH-S0e6Npw#v=onepage&q=Handbook%20of%20Socialization%3A%20Theory%20and%20Research&f=false. Accessed September 10, 2023.
- Tanner T. Significant life experiences: a new research area in environmental education. *J Environ Educ*. 1980;11(4):20–24. <https://doi.org/10.1080/00958964.1980.9941386>.
- Boullier M, Blair M. Adverse childhood experiences. *Paediatr Child Health (Oxf)*. 2018;28(3):132–137. <https://doi.org/10.1016/j.paed.2017.12.008>.
- Luszczynska A, Schwarzer R. Social cognitive theory. *FAC Health Sci Publ*. 2015:225–251. <https://books.google.com/books?hl=en&lr=&id=pMkvEAAAQBAJ&oi=fnd&pg=PA225&dq=Social+cognitive+theory&ots=eXYGx6jjFA&sig=PSiIk3NlavO8RtE9X6BKfsCfr6E#v=onepage&q=Social%20cognitive%20theory&f=false>. Accessed September 10, 2023.
- Gill T. The benefits of children's engagement with nature: a systematic literature review. *Child Youth Environ*. 2014;24(2):10–34. <https://doi.org/10.1353/cye.2014.0024>.
- Chawla L. Life paths into effective environmental action. *J Environ Educ*. 1999;31(1):15–26. <https://doi.org/10.1080/00958969909598628>.
- Ewert A, Place G, Sibthorp JIM. Early-life outdoor experiences and an individual's environmental attitudes. *Leis Sci*. 2005;27(3):225–239. <https://doi.org/10.1080/01490400590930853>.
- Furihata S, Ishizaka T, Hatakeyama M, Hitsumoto M, Ito S. Potentials and challenges of research on “Significant Life Experiences” in Japan. *Child Youth Environ*. 2007;17(4):207–226. <https://doi.org/10.1353/cye.2007.0028>.
- Dewey AM. Shaping the environmental self: the role of childhood experiences in shaping identity standards of environmental behavior in adulthood. *Sociol Perspect*. 2021;64(4):657–675. <https://doi.org/10.1177/0731121420981681>.
- Giusti M, Svane U, Raymond CM, Beery TH. A framework to assess where and how children connect to nature. *Front Psychol*. 2017;8:2283. <https://doi.org/10.3389/fpsyg.2017.02283>.
- Wells NM, Lekies KS. Nature and the life course: pathways from childhood nature experiences to adult environmentalism. *Child Youth Environ*. 2006;16(1):1–24. <https://doi.org/10.1353/cye.2006.0031>.
- Bixler RD, Floyd MF, Hammitt WE. Environmental socialization: quantitative tests of the childhood play hypothesis. *Environ Behav*. 2002;34(6):795–818. <https://doi.org/10.1177/001391602237248>.
- van Heezik Y, Freeman C, Falloon A, Buttery Y, Heyzer A. Relationships between childhood experience of nature and green/blue space use, landscape preferences, connection with nature and pro-

- environmental behavior. *Landsc Urban Plan.* 2021;213:104135. <https://doi.org/10.1016/j.landurbplan.2021.104135>.
32. Asah ST, Bengston DN, Westphal LM. The influence of childhood. *Environ Behav.* 2012;44(4):545–569. <https://doi.org/10.1177/0013916510397757>.
 33. Pensini P, Horn E, Caltabiano NJ. An exploration of the relationships between adults' childhood and current nature exposure and their mental well-being. *Child Youth Environ.* 2016;26(1):125–147. <https://doi.org/10.1353/cye.2016.0027>.
 34. Thompson CW, Aspinall P, Montarzino A. The childhood factor. *Environ Behav.* 2008;40(1):111–143. <https://doi.org/10.1177/0013916507300119>.
 35. Izenstark D, Middaugh E. Patterns of family-based nature activities across the early life course and their association with adulthood outdoor participation and preference. *J Leis Res.* 2022;53(1):4–26. <https://doi.org/10.1080/00222216.2021.1875274>.
 36. Louv R. *Last Child in the Woods: Saving Our Children From Nature-Deficit Disorder.* Chapel Hill, NC: Algonquin books; 2008. <https://books.google.com/books?hl=en&lr=&id=WnLBBwAAQBA-J&oi=fnd&pg=PP1&dq=Last+Child+in+the+Woods:+Saving+Our+Children+From+Nature-Deficit+Disorder.&ots=XDzzwQ8Rxe&sig=j3rag1i7zMLoURz-jHNBjU8Ihwo#v=onepage&q=Last%20Child%20in%20the%20Woods%3A%20Saving%20Our%20Children%20From%20Nature-Deficit%20Disorder%2C&f=false>. Accessed September 10, 2023
 37. Boateng GO, Neilands TB, Frongillo EA, Melgar-Quinonez HR, Young SL. Best practices for developing and validating scales for health, social, and behavioral research: A primer. *Front Public Health.* 2018;6:149. <https://doi.org/10.3389/fpubh.2018.00149>.
 38. Maddock JE, Suess C, Bratman GN, et al. Development and validation of an attitude toward spending time in nature scale. *Ecopsychology.* 2022;14(3):200–211. <https://doi.org/10.1089/eco.2022.0017>.
 39. Maddock JE, Suess C, Bratman GN, et al. Development and validation of self-efficacy and intention measures for spending time in nature. *BMC Psychol.* 2022;10(1):51. <https://doi.org/10.1186/s40359-022-00764-1>.
 40. Redding CA, Maddock JE, Rossi JS. Measurement of theoretical constructs for health behavior. *Calif J Health Promot.* 2006;4(1):83–101. <https://doi.org/10.32398/cjhp.v4i1.736>.
 41. The people and nature survey. GOV.UK. <https://www.gov.uk/government/collections/people-and-nature-survey-for-england>. Updated April 17, 2024. Accessed June 18, 2024.
 42. Anderson JC, Gerbing DW. Structural equation modeling in practice: a review and recommended two-step approach. *Psychol Bull.* 1988;103(3):411–423. <https://doi.org/10.1037/0033-2909.103.3.411>.
 43. Hair JF, Anderson RE, Babin BJ, Black WC. *Multivariate Data Analysis: A Global Perspective, 7.* Upper Saddle River, NJ: Pearson, 2010.
 44. Byrne BM. Adaptation of assessment scales in cross-national research: issues, Guidelines, and Caveats. *Int Perspect Psychol.* 2016;5(1):51–65. <https://doi.org/10.1037/ipp0000042>.
 45. Goudas M, Dermitzaki I, Leondari A, Danish S. The effectiveness of teaching a life skills program in a physical education context. *Eur J Psychol Educ.* 2006;21(4):429–438. <https://DOI.ORG/10.1007/BF03173512>.
 46. Sofranko AJ, Nolan MF. Early life experiences and adult sports participation. *J Leis Res.* 1972;4(1):6–18. <https://doi.org/10.1080/00222216.1972.11970052>.
 47. Burch WR. The social circles of leisure: competing explanations. *J Leis Res.* 1969;1(2):125–147. <https://doi.org/10.1080/00222216.1969.11969720>.
 48. Cleary A, Fielding KS, Murray Z, Roiko A. Predictors of nature connection among urban residents: assessing the role of childhood and adult nature experiences. *Environ Behav.* 2018;52(6):579–610. <https://doi.org/10.1177/0013916518811431>.