

RESEARCH ARTICLE

Implications of disparities in social and built environment antecedents to adult nature engagement

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Abstract

Antecedent factors which influence adult engagement with nature are underexplored given the human health benefits strongly associated with nature exposure. Formative pathways and impediments to nature contact merit understanding as they may contribute to later-life health disparities. We probed experiential pathways and attitudes toward nature engagement among adults purposefully sampled across U.S. regions, age, race/ethnicity, and urbanicity through semi-structured focus group discussions. The research aims were to explore entryways and barriers to experiencing nature and learn how nature and built environments compete in influencing human-nature relationships. Sessions were recorded, transcribed, and analyzed following Braun and Clarke's phases of thematic analysis. Qualitative content analysis of discussions identified three principal themes: 1) formative influences promoting adult nature engagement (i.e., persons/organizations and places of origin), 2) detractors from nature engagement (i.e., perceptual, material, and physical barriers), and 3) role of current setting (i.e., natural and built environments) shaping nature-seeking relationships. We found experiential factors that included early life exposures outdoors, personal mentorship, and organizational affiliation to be highly influential in socializing individuals to nature and in soldering attachment to nature which manifests into adulthood. In contrast, changing demographics and childhood, inequity, social dynamics, metropolitan growth, urban renewal explained alienation from nature. These findings emphasize the importance of efforts to expand opportunities for nature contact, especially for youth living in economically challenged urban areas, which go beyond increasing greenspace to encompass mentoring partnerships for gaining skills and comfort outdoors and redesign of safe natured spaces within cities for hands-on learning and discovery.

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Introduction

Dimensions of nature exposure

Research documenting the health gains from nature exposure often concludes with the caveat that it remains unknown if and how individuals actually engage with nature [1–6]. Evidence from many countries suggests that population-based health endpoints generally improve with proximity, extent and appeal of urban greenspace and walkable infrastructure [7–11]. However, these mostly favorable outcomes reveal little of the social-structural antecedents which pre-position exposure levels fundamental to the nature-health relationship. What makes up nature exposure and how different subgroups regard and interact with nature remains ambiguous for gauging health targets. Who is being exposed to nature and under what conditions exposure occurs, if at all, requires greater attention as a population health [12] as well as environmental justice concern [13–16].

Time spent outdoors has declined for most children and adults globally [17–19]. For many, the built environment represents the only setting in which individuals live, work, and recreate, with urban greenspace the singular form of nature experienced by these individuals from childhood to adulthood [20–22]. Yet encountering safe, proximate, and useful greenspace can be problematic within the urban landscape [23, 24]. Metropolitan growth, building densification, and generational dispersal of families have changed nature interaction in spatially and socially determined ways, requiring effort to access natural spaces formerly more easily reached. Individuals thus feel more disengaged and alienated from routine nature experiences [25–27]. Nature alienation diminishes baseline knowledge of nature and its processes [28], biophilic attachment [29–34], pro-environmentalism [35–38], and even expectations of nature-based experiences [39]. Reduced nature exposure weakens opportunities to activate a latent nature affinity which predicts life-long nature contact and concern for environmental sustainability and stewardship [40–44].

The potential for experiencing the health benefits of nature contact furthermore remains beset by socioeconomic disparities [45–47]. Socioeconomic status (SES) is an acknowledged determinant of health as it shapes the likelihood and ability of adults to encounter supportive green environments for physical activity [48, 49] and mental health [50, 51]. In neighborhoods of low SES, greenspace not only is less available but often qualitatively inferior through poorer maintenance, less biodiversity, and fewer amenities [15, 52–54]. Vulnerable communities, frequently those of color, experience a form of environmental injustice [55–57] through exclusion from healthy nature contact [58]. Cross-cultural research shows children across income and race exhibit a universal biophilic concern; however, ecological degradation in socioeconomically deprived neighborhoods accentuates this concern, despite fewer tangible opportunities for nature interaction [59]. Such groundwork from child ecopsychology urges an exploration of social and environmental disparities upstream of nature contact as currently conceived and measured.

This study qualitatively explores nature engagement across race, region, age, and biophilic need to understand the origins of nature-seeking tendencies and reluctances to engage with nature that result in patterns of access and use. These methods are meant to complement empirical evidence on nature and health and reflect twenty-first century societal norms and patterns currently affecting historical human-nature relationships. Qualitative approaches seen in built environmental and health literature occasionally have addressed neighborhood-level factors, though not nature exposure per se. This research aims to 1) elucidate antecedent factors motivating nature-seeking in adulthood; 2) identify pertinent social and built environment contributors and barriers to nature use, which can amplify over time; and 3) discern elements common or unique to nature engagement or disengagement by specific group [60]. Our

research objectives strongly bear on outcomes related to environmental health, given the potential for unaddressed nature deprivation to widen existing urban health disparities.

Factors associated with nature engagement

A rich literature exploring predictors of environmental activism and ecological sensitivities points toward formative childhood experiences with nature [20, 61–66]. Significant life experience (SLE) anchors this research, with unfettered childhood discovery of the nature world, often in solitude, supporting the development of pro-environmental attitudes and activism in adulthood [58, 67–73]. Early SLE studies conducted among conservationists and environmental educators retroactively mapped childhood paths to known behavioral outcomes in adulthood [74, 75]. Far less is known about the motivational impulses behind nature-seeking outside these initial conservation-oriented professions. Moreover, the foundational SLE literature regarding nature engagement trails social and demographic transitions which pose constraints to current nature contact and predates the emergence of screen-based technologies, e.g., internet, social media, which crowd out time in nature [76, 77]. Metropolitan growth, urban densification, and declining car ownership additionally have made nature less accessible than when first formally examined [78].

Scales to measure nature connectedness have developed parallel to SLE work and help explain nature-seeking in adulthood [41, 43, 79–81]. Still, evidence that greater nature affinity favors the likelihood of pro-environmentalism does not shed light on the origins of nature affinity as a cultivated or innate sensibility, or correlated to trustful mentoring experiences, or specific to developmental age. Motivations to spend time in nature may be influenced in ways different from environmental protection, though both have implications for individual wellbeing as an extension of planetary health.

Current literature remains weak in addressing experiential precursors that set in motion different exposure pathways and desires to engage with nature across the life course [82], even though research indicates that social determinants related to urban nature access are spatially patterned [83, 84]. Local environments, population densities and sociodemographic attributes may exert different influences on individual access to and use of nature-based places not captured ecologically [85, 86]. Viewing the nature-health relationship in terms of antecedent natural, built, and social environments may unveil why adult individuals do and do not seek out nature beyond reasons of proximity. The ways different subpopulations “access, use, and respond to nature” therefore merit more exploration [4, 87].

Societal changes challenging nature use may embed factors that differentiate formative pathways culminating in active adult nature engagement. Thematic factors believed categorically relevant to nature relationships assemble around life events, operationalization, and emotions and cognitions. Life events consist of early life experiences in nature, influential adults who socialized participants to nature, and place-based associations with nature. Elements associated with operationalization of nature affinity regard effort to access nature, safety and well-being concerns, positive and negative emotions toward nature, inherited family environmental values, and knowledge of nature. Social attributes include age, mobility, organizational affiliation oriented to outdoor participation including schools, income by inference as facilitating or obstructing nature use, and perceived social exclusion. Factors in each of these categories are relevant to emotional imprinting, social vulnerability, and habit formation through early adulthood. Generational age provides a temporal lens to pick out ongoing levers of influence against those supplanted by fast-moving societal shifts which erode traditional pathways for discovering and partaking in nature. This research proposes to gain insights into experiential factors and socioenvironmental dynamics across varied demographic perspectives

which enable and/or detract from a relationship empirically shown to improve individual health and wellbeing.

Methods

Theoretical approach to research design

We pursued phenomenology as our investigative method to explain the foundations of nature-seeking in adulthood through personal experiences of study participants [88]. Perspectives were inductively organized by inquiry aimed at describing the semantic meaning and significance of personally narrated events [89, 90]. The use of focus group discussions (FGDs) was well suited to a research design reliant on ancillary organizers to recruit and convene study participants unaffiliated with the interviewer [91, 92]. COREQ reporting guidelines helped frame and report this study to improve transparency and analytical rigor of interview design and analysis [90].

Participant recruitment

Our study population consisted of individuals recruited in two waves to explore formative experiences and origins of attitudes shaping nature-seeking behaviors as adults. Recruitment initiated with Facebook advertisements placed October 2019 in four geographically diverse regions inviting volunteers to an on-line enrollment portal explaining study goals. Inclusion criteria included over-18 adult age and ability to attend an in-person focus group in one of the four target areas. 596 participants registered through the on-line portal, listing only city and gender, which resulted in a meta-population of 82.8% women, 15.0% men, 1.5% non-binary gender. The goal of gender parity meant all enrollees who identified as male or non-binary were invited by email to attend a focus group, with rolling replacement invitations issued to females until twelve participants per group confirmed. Males responded at higher rates but had lower attendance availability, while females had opposite response trends. Having discovered that variation sampling strategy [93] did not yield adequate demographic representation necessary to conduct this study, we sought to expand sampling representation through an affiliated organizational network of public health fellows who work with local community groups. We then invited community group members who might bring economic, racial, gender and age diversity to our sampling population. This second recruitment method allowed us to pair one Facebook-recruited focus group comprised of varied but self-selected participants from each metro area with a more homogeneous focus group defined by sociodemographic dimensions underrepresented through ad response. The addition of two conservation groups provided a subpopulation comparable to those studied in the original SLE literature and which also bookended the spectrum of participant time spent in nature. All final study participants voluntarily enrolled and provided electronic consent.

Study setting

We convened study participants from the environs of San Francisco Bay, Atlanta, Phoenix, Boston, and Hartford and organized a session for conservation officers at their annual national conference. All FGDs were conducted in-person at a community meeting room or university classroom except for a final discussion held over Zoom in accordance with IRB protocol restrictions under COVID-19.

Participatory research tools

The research team chose FGDs for efficiency over individual interviews. A semi-structured topic guide (S1 Table) informed by the background literature [61, 67, 94, 95] and expert

recommendations for future nature-health research [87] was developed specifically to explore individuals' attitudes and experiences which shape current nature engagement, refined for participant inclusivity. An introduction to the research purpose began each session. Participants were next invited to recall a place meaningfully associated with nature and reasons supporting their choice to establish the thematic arc of the topic guide. New subtopics which arose were incorporated into subsequent sessions owing to the iterative nature of the research methods [96].

Ethics statement

All participants reiterated oral consent prior to commencing the discussion and were informed of their right to opt out at any point during the process. The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of Harvard T.H. Chan School of Public Health (protocol code 19–1419 on 28 August 2019). Arizona and Georgia State Universities additionally consented to allow data collection under the referenced IRB.

Data collection

The first author and main facilitator (LPT) conducted ten FGDs lasting between 1.5 to two hours each, with 8–19 participants per group. Data were collected in-person between September 2019 to January 2020 and over Zoom in November 2020. The sessions were digitally recorded with participants' permission, transcribed verbatim by an outside person, and reviewed by the interviewer to ensure accuracy. Transcripts contained no identifiable participant information or self-identified sociodemographic data beyond gender and region gathered at study enrollment. Theoretical saturation was determined once no new themes surfaced in ongoing data analysis, suggesting adequate sampling representation [90]. Focus group participants received a \$20 retail gift card at session conclusion to acknowledge their time.

Data analysis

Transcribed interview content was analyzed and managed using NVivo 12 Plus [97]. After transcript review, the FGD facilitator (LPT) inductively identified codes based on subject knowledge and group interface. LPT subsequently developed a code manual to define emergent themes and subthemes based on the study framework and existing literature, specifying when and when not to use each [98], to share with the second analyst (MMF). MMF identified further subthemes not covered by the first analyst (LPT) to produce a final codebook. Open coding allowed the two analysts to ascribe additional subthemes to the initial organizational scheme when omissions and new ideas were detected [99] until consensus was reached on themes. The analysis was performed systematically across the ten groups and independently of the study guide questions. The study's internal validity was strengthened through analysts' regular discussions of contextual meaning based on increasing familiarity with transcript content and participant intention. Inter-rater reliability was maintained through multiple and separate reading of transcripts to reconcile coding discrepancies and mitigate any bias that may occur during data interpretation, merge overlapping subthemes, and drop nascent themes where text evidence proved insufficient [92]. LPT created a concept map depicted as Fig 1 to connect final categories as supported by thematic evidence [96, 99–101]. Together the two analysts coded a total of 61.5% of the transcript data, reaching concordance on 82.6% [102, 103]. An unweighted kappa coefficient of 78.3% measured agreement corrected for chance.

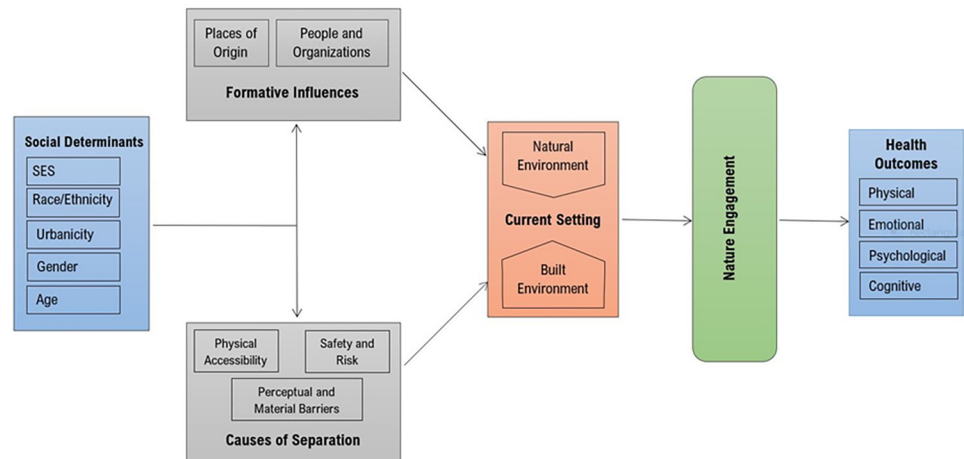


Fig 1. Conceptual framework describing a general model of exposure pathways to nature engagement identified through qualitative methods.

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Results

Our 127 participants represented 49 individuals recruited through variation sampling, 44 through an affiliated public health network, and 34 professionally or avocationally working in conservation. The four ad respondent groups were of mixed demographics, the community network groups of homogenous character by race/ethnicity and/or age, and the conservation groups likewise homogenous in terms of race, suburban or rural residence, and slightly older mean age. Two groups were predominantly composed of black individuals, and one group of Central and South American origin. This latter FGD was conducted in Spanish. Persons of color participated in some of the Facebook response groups, bringing representation of non-white individuals to one-third of total study population. Lower income groups based on recruitment census tract represented one-quarter of participants. [Table 1](#) describes focus group characteristics; [Fig 2](#) illustrates focus group locations.

Table 1. Focus groups characteristics.

Group	Location	Recruitment type	Gender ^b	Age Range	N =
1	Tempe, AZ	PH ^a community network	6 F, 5 M	25–35	11
2	Phoenix	Facebook ad respondents	4 F, 6 M	Mixed age	10
3	Rural WV	Govt conservation officials	5 F, 10 M	40–65	15
4	Boston, MA	Facebook ad respondents	11 F, 3 M, 1 NB	Mixed age	15
5	Urban CT	PH community network	2 F, 8 M	18–22	10
6	Downtown Atlanta	PH community network	13 F, 2 M	18–22	15
7	Suburban Atlanta	Facebook ad respondents	9 F, 2 M	Mixed age	11
8	Berkeley, CA	Facebook ad respondents	9 F, 3 M, 1 NB	Mixed age	13
9	Sacramento, CA	PH community network	7 F, 1 M	24–28	8
10	Suburban CT	Local conservation group	11 F, 8 M	Over 50	19

^a PH = public health

^b M = male, F = female, NB = Non-binary

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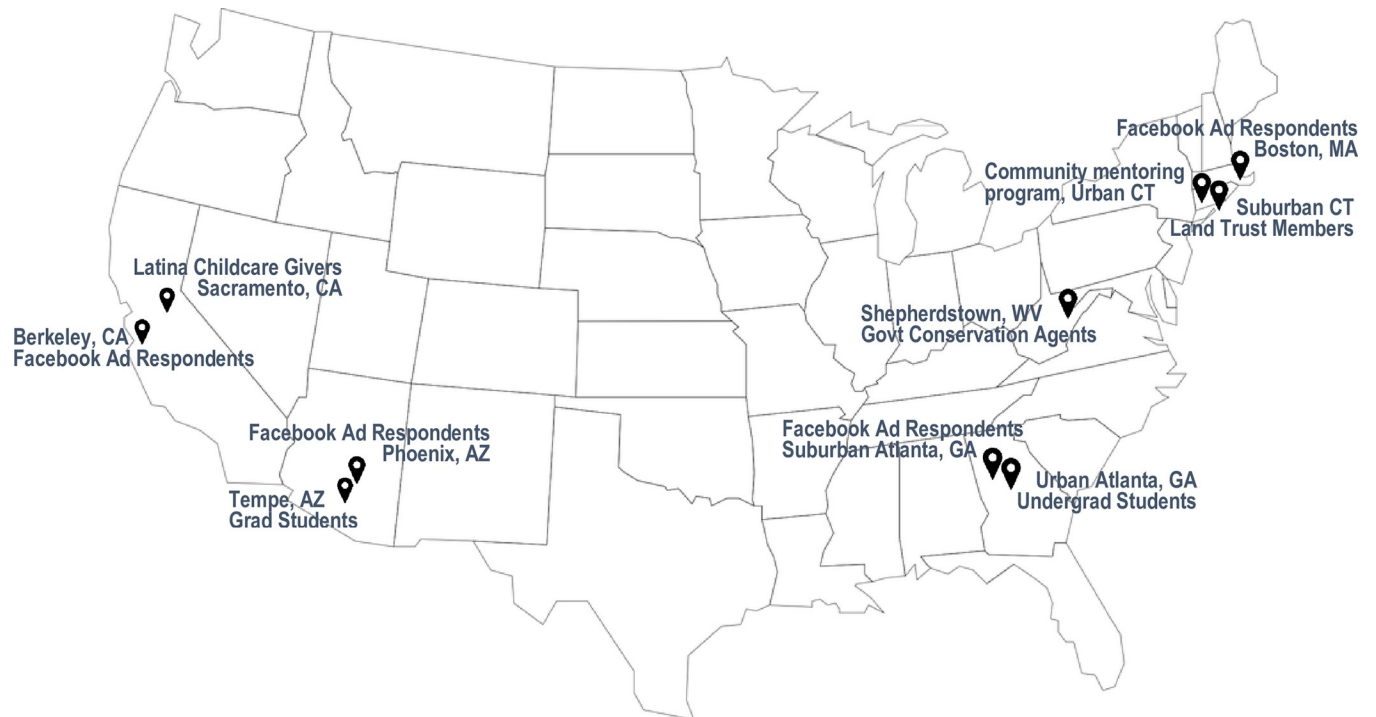


Fig 2. Focus group locations. Ten focus groups were held in four metropolitan regions and at a national conference of federal conservation officials. U.S. map is made available under the Creative Commons CC0 1.0 Universal Public Domain Dedication.

<https://doi.org/10.1371/journal.pone.0274948.g002>

What formative influence shape our affinity for nature?

Formative influences, grouped as places of origin and persons or organizations providing positive introductions to nature, strongly inclined individuals to pursue nature engagement in adulthood (S2 and S3 Tables).

Formative places. Place of origin conditioned life-long attachments to regional geographies independent of current setting. Growing up near untamed nature enabled free exploration outdoors which shaped lifelong affinity for wildness. Childhood vacations awakened nature affinity and imparted assurance and skills to engage comfortably in nature for many.

I'm from Madison, Wisconsin. We grew up going to state parks a lot. Madison used to have more parks per capita than any other place in the country. We were always going to parks, whether city parks in Madison or the state parks. One in particular, Devil's Lake State Park, has a lot of glacial features, tumbled rocks, so that's my favorite place to be. Suburban Atlanta, Family travel subtheme

Participants, particularly those in conservation and those foreign-born, described deeply held emotions toward favorite places and memories formed there [104]. Interviewees frequently mentioned discovery of new landscapes in adulthood which cast childhood nature experiences as different and unique, a realization also common to those from less-natured areas. Participants over-50 spoke fondly of developing nature affinity through unsupervised play outdoors. In contrast, younger interviewees and those raised in large cities rarely played outdoors unattended.

The closest I got to nature was when I went to ‘Cali’ and I hiked the Hollywood Sign, all the way to the top. That’s when I really experienced the way nature is and seeing how it’s different from Connecticut. Just being way at the top, it literally hit me, like wow. It’s a really different life from here to there. Urban CT. Uniqueness of own nature subtheme

Formative persons and organizations. Participants very specifically recalled persons or organizations responsible for “socializing” them to nature. Women and men post-45 credited fathers for introducing them to nature via hands-on knowledge-sharing in reassuring natural environments. Busy mothers played direct and indirect roles as nature advocates, spearheading outdoor activities or banishing children outside. Under-30 individuals infrequently mentioned their parents or family members having introduced them to nature, except those foreign-born, particularly Afro-Caribbean. Individuals from all demographics said that nearby older relatives, particularly grandparents, strongly shaped their childhood experiences in nature. Transfer of ecological values through vegetable gardening, growing seasons, and plant hardiness was intrinsic to time spent in nature with grandparents who metaphorically conveyed life lessons of self-reliance under adversity.

A significant person would have to be my great-grandmother and my grandmother. Growing up, they had their own houses down in Grenada and their own farmland where they produced their own food products. So it was definitely a wonderful experience just watching natural things grow. Downtown Atlanta. Extended family subtheme

Camp played an oversized role for city kids with little family or backyard introduction to nature. Urban participants of all ages used rich, sensory language to recall memories of bonfires, night skies, and tent camping discovered at overnight camp. U.S. and international participants spoke of acquiring high skill levels and comfort outdoors through scouting or church excursions. Urban residents with weaker institutional support mentioned extracurricular athletics, e.g., school football, as their nature introduction.

In middle school I was part of a church-sponsored ecology group. One of our best trips was riding our bikes from Atlanta to St. Simon’s Island which took us five days. We had a chaperone group that would go ahead of us and set up tents and then mark our spots. That was the most influential, to be part of those groups. Suburban Atlanta. Scouts/organization subtheme

How does environment influence nature engagement?

Discussants spoke of ways current settings have unwittingly bolstered a desire for nature engagement by pulling toward natural environments and pushing against built environments (S4 and S5 Tables).

Push of built environments. Many speakers referenced nature as antidotal to built environments, which they associated with frustration and entrapment. Repudiation of indoor environments even opened some conservation rangers’ permanent career paths. Nearly all participants found the “artifice” of anything manufactured to detract from nature enjoyment, though urbanites less stridently opposed constructed facilities. While suburban, retired, and non-working individuals seemed less agitated by structural enclosures, office workers described turning to nature-based recreation to escape the pressures of current work.

My job is one of those twenty-hours-a-day, you’re never not working, always answering emails and phone calls and everything. So we started purposely planning trips—hey, we’re going to

hike through the Smokies or the Tetons, go someplace where my phone's not going to work. So getting away is my touchstone to reset and rediscover what's actually a priority. New Jersey. Nature as place of escape

Encountering other people outdoors generated mixed emotions, though many participants rebuffed venues supporting elevated levels of visitation as “nature.”

It added something for me when people were [visible] rather than only the environment. Minnesota

Now I'm just the opposite. For me, I want to be by myself in nature. California. Human-nature interaction subtheme

Pull of natural environments. Geographies experienced early in life appeared permanently to imprint participants' notion of nature. Places lived and experienced caused many to feel proprietary toward specific landscapes, perhaps revealing regional bias, and influenced a dissatisfaction toward current nature availability for some. Individuals in the two land-locked sites repeatedly mentioned yearning for waterscapes. Backyard gardens provided private nature enclaves for some urban residents uninterested in expending greater effort to scale-up landscape exposure. Other city dwellers highlighted the unexpected delights of urban nature.

What really brought me a lot of joy as I got older was my first real trip on my own to Washington D.C. I was down there during the season of cherry blossoms, and—even though I still think of D.C. as a city—just having nature in the middle of the city. . . it's so peaceful walking there at night, and it was also a calm, soothing and beautiful experience. Urban CT. Pull of natural environment subtheme

What separates us from nature engagement?

Obstacles to nature engagement fell into three general categories: individual-level material or perceptual barriers, public-level physical and structural barriers, and safety concerns (S6–S8 Tables).

Perceptual and material barriers. Lack of time topped every focus group's recitation of barriers to nature access. Consuming weekday and weekend schedules of work, college studies, and child-raising leave little free time for leisure of any type, including nature. Subjective hurdles, e.g., guilt, lax motivation, or preference for indoor comforts, further interfere with routine nature contact. Perceived social exclusion, marginalization vis-à-vis other greenspace users, or behavioral expectations limited enjoyment of nature sites for some urban individuals of color, who also expressed frustration over restrictive use of city parks. Some participants mentioned feeling uncomfortable and unsure around nature due to a lack of mentorship which stood in their way of accessing and enjoying nature. Mothers in attendance conveyed how parenting pressures, even in two-earner families, compromise their ability to bring children into nature in ways they remember from childhood. Central and South American child-care workers sharply noted an indifference toward nature within U.S. families vis-à-vis their homelands that is reinforced by working parents too fatigued to plan outdoor excursions on weekends and young children's captivation with technology [105, 106]. Technology was reviled as directly competing with time outdoors and intrusively disrupting nature's quiet, though a few praised app-based technologies for making nature excursions more accessible

and time efficient. Nonetheless, participants of every age blamed generational changes underlying nature withdrawal.

I have 17 great-nieces and -nephews, and they all come up and spend time in eastern Washington. Richard Louv had released “Last Child in the Woods,” and I tried to see if that really mattered regarding nature and behavioral issues. We arrived on Thursday evening and didn’t go back until Sunday. And the difference from when they got there and when they left was absolutely measurable and marked. It was incredible, so wonderful to see that being facilitated by nature. Phoenix. Generational differences subtheme

Finances and vehicle ownership posed the principal material obstacles to ex-urban nature engagement for many younger individuals. Camping vacations created a generational fault line drawn by financially out-of-reach equipment and transport. Older commenters amusingly recalled family “budget” camping trips from childhood, while younger parents winced at a family camping vacation’s prohibitive cost. Older individuals with fewer barriers to nature access—a primary or second residence outside urban cores near nature, car ownership, and some financial cushion—appeared more resolved to spend as much time outdoors prior to ill health’s onset.

Physical and structural barriers. Respondents generally viewed nature access as a function of convenience and preference. Most participants except core city residents felt urban nature did not suffice if wild nature lay within a 1.5 to 2-hour car ride. A few suburban participants spoke of satisfying biophilic need locally given the time and transport required for large-scale nature access. City dwellers from sparsely vegetated neighborhoods interpreted nature contact more liberally, as infrastructure shortcomings preclude them from fuller nature exposure. Inefficient transit systems and sidewalk disrepair discouraged many residents of larger cities such as Atlanta even to attempt getting outdoors.

I’ve tried to go to the parks with the waterfall. They have certain times that they’re open. You have to plan to be there early so you can be there long enough—if you do have to drive or travel—kind of to make that trip worth it. Urban Atlanta. Barriers to nature subtheme

Safety and risk concerns. Safety perceptions and risk aversion presented further wedges to nature-seeking. Focus group members premised their responses around previous outdoor experiences, finding the question “is nature safe?” highly subjective. Some contextualized safety to one’s personal location. Others discriminated safety from comfort, focusing on risk management in nature to stave off potentially unsafe situations. While most agreed that feeling safe in nature is tantamount for enjoying the outdoors, group-level dynamics established a spectrum of safety bounded by instinctive comfort and unnecessary risk-taking [107]. A few men also remarked on the potential for nature’s destructiveness for fear of property damage. Several commenters found risk-taking inherent to nature contact and risk key to nature’s attractiveness. A few male and female Southwesterners recounted harrowing episodes in extreme nature, concluding that the high stakes nature poses created a sense of vulnerability that had permanently shaped their character.

The memory of the creek was a place that I wanted to be because it was unsafe. It wasn’t super unsafe, but there was a sort of wildness and a fierce independence in being in that space, particularly as a kid all by myself. But that was somehow part of the allure for me. Tempe, AZ. Thrill of pushing safety boundaries subtheme

All groups debated if people or nature posed the greater threat outdoors, though “creepy people” were commonly perceived as the greater endangerment. Inexperience in nature paired with feeling safer near crowds; conversely, interviewees comfortable outdoors admitted to high urban anxiety.

The fact that it's a safe nature space is calming enough for me that no matter what dangers there are, whether animal or environmental, it's still going to feel safer than what may happen in an unnatural space like a city. Berkeley. Nature vs human safety subtheme

We found alignment of thought along demographic attribute regarding issues of safety. Non-urban females emphasized feeling more secure in nature than they do within built environments. Urban residents of color, male and female alike, spoke of nature as a forbidding, fearful place. Participants of all races expressed concern over racial and SES foundations of inequitable nature access, particularly for children.

Probably 3% of students are white. Most are black and Hispanic and a few Asians. They don't go outside. Many live in Section 8 housing. A lot of my students are not permitted to go outside because their families worry about their safety. So they never, ever get outside. Often, they don't even feel safe inside their own homes, much less just in the yard. Suburban Atlanta. Equity subtheme

One non-white participant recounted perceived prejudice while hiking, adding that more rangers and trail-users of color becoming a familiar site could diffuse reciprocal outdoor unease.

Most of my experiences in nature are very positive because I create them, but they're not always positive because people project a sense of fear when I'm approaching. So I feel safe, but people may not always feel safe around me. So seeing a park ranger who looks like me makes the difference. Seeing another person who is not white in nature is important. Boston. Safety and risk/ Equity subthemes

Discussion

We approached nature contact as experienced outdoors and explored through qualitative methods how individuals form perceptions and patterns around their own nature use. Inductive thematic analysis across ten focus group sessions showed a concurrent, dialectical pull of early life influences toward nature in tension with multiple barriers pushing individuals away from adult nature engagement. Most but not all study participants spoke of spending time outdoors. In examining current social complexities underpinning nature exposure and nature equity, our discussions revealed how upstream factors predispose individuals to engage or disengage with nature early in life and subsequently perpetuate disparities in nature contact into adulthood. Data organization and analysis across a variety of geographies, population densities, and sociodemographics uncovered a clear patterning around the bases for engaging in nature and the hazards or barriers to accessing nature in ways not entirely predicted at study onset. We found a decisive cluster of factors common and recurring across subpopulations which incline individuals toward adult nature-seeking, along with uniquenesses defying prevalent trends.

In seeking to elucidate antecedent factors motivating nature-seeking in adulthood, our first study objective, we found two distinct but consistent models of entry into nature for most

individuals. The first model appears to set in motion deep-seated emotional attachments to nature and intentional pursuit of familiar nature environments and is heavily and positively characterized by childhood place of origin, trusted adult mentorship, and current setting merging supportive built and natural environments. Some acute and chronic barriers detract from lifetime nature engagement, e.g., urban densities, distance to nature in childhood, but remain surmountable given resource availability and personal interest.

Central to this model for most individuals over-30 who self-described as currently active outdoors was socialization to nature in childhood through adult modeling, supplemented by organizations when family and neighborhood context waived that role [108]. Many conservationists and Facebook ad respondents fit this profile. Concurrence across our study reaffirms the importance of mentorship in socializing children to nature [63, 109, 110]. Without direct nature interaction guided by knowledgeable mentors, children may lose an important connection to inherent sensibilities [66]. Previous research has found that adult support of children's nature-based play predicts heightened self-discovery [111, 112], deeper nature affinity [41], and more complex psychological, emotional, and physical development than what green exercise alone offers [113], despite some evidence to the contrary [110, 114].

Detailed thematic analysis also revealed that place of origin strongly primes individuals toward nature engagement by shaping an interconnected cultural set centered around childhood residence, family vacation sites, special nature corners for unsupervised play, and nature proximity in childhood. Place of origin showed robust imprinting on participants' positive attitudes toward nature and their continued desire for nature contact as adults, despite an oft-greater effort to access natural environments resembling those frequented in childhood. A geography of childhood tied to contact with wild nature overshadowed current setting in drawing individuals outdoors [115–117]. Individuals introduced to nature in childhood make deliberate choices as adults to seek out nature despite constraints like time [118, 119]. In fact, recollection of early imprinted nature stirred up feelings of separation in participants who differentiated currently accessible nature from “the nature I desire.”

Such findings reaffirm existing literature on place-based identity. Not only does place shape the experiences that contribute to identity formation [115], along with attitudes, beliefs and behaviors toward nature [69], but nature availability in childhood reinforces a sense of place and wellbeing created through lasting experiences in untamed natural environments [120]. Nature-centered play in childhood is shown to exceed all other background variables in informing frequency of adult time in nature, with weak childhood nature contact predicting low or no adult nature visitation [113, 121, 122]. Most adults, including our study participants, identify the outdoors as their most significant childhood place such that the landscapes of childhood serve not just as backdrop to other events, but memorable events unto themselves [123].

An alternative nature entry model characterizes urban, socioeconomically challenged groups, resulting in more circumstantial, passive nature contact and cautioned use of nature environments. Reduced opportunities for formative learning and engagement in nature at a younger age, fewer nature-inclined mentors, layered spatial and structural barriers to access nature, and urban inefficiencies factor more heavily within this paradigm. Negative perceptions of wild nature also off-put individuals lacking reassuring introduction to untamed nature [123]. Opportunities to spend time in wild nature have worsened for this population as extended family members sell off small family farms and rural homes for urban locations, creating more insular urban nature contact. Early-life impediments to experiencing nature open pathways to adult nature alienation and forfeit the potential for health-inducing nature exposure.

Our second study aim of identifying pertinent social and built environment contributors and barriers to current nature use found many common roots of nature disengagement across our study population and fewer shared elements predicting nature engagement. Most individuals attributed their nature separation to social reasons as varied as time pressures, workloads, and competing attractions. The universal curse of scarce time imposed by work, childcare, and weekend chores affecting all participants echoes previous findings on time infringements on nature engagement [124]. Individuals today not only have less time overall for nature engagement but for recreation in general. Resource barriers to equitably accessing nature tended to focus on lack of money for equipment or user fees, though income elasticity only partially explained why certain groups do not partake in recreational nature pursuits. Transit inadequacy, for instance, stymies pursuit of larger landscapes specific to nature-based activities such as hiking, cutting off options for vigorous physical activity supporting health and wellbeing for many urbanites who cannot or choose not to acquire a car.

Societal transformations of the past two generations have additionally compounded adult nature disengagement in ways few individuals are immune. First among these is the changed nature of childhood. Harried parents a generation ago “threw [kids] out into nature;” today, busy parents reluctantly keep children inside due to public safety concerns. As compared with prior generations, often children today have more structured, activity-based schedules and less overall free time to spend meandering outdoors without parental oversight. Parents who allow children to play unsupervised outside have even been accused of negligence [125]. Children in day- or afterschool- care at best may have highly circumscribed on-site outdoor time, while within the home even young children’s absorption with electronics and video games negates actual nature beyond their screens. The withdrawal of independent childhood play in nature has diminished opportunities to explore outdoors and with them, sensory capacities developed from interacting with biodiversity [126]. Moreover, affordances for creative nature-based play on indistinct urban greenspace dim when compared to more organic, wild spaces [127].

A second societal transformation concerns the weakening of family and organizational structures which has negatively impacted traditional mentoring relationships outdoors, the most cited contributor to nature engagement. Declines in membership groups like scouting, civic and religious affiliation, and local business patronage have meant reduced operational and financial support of community- or church-run summer nature camps, jeopardizing a positive and perhaps one-time experience in wild nature which particularly impacts urban youth. The loss of wild nature contact in childhood is transversal: “*I was a boy scout growing up, so I got a lot of merit badges for nature, so my experience was right there.*” Such generationally-rooted observations suggest a gradual alienation from untamed nature felt by many adults and most acutely by young urban residents, with the potential for deepening health disparities posited on the benefits of early outdoor exposure [128, 129].

Feeling safe in nature also manifested as a learned skill which deters many urban participants not acculturated to nature over time. Outdoor phobias such as fear of snakes and bears [130, 131], entomophobic disgust, or dread of nightfall are confronted and overcome through social modeling, while differences in the physical structuring of natural environments influence perceived safety, e.g., disorientation [132, 133]. Woodlands offer low degrees of prospect and refuge [134] so that evolutionary response combined with cultural legacy may heighten urban non-white residents’ distrust of forested environments. Awareness and management of risk is therefore central to outdoor mentorship. Our results stand up to previous research findings in the older SLE literature that mentorship in nature is critical in operationalizing long-term nature attachment and its use.

Assumptions of the nature-health relationship are heavily premised on the spatial patterning of urban nature access where socioeconomic factors of park use are embedded but not

made explicit. Greenspace proximity disregards neighborhood safety—even backyard safety—which effectually renders many urban parks inaccessible. Young urban adults we spoke with confirmed they avoid local greenspace when connector neighborhoods feel unsafe, regardless of security enhancements made within parks. They similarly fear strangers who frequent local parks, a phenomenon not previously observed in more vegetated neighborhoods [135]. While many lifelong city residents favorably embraced urban ecology broadly described, young adults of color spoke apprehensively of urban forest environments. Research evidence both upholds and refutes this last observation [53, 132].

The third study objective aimed to discern elements common or unique to nature engagement or disengagement by specific group. Access to natured areas within and beyond city limits depends on functional built environments, though sprawl, transit inadequacy, and concentrated urban green space discouraged nature pursuit for many. Furthermore, these built environment changes interact with and compound one another. For example, expanded urban districts demand more time to reach landscape-scale nature, so the value proposition of spending time in nature diminishes, even for those owning a car. This spatial reality suggests that urban residents craving nature's restorative offerings face less surmountable barriers to access healthful natured environments than residents of lower-density areas.

Despite some occurrences of racial stigmatization, urban young adults felt drawn to city parks more than big landscape, provided urban greenspace offers “something useful to do.” Equalizing park access and quality to promote health of urban residents extends this mandate [128], but urban greenspace does not in itself give children the affordances and opportunities for independent nature discovery. In fact, much greenspace viewed aerially consists of baseball diamonds or cemeteries, neither being of much everyday use to most individuals nor can feel more artificial than natural. This observation speaks to informal park amenities: if children lack safe and receptive places to interact with nature, their nature contact remains purely visual. At the same time, urban recreational greenspace offers scant opportunity for the solitude and emotional reset so highly prized by landscape-scale nature-seekers but off-limits in areas where personal safety concerns eclipse the need for urban stress reduction.

Three insights differentiate this research from existing scholarship: 1. Dual spatial contexts—the neighborhood and the city itself—mark urban nature accessibility. Neighborhood context is determined by nature proximity, vegetation amount and quality, and “safe passage” to greenspace. The city context is proxied by the effort individuals can expend in leaving the built environment to reach their defined nature, with its opportunities for active recreation, solitude, and mental restoration. 2. Dual temporal contexts of childhood formative experiences in nearby nature that once timelessly held a child's attention have now ceded to inside play, activity scheduling, safety concerns, and screentime fascination, diminishing children's independent nature experiences which seed healthful adult associations outdoors. 3. The retreat of close family members and other mentors who once provided hands-on interaction in nature by positively introducing and modeling outdoor acculturation, thus inspiring curiosity as well as resilience outdoors. Teachers and schools may fill that role today if time, inclination, and nature proximity permit, but such convergence remains rare in high-density areas. Taken together, this trio of spatial, temporal, and social factors reveals widening structural differences between city and non-city dwellers and that put the human health-nature relationship at risk, particularly for young residents of low-income urban areas.

Implications and recommendations

We detected three groups of individuals whose possibilities for nature engagement cluster spatially: 1. those for whom access to nature is impeded by neighborhood, including safety; 2.

those deterred from active nature recreation by urban density and cost. 3. those fully able to partake in close landscape-scale nature, restricted only by time. This latter group derives a clearly articulated set of benefits from the nature experience discernible as mental and emotional wellbeing linked to solitude in nature, physical activity specific to outdoor nature sites, and a sense of accomplishment achieved through goals oriented to nature. Users of urban greenspace, despite being in nature, rarely spoke of these benefits. Park revitalization might mean offering safe spaces for contemplative reflection and “something to do” on greenspace like ropes courses, adventure education, or urban forest loops so that urban residents can choose relaxation with the self-satisfaction that comes with goals achieved as a form of positive risk-reward. The thrill of pushing boundaries and feelings of victory instrumental to outdoor enjoyment embody positive psychological outcomes linked to nature-based adventure sports [136].

Public policy lags science concerning the conservation and use of urban natural environments to achieve health objectives. In addition to furnishing ecological benefits [137], urban greenspace associates with improvements in neurocognitive functioning to impact behavior [138]. Studies from various global cities confirm that prioritizing biodiversity in planning urban greenspace yields improvements in mental health [139, 140] and emotional regulation [141]. In Berlin, the amount of forest coverage was associated with greater amygdala integrity, suggesting that certain forms of biodiversity natured environments positively influence brain plasticity [142]. Ongoing gaps in public policy suggest the undervaluation of urban vegetation to support the cognitive health and emotional wellbeing of individuals including the aging [143].

Recommendations to “design communities that facilitate free access to nature” are not novel and expressly stem from earlier investigation of how conservation behaviors develop among children and adolescents [111]. Further research is needed to learn if interventions for children to experience urban nature through creative, haptic play can emulate nature engagement in lower-density environments where geographies of childhood were formerly cemented. Affordances for creative nature-based play on indistinct urban greenspace dim when compared to more organic, wild spaces [127]. Studies investigating prescriptive nature contact should consider the role of mentorship in teaching urban youth how to engage safely and confidently with nature in both wild and urban settings. Nature exposure alone may not suffice if contextual support for socializing children to nature is missing [144].

As a future next direction we recommend participatory research bringing together stakeholders whose inputs for designing, using, and managing of urban nature inform improvements of the city park experience. Participants could include municipal managers of parks and recreations, public health, youth and senior service departments, public works officials to discuss safe corridors to access parks, nature users of various ages and interests, and community not-for-profits to operationalize nature use. Municipal parks departments have observed facility under-utilization. Park non-use speaks to the need for programmatic services, not just greenspace. What should urban parks offer families, adolescents, older adults to engage and relax? Focus groups can present place-making of different nature scenarios, e.g., water features like riverine or pond trails, exploratory sites for children, or immersive, pristine parcels such as Boston’s Urban Wilds program, to create preferences for nature environments where people will want to develop recurrent and habitual engagement with nature.

Strengths

Our multi-site study design and access to a range of perspectives into nature use offered original insights on social and structural factors of nature contact absent from quantitative

methods. Multi-site research importantly provided a broader foundation for discovering patterns between sites or among subsets of sites and greater validity for drawing conclusions than single-site inquiries allow [145, 146]. The influence of diverse regional culture, climate and geography on participant perspectives strengthened opportunities to discover similarities in attitudes and practices of using nature which transcend place and circumstance while accentuating uniquenesses tied to individual origin and on-going experience. Qualitative data collection occurred across heterogeneous groups, e.g., Facebook ad respondents, and more homogeneous groups, e.g., liaised community networks. The variability of participant experiences introduced into the nature and health literature responds to recommendations to include individual factors into ecological studies.

Limitations

Our findings should be considered in light of study limitations. A population sampling strategy that relied on advertised recruitment and self-selection likely limited prospective participation; older mean participant age perhaps owed to FGD scheduling availability and use of Facebook Timeline less popular with younger audiences. Data collected may reflect an inability to have reached all individual viewpoints due to research methods aimed at group engagement. While we sought out the broadest socio-demographic range available and engageable to describe nature experiences, we were unable to obtain viewpoints most likely to reflect nature disenfranchisement. The community networked focus groups of urban young adults made up the more economically challenged groups, making us unable to associate SES with nature engagement at later life-course stages. The Facebook ad respondent groups may have included individuals across the socioeconomic spectrum, but since we did not capture individual-level characteristics at intake beyond gender and region, we could only infer participant attributes from commentary. Our imbalanced gender ratio in many focus groups may have inhibited deeper narratives tied to gender in operationalizing nature contact as well as an under-exploration of gender vis-à-vis the nature construct. In-person attendance requirement and meeting times likely deterred families, married couples, and hourly workers from participating, depriving our study of important demographic perspectives of affordability and safety in nature outside individualized experience.

Conclusion

In this article, we presented results from our investigation of antecedents to adult nature engagement as a qualitative extension of exposure assessment. Our qualitative inquiry sought to complement statistical findings around exposure patterning by examining current social complexities underpinning nature use. We methodically gathered and studied upstream contributors which shape adult inclinations and abilities to engage in nature.

We found that few influences substitute for direct outdoor experience in childhood, personal mentorship to acquire comfort and skill in nature, and/or organizational affiliation, particular for children raised in dense built environments, to become socialized to nature. These factors featured across subpopulations and sociodemographic attributes. Individuals today face a concurrent suite of barriers to nature immersion that includes time, urbanization, job responsibilities, uncertain quality of nature experiences, transportation, lack of know-how in nature, and, for many, costs associated with nature engagement [147]. The changing nature of childhood may truthfully predict why many children no longer play independently outdoors as much as distance to greenspace or recreational affordances within these spaces does [76, 148, 149]. Greater time constraints and safety worries faced by working parents translate into

less park use for children in city cores vs. suburban communities [150]. These obstacles afford fewer opportunities to expose children to nature than available in previous generations.

In obtaining the views of a broad population toward nature engagement, this research presents perspectives and experiences useful to developing means for surmounting challenges to nature disengagement which are disproportionately distributed due to social and environmental factors. Understanding what enables and detracts from nature-seeking attitudes and behaviors grounds intervention options. Identifying patterns in nature engagement across regions and subpopulations and uniquenesses within them can inform integrated public health policy and urban planning decisions around meaningful nature access at younger ages. Equitable as well as healthful nature engagement antecedents to measured exposures can then carry the nature-health paradigm toward fuller fruition.

Supporting information

S1 Table. Topic guide for semi-structured focus group discussion.

(DOCX)

S2 Table. Formative places in nature. Selected participant comments share how formative places in nature in childhood influenced adult nature engagement.

(DOCX)

S3 Table. Formative persons and organizations. Selected participant comments discuss formative persons or organizations who socialized them to nature in childhood.

(DOCX)

S4 Table. Push of the built environment. Selected comments reveal predominantly negative attitudes toward the built environment which turn individuals toward nature-seeking.

(DOCX)

S5 Table. Pull of the natural environment. Selected comments indicate the positive pull nature exerts on individuals.

(DOCX)

S6 Table. Perceptual and material barriers to accessing nature.

(DOCX)

S7 Table. Physical and structural barriers to accessing nature.

(DOCX)

S8 Table. Safety and risk concerns as barriers to accessing nature.

(DOCX)

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References

1. Bosch M van den, Bird W. Oxford Textbook of Nature and Public Health: The role of nature in improving the health of a population. Oxford University Press; 2018. 361 p.
2. Bratman GN, Anderson CB, Berman MG, Cochran B, Vries S de, Flanders J, et al. Nature and mental health: An ecosystem service perspective. *Sci Adv*. 2019 Jul 1; 5(7):eaax0903. <https://doi.org/10.1126/sciadv.aax0903> PMID: 31355340
3. Frumkin H. The evidence of nature and the nature of evidence. *Am J Prev Med*. 2013 Feb; 44(2):196–7. <https://doi.org/10.1016/j.amepre.2012.10.016> PMID: 23332341
4. Hartig T, Mitchell R, de Vries S, Frumkin H. Nature and Health. *Ann Rev Public Health*. 2014; 35(1):207–28. <https://doi.org/10.1146/annurev-publhealth-032013-182443> PMID: 24387090
5. Kondo MC, Fluehr JM, McKeon T, Branas CC. Urban Green Space and Its Impact on Human Health. *Int J Environ Res Public Health*. 2018 Mar; 15(3):445. <https://doi.org/10.3390/ijerph15030445> PMID: 29510520
6. Markevych I, Schoierer J, Hartig T, Chudnovsky A, Hystad P, Dzhambov AM, et al. Exploring pathways linking greenspace to health: Theoretical and methodological guidance. *Environ Res*. 2017 Oct 1; 158:301–17. <https://doi.org/10.1016/j.envres.2017.06.028> PMID: 28672128
7. Banay RF, Bezold CP, James P, Hart JE, Laden F. Residential greenness: current perspectives on its impact on maternal health and pregnancy outcomes. *Int J Womens Health*. 2017 Feb 28; 9:133–44. <https://doi.org/10.2147/IJWH.S125358> PMID: 28280395
8. Grazuleviciene R, Danileviciute A, Dedele A, Vencloviene J, Andrusaityte S, Uzdanaviciute I, et al. Surrounding greenness, proximity to city parks and pregnancy outcomes in Kaunas cohort study. *Int J Hyg Environ Health*. 2015 May; 218(3):358–65. <https://doi.org/10.1016/j.ijheh.2015.02.004> PMID: 25757723
9. Peter James, Hart Jaime E., Banay Rachel F., Laden Francine. Exposure to Greenness and Mortality in a Nationwide Prospective Cohort Study of Women. *Environ Health Perspect*. 2016 Sep 1; 124(9):1344–52. <https://doi.org/10.1289/ehp.1510363> PMID: 27074702
10. McCormack GR, Giles-Corti B, Bulsara M. The relationship between destination proximity, destination mix and physical activity behaviors. *Prev Med*. 2008 Jan; 46(1):33–40. <https://doi.org/10.1016/j.ypmed.2007.01.013> PMID: 17481721
11. Orstad SL, Szuhany K, Tamura K, Thorpe LE, Jay M. Park Proximity and Use for Physical Activity among Urban Residents: Associations with Mental Health. *Int J Environ Res Public Health*. 2020 Jan; 17(13):4885. <https://doi.org/10.3390/ijerph17134885> PMID: 32645844
12. Maller C, Townsend M, Pryor A, Brown P, St Leger L. Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. *Health Promot Int*. 2006 Mar 1; 21(1):45–54. <https://doi.org/10.1093/heapro/dai032> PMID: 16373379
13. Byrne J, Wolch J, Zhang J. Planning for environmental justice in an urban national park. *J Environ Plann Manage*. 2009 Apr 1; 52(3):365–92.

14. Jennings V, Baptiste AK, Osborne Jelks N, Skeete R. Urban Green Space and the Pursuit of Health Equity in Parts of the United States. *Int J Environ Res Public Health*. 2017 Nov; 14(11):1432. <https://doi.org/10.3390/ijerph14111432> PMID: 29165367
15. Rigolon A, Browning MHEM, McAnirlin O, Yoon H (Violet). Green Space and Health Equity: A Systematic Review on the Potential of Green Space to Reduce Health Disparities. *Int J Environ Res Public Health*. 2021 Jan; 18(5):2563. <https://doi.org/10.3390/ijerph18052563> PMID: 33806546
16. Schulz A, Northridge ME. Social Determinants of Health: Implications for Environmental Health Promotion. *Health Educ Behav*. 2004 Aug; 31(4):455–71. <https://doi.org/10.1177/1090198104265598> PMID: 15296629
17. Gray C, Gibbons R, Larouche R, Sandseter EBH, Bienenstock A, Brussoni M, et al. What Is the Relationship between Outdoor Time and Physical Activity, Sedentary Behaviour, and Physical Fitness in Children? A Systematic Review. *Int J Environ Res Public Health*. 2015 Jun; 12(6):6455–74. <https://doi.org/10.3390/ijerph120606455> PMID: 26062039
18. Lee EY, Bains A, Hunter S, Ament A, Brazo-Sayavera J, Carson V, et al. Systematic review of the correlates of outdoor play and time among children aged 3–12 years. *Int J Behav Nutr Phys Act*. 2021 Mar 18; 18(1):41. <https://doi.org/10.1186/s12966-021-01097-9> PMID: 33736668
19. Outdoor Foundation. 2020 Outdoor Participation Report [Internet]. Outdoor Industry Association; 2020 Dec [cited 2021 Mar 23]. Available from: <https://outdoorindustry.org/resource/2020-outdoor-participation-report/>
20. 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*. 2020 Jul 1; 52(6):579–610.
21. Kardan O, Gozdyra P, Misic B, Moola F, Palmer LJ, Paus T, et al. Neighborhood greenspace and health in a large urban center. *Sci Rep*. 2015 Jul 9; 5(1):11610.
22. Taylor L, Hochuli DF. Defining greenspace: Multiple uses across multiple disciplines. *Landsc Urban Plan*. 2017 Feb 1; 158:25–38.
23. Jarvis I, Gergel S, Koehoorn M, van den Bosch M. Greenspace access does not correspond to nature exposure: Measures of urban natural space with implications for health research. *Landsc Urban Plan*. 2020 Feb 1; 194:103686.
24. Solecki WD, Welch JM. Urban parks: green spaces or green walls? *Landsc Urban Plan*. 1995 Jun 1; 32(2):93–106.
25. Pyle RM. Nature matrix: reconnecting people and nature. *Oryx*. 2003 Apr; 37(2):206–14.
26. Colléony A, Cohen-Seffer R, Shwartz A. Unpacking the causes and consequences of the extinction of experience. *Biol Conserv*. 2020 Nov 1; 251:108788.
27. Cox DTC, Gaston KJ. Urban Bird Feeding: Connecting People with Nature. *PLoS One*. 2016 Jul 18; 11(7):e0158717. <https://doi.org/10.1371/journal.pone.0158717> PMID: 27427988
28. Pilgrim SE, Cullen LC, Smith DJ, Pretty J. Ecological Knowledge is Lost in Wealthier Communities and Countries. *Environ Sci Technol*. 2008 Feb 1; 42(4):1004–9. <https://doi.org/10.1021/es070837v> PMID: 18351064
29. Baum F. Researching public health: Behind the qualitative-quantitative methodological debate. *Soc Sci Med*. 1995 Feb; 40(4):459–68. [https://doi.org/10.1016/0277-9536\(94\)e0103-y](https://doi.org/10.1016/0277-9536(94)e0103-y) PMID: 7725120
30. Hinds J, Sparks P. Engaging with the natural environment: The role of affective connection and identity. *J Environ Psychol*. 2008 Jun 1; 28(2):109–20.
31. Kellert SR, Wilson EO. *The Biophilia Hypothesis*. Island Press; 1995. 493 p.
32. Lumber R, Richardson M, Sheffield D. Beyond knowing nature: Contact, emotion, compassion, meaning, and beauty are pathways to nature connection. *PLoS One*. 2017 May 9; 12(5):e0177186. <https://doi.org/10.1371/journal.pone.0177186> PMID: 28486515
33. Richardson M, Sheffield D. Three good things in nature: noticing nearby nature brings sustained increases in connection with nature / *Tres cosas buenas de la naturaleza: prestar atención a la naturaleza cercana produce incrementos prolongados en conexión con la naturaleza*. *Psychology*. 2017 Jan 2; 8(1):1–32.
34. Wilson EO. *Biophilia*. Revised ed. edition. Cambridge, Mass.: Harvard University Press; 1984. 157 p.
35. Broom C. Exploring the Relations Between Childhood Experiences in Nature and Young Adults' Environmental Attitudes and Behaviours. *Aust J Environ Educ*. 2017; 33(1):34–47.
36. Martin L, White MP, Hunt A, Richardson M, Pahl S, Burt J. Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. *J Environ Psychol*. 2020 Apr 1; 68:101389.

37. Rosa CD, Collado S. Experiences in Nature and Environmental Attitudes and Behaviors: Setting the Ground for Future Research. *Front Psychol*. 2019 Apr 9; 10(763):1–9. <https://doi.org/10.3389/fpsyg.2019.00763> PMID: 31024400
38. Whitburn J, Linklater W, Abrahamse W. Meta-analysis of human connection to nature and proenvironmental behavior. *Conserv Biol*. 2020; 34(1):180–93. <https://doi.org/10.1111/cobi.13381> PMID: 31251416
39. Kahn PH, Weiss T. The Importance of Children Interacting with Big Nature. *Child Youth Environ*. 2017; 27(2):7–24.
40. Fabio Di et al A. Connectedness to nature, personality traits and empathy from a sustainability perspective. *Curr Psychol*. 2018;
41. Kals E, Schumacher D, Montada L. Emotional Affinity toward Nature as a Motivational Basis to Protect Nature. *Environ Behav*. 1999 Mar 1; 31(2):178–202.
42. Mayer FS, Frantz CM, Bruehlman-Senecal E, Dolliver K. Why Is Nature Beneficial?: The Role of Connectedness to Nature. *Environ Behav*. 2009 Sep 1; 41(5):607–43.
43. Nisbet EK, Zelenski JM, Murphy SA. The Nature Relatedness Scale: Linking Individuals' Connection With Nature to Environmental Concern and Behavior. *Environ Behav*. 2009 Sep 1; 41(5):715–40.
44. Molinaro E, Lorenzi C, Bartoccioni F, Perucchini P, Bobeth S, Colléony A, et al. From childhood nature experiences to adult pro-environmental behaviors: An explanatory model of sustainable food consumption. *Environ Educ Res*. 2020 Aug 2; 26(8):1137–63.
45. Dai D. Racial/ethnic and socioeconomic disparities in urban green space accessibility: Where to intervene? *Landsc Urban Plan*. 2011 Sep 30; 102(4):234–44.
46. Jennings V, Gaither CJ. Approaching Environmental Health Disparities and Green Spaces: An Ecosystem Services Perspective. *Int J Environ Res Public Health*. 2015 Feb; 12(2):1952–68. <https://doi.org/10.3390/ijerph120201952> PMID: 25674782
47. Ravenscroft N, Markwell S. Ethnicity and the integration and exclusion of young people through urban park and recreation provision. *Manage Leis*. 2000 Jan 1; 5(3):135–50.
48. Giles-Corti B, Donovan RJ. Socioeconomic Status Differences in Recreational Physical Activity Levels and Real and Perceived Access to a Supportive Physical Environment. *Prev Med*. 2002 Dec 1; 35(6):601–11. <https://doi.org/10.1006/pmed.2002.1115> PMID: 12460528
49. Estabrooks PA, Lee RE, Gyurcsik NC. Resources for physical activity participation: Does availability and accessibility differ by neighborhood socioeconomic status? *Ann Behav Med*. 2003 Apr 1; 25(2):100–4. https://doi.org/10.1207/S15324796ABM2502_05 PMID: 12704011
50. Nutsford D, Pearson AL, Kingham S. An ecological study investigating the association between access to urban green space and mental health. *Public Health*. 2013 Nov 1; 127(11):1005–11. <https://doi.org/10.1016/j.puhe.2013.08.016> PMID: 24262442
51. Beyer KMM, Kaltenbach A, Szabo A, Bogar S, Nieto FJ, Malecki KM. Exposure to Neighborhood Green Space and Mental Health: Evidence from the Survey of the Health of Wisconsin. *Int J Environ Res Public Health*. 2014 Mar; 11(3):3453–72. <https://doi.org/10.3390/ijerph110303453> PMID: 24662966
52. Mitchell RJ, Richardson EA, Shortt NK, Pearce JR. Neighborhood Environments and Socioeconomic Inequalities in Mental Well-Being. *Am J Prev Med*. 2015 Jul 1; 49(1):80–4. <https://doi.org/10.1016/j.amepre.2015.01.017> PMID: 25911270
53. Taylor DE. Racial and Ethnic Differences in Connectedness to Nature and Landscape Preferences Among College Students. *Environ Justice*. 2018 Apr 5; 11(3):118–36.
54. Williams TG, Logan TM, Zuo CT, Liberman KD, Guikema SD. Parks and safety: a comparative study of green space access and inequity in five US cities. *Landsc Urban Plan*. 2020 Sep 1; 201:103841.
55. Banzhaf S, Ma L, Timmins C. Environmental Justice: The Economics of Race, Place, and Pollution. *J Econ Perspect*. 2019 Feb; 33(1):185–208. PMID: 30707005
56. Brown P. *Toxic Exposures: Contested Illnesses and the Environmental Health Movement*. Columbia University Press; 2007. 393 p.
57. Rachel Morello-Frosch, Manuel Pastor, Carlos Porras, James Sadd. Environmental justice and regional inequality in southern California: implications for future research. *Environ Health Perspect*. 2002 Apr 1; 110(suppl 2):149–54.
58. Payne P. The Significance of Experience in SLE Research. *Environ Educ Res*. 1999 Nov 1; 5(4):365–81.
59. Kahn PH. *The Human Relationship with Nature: Development and Culture*. MIT Press; 1999. 302 p.

60. Sanger-Katz M. Income Inequality: It's Also Bad for Your Health. *The New York Times* [Internet]. 2015 Mar 30 [cited 2021 Mar 10]; Available from: <https://www.nytimes.com/2015/03/31/upshot/income-inequality-its-also-bad-for-your-health.html>
61. Chawla L. Significant Life Experiences Revisited: A Review of Research on Sources of Environmental Sensitivity. *J Environ Educ*. 1998 Jan 1; 29(3):11–21.
62. Chawla L. Childhood Experiences Associated with Care for the Natural World: A Theoretical Framework for Empirical Results. *Child Youth Environ*. 2007; 17(4):144–70.
63. Cheng JCH, Monroe MC. Connection to Nature: Children's Affective Attitude Toward Nature. *Environ Behav*. 2012 Jan 1; 44(1):31–49.
64. Kahn PH. Developmental Psychology and the Biophilia Hypothesis: Children's Affiliation with Nature. *Dev Rev*. 1997 Mar 1; 17(1):1–61.
65. Kahn PH, Kellert SR, editors. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. Cambridge, Mass: The MIT Press; 2002.
66. 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.
67. Tanner T. Significant Life Experiences: A New Research Area in Environmental Education. *J Environ Educ*. 1980 Jul 1; 11(4):20–4.
68. Chawla L. Research methods to investigate significant life experiences: review and recommendations. *Environ Educ Res*. 2006 Jul 1; 12(3–4):359–74.
69. Colvin C. R. (2013). Significant life experience: Exploring the lifelong influence of place-based environmental and science education on program participants. University of Colorado at Denver. 210 p.
70. Hsu SJ. Significant life experiences affect environmental action: a confirmation study in eastern Taiwan. *Environ Educ Res*. 2009 Aug 1; 15(4):497–517.
71. Chawla L. Life Paths Into Effective Environmental Action. *J Environ Educ*. 1999 Jan 1; 31(1):15–26.
72. Palmer JA, Suggate J, Bajd B, K.P PH, Ho RKP, Ofwono-Orecho JKW, et al. An Overview of Significant Influences and Formative Experiences on the Development of Adults' Environmental Awareness in Nine Countries. *Environ Educ Res*. 1998 Nov 1; 4(4):445–64.
73. Palmer JA, Suggate J. Influences and Experiences Affecting the Pro-environmental Behaviour of Educators. *Environ Educ Res*. 1996 Feb 1; 2(1):109–21.
74. Tanner T. Choosing the Right Subjects in Significant Life Experiences Research. *Environ Educ Res*. 1998 Nov 1; 4(4):399–417.
75. James JJ, Bixler RD, Vadala CE. From Play in Nature, to Recreation then Vocation: A Developmental Model for Natural History-Oriented Environmental Professionals. *Child Youth Environ*. 2010; 20(1):231–56.
76. Clements R. An Investigation of the Status of Outdoor Play. *Contemporary Issues Early Childhood*. 2004 Mar 1; 5(1):68–80.
77. Gough A. Kids Don't Like Wearing the Same Jeans as their Mums and Dads: so whose 'life' should be in significant life experiences research? *Environ Educ Res*. 1999 Nov 1; 5(4):383–94.
78. Chawla L. Benefits of Nature Contact for Children. *J Plann Lit*. 2015 Nov 1; 30(4):433–52.
79. Martin C, Czellar S. Where do biospheric values come from? A connectedness to nature perspective. *J Environ Psychol*. 2017 Oct; 52:56–68.
80. Mayer FS, Frantz CM. The connectedness to nature scale: A measure of individuals' feeling in community with nature. *J Environ Psychol*. 2004 Dec 1; 24(4):503–15.
81. Stern PC, Dietz T, Guagnano GA. A Brief Inventory of Values. *Educ Psychol Meas*. 1998 Dec 1; 58(6):984–1001.
82. Baxter DE, Pelletier LG. Is nature relatedness a basic human psychological need? A critical examination of the extant literature. *Can Psych*. 2019; 60(1):21–34.
83. Roe J, Aspinall PA, Ward Thompson C. Understanding Relationships between Health, Ethnicity, Place and the Role of Urban Green Space in Deprived Urban Communities. *Int J Environ Res Public Health*. 2016 Jul; 13(7):681.
84. Razani N, Long D, Hessler D, Rutherford GW, Gottlieb LM. Screening for Park Access during a Primary Care Social Determinants Screen. *Int J Environ Res Public Health*. 2020 Jan; 17(8):2777. <https://doi.org/10.3390/ijerph17082777> PMID: 32316482
85. Lobdell DT, Gilboa S, Mendola P, Hesse BW. Use of focus groups for the environmental health researcher. *J Environ Health*. 2005 May; 67(9):36–42. PMID: 15957321

86. O'Brien L, Varley P. Use of ethnographic approaches to the study of health experiences in relation to natural landscapes. *Perspect Public Health*. 2012 Nov 1; 132(6):305–12. <https://doi.org/10.1177/1757913911434895> PMID: 23111086
87. Frumkin H, Bratman GN, Breslow SJ, Cochran B, Kahn PH, Lawler JJ, et al. Nature Contact and Human Health: A Research Agenda. *Environ Health Perspect*. 2017 Jul 31; 125(7):075001. <https://doi.org/10.1289/EHP1663> PMID: 28796634
88. Teherani A, Martimianakis T, Stenfors-Hayes T, Wadhwa A, Varpio L. Choosing a Qualitative Research Approach. *J Grad Med Educ*. 2015 Dec; 7(4):669–70. <https://doi.org/10.4300/JGME-D-15-00414.1> PMID: 26692985
89. Creswell J. Ch 8: Data Analysis and Representation. In: *Qualitative Inquiry and Research Design*. SAGE Publications; 2013. p. 179–211.
90. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care*. 2007 Sep 16; 19(6):349–57. <https://doi.org/10.1093/intqhc/mzm042> PMID: 17872937
91. Fritzen-Pedicini C, Bleasdale SC, Brosseau LM, Moritz D, Sikka M, Stiehl E, et al. Utilizing the focused conversation method in qualitative public health research: a team-based approach. *BMC Health Serv Res*. 2019 May 14; 19(1):306. <https://doi.org/10.1186/s12913-019-4107-0> PMID: 31088551
92. Krueger RA, Casey MA. *Focus groups: a practical guide for applied research*. Los Angeles: SAGE; 2009.
93. Isaacs A. An overview of qualitative research methodology for public health researchers. *Int J Med Public Health*. 2014; 4(4):318–23.
94. Palmer JA. Development of Concern for the Environment and Formative Experiences of Educators. *J Environ Educ*. 1993 Apr 1; 24(3):26–30.
95. Petersen NH, Hungerford R. Developmental variables affecting environmental sensitivity in professional environmental educators: A research abstract. *Curr Iss Environ Educ Environ Stud*. 1981; 7:111–3.
96. Braun V, Clarke V. *Successful Qualitative Research: A Practical Guide for Beginners*. SAGE; 2013. 402 p.
97. NVivo 12 [Internet]. QSR International Pty Ltd.; 2020. Available from: <https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home>
98. MacQueen KM, McLellan E, Kay K, Milstein B. Codebook Development for Team-Based Qualitative Analysis. *CAM Journal*. 1998 May 1; 10(2):31–6.
99. Maxwell JA. *Qualitative Research Design: An Interactive Approach*. SAGE Publications; 2012. 233 p.
100. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006 Jan 1; 3(2):77–101.
101. Braun V, Clarke V. One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qual Res Psychol*. 2020 Aug 12; 0(0):1–25.
102. Miles MB, Huberman AM. *Qualitative Data Analysis: An Expanded Sourcebook*. SAGE; 1994. 358 p.
103. Seidman I. *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences*. Teachers College Press; 2006. 356 p.
104. Chawla L. Childhood Place Attachments. In: Altman I, Low SM, editors. *Place Attachment* [Internet]. Boston, MA: Springer US; 1992 [cited 2021 Feb 22]. p. 63–86. (Human Behavior and Environment). Available from: https://doi.org/10.1007/978-1-4684-8753-4_4
105. Kellert Stephen R., Case David J., Escher Daniel, Witter Daniel J., Mikels-Carrasco Jessica, Seng Phil T. *The Nature of Americans*. 2017 Apr.
106. Larson LR, Szczytko R, Bowers EP, Stephens LE, Stevenson KT, Floyd MF. Outdoor Time, Screen Time, and Connection to Nature: Troubling Trends Among Rural Youth? *Environ Behav*. 2019 Oct 1; 51(8):966–91.
107. Tang IC, Sullivan WC, Chang CY. Perceptual Evaluation of Natural Landscapes: The Role of the Individual Connection to Nature. *Environ Behav*. 2015 Jul 1; 47(6):595–617.
108. Giusti M. Human-nature relationships in context. Experiential, psychological, and contextual dimensions that shape children's desire to protect nature. *PLoS One*. 2019; 14(12):e0225951. <https://doi.org/10.1371/journal.pone.0225951> PMID: 31805141
109. Ruby M, Kenner C, Jessel J, Gregory E, Arju T. Gardening with grandparents: an early engagement with the science curriculum. *Early Years*. 2007 Jul 1; 27(2):131–44.
110. Stevenson KT, Peterson MN, Carrier SJ, Strnad RL, Bondell HD, Kirby-Hathaway T, et al. Role of Significant Life Experiences in Building Environmental Knowledge and Behavior Among Middle School Students. *J Environ Educ*. 2014 Jul 3; 45(3):163–77.

111. Chawla L, Derr V. The development of conservation behaviors in childhood and youth. In: *The Oxford handbook of environmental and conservation psychology*. New York, NY, US: Oxford University Press; 2012. p. 527–55. (Oxford library of psychology).
112. Reed ES. *Encountering the World: Toward an Ecological Psychology*. Oxford University Press; 1996. 230 p.
113. Thompson CW, Aspinall P, Montarzino A. The Childhood Factor: Adult Visits to Green Places and the Significance of Childhood Experience. *Environ Behav*. 2008 Jan 1; 40(1):111–43.
114. Lohr VI. Early childhood experiences in nature: does it matter who is present with children? *Acta Horti*. 2016 Jul;(1121):103–8.
115. Holland D. Multiple identities in practice: On the dilemmas of being a hunter and an environmentalist in the USA. In: FOCAAL-UTRECHT-, 2003. p. 31–50.
116. Canter DV. *The Psychology of Place*. 1st edition. New York: Palgrave Macmillan; 1977. 198 p.
117. Nabhan GP, Trimble S. *The Geography of Childhood: Why Children Need Wild Places*. Beacon Press; 1994. 212 p.
118. Asah ST, Bengston DN, Westphal LM. The Influence of Childhood: Operational Pathways to Adulthood Participation in Nature-Based Activities. *Environ Behav*. 2012 Jul; 44(4):545–69.
119. Crompton JL, Kim SS. Temporal Changes in Perceived Constraints to Visiting State Parks. *J Leis Res*. 2004 Jun 1; 36(2):160–82.
120. Kuo FE, Faber Taylor A. A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence From a National Study. *Am J Public Health*. 2004 Sep 1; 94(9):1580–6. <https://doi.org/10.2105/ajph.94.9.1580> PMID: 15333318
121. Bingley A, Milligan C. Climbing trees and building dens. Mental health and well-being in young adults and the long-term effects of childhood play experience. [Internet]. Lancaster, UK: Lancaster University, Institute of Health Research; 2004 p. 80. Available from: <http://escalate.ac.uk/downloads/4725.pdf>
122. 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*. 2021 Mar 12; 0(0):1–23.
123. Sebba R. The Landscapes of Childhood: The Reflection of Childhood's Environment in Adult Memories and in Children's Attitudes. *Environ Behav*. 1991 Jul 1; 23(4):395–422.
124. Skar M, Wold LC, Gundersen V, O'Brien L. Why do children not play in nearby nature? Results from a Norwegian survey. *J Advent Educ Outdoor Learn*. 2016 Jul 2; 16(3):239–55.
125. McFarland L, Laird SG. Children need to play outdoors, but we're not letting them [Internet]. *The Conversation*. [cited 2022 Jan 31]. Available from: <http://theconversation.com/children-need-to-play-outdoors-but-were-not-letting-them-31295>
126. Beery T, Jørgensen KA. Children in nature: sensory engagement and the experience of biodiversity. *Environ Educ Res*. 2018 Jan 2; 24(1):13–25.
127. Taylor AF, Wiley A, Kuo FE, Sullivan WC. Growing Up in the Inner City: Green Spaces as Places to Grow. *Environ Behav*. 1998 Jan 1; 30(1):3–27.
128. Coen SE, Ross NA. Exploring the material basis for health: Characteristics of parks in Montreal neighborhoods with contrasting health outcomes. *Health Place*. 2006 Dec 1; 12(4):361–71. <https://doi.org/10.1016/j.healthplace.2005.02.001> PMID: 16814195
129. Leslie E, Cerin E, Kremer P. Perceived Neighborhood Environment and Park Use as Mediators of the Effect of Area Socio-Economic Status on Walking Behaviors. *J Phys Act Health*. 2010 Nov 1; 7(6):802–10. <https://doi.org/10.1123/jpah.7.6.802> PMID: 21088312
130. Bixler RD, Floyd MF. Nature is Scary, Disgusting, and Uncomfortable. *Environ Behav*. 1997 Jul 1; 29(4):443–67.
131. Taylor DE. College Students and Nature: Differing Thoughts of Fear, Danger, Disconnection, and Loathing. *Environ Manage*. 2019 Jul 1; 64(1):79–96. <https://doi.org/10.1007/s00267-019-01172-9> PMID: 31076829
132. Bixler RD, Carlisle CL, Hammlt WE, Floyd MF. Observed Fears and Discomforts among Urban Students on Field Trips to Wildland Areas. *J Environ Educ*. 1994 Oct 1; 26(1):24–33.
133. Bøgeholz S. Nature experience and its importance for environmental knowledge, values and action: recent German empirical contributions. *Environ Educ Res*. 2006 Feb 1; 12(1):65–84.
134. Gatersleben B, Andrews M. When walking in nature is not restorative—the role of prospect and refuge. *Health Place*. 2013 Mar; 20:91–101. <https://doi.org/10.1016/j.healthplace.2013.01.001> PMID: 23399852

135. Foster S, Wood L, Francis J, Knuiman M, Villanueva K, Giles-Corti B. Suspicious minds: Can features of the local neighbourhood ease parents' fears about stranger danger? *J Environ Psychol*. 2015 Jun 1; 42:48–56.
136. Mackenzie SH, Brymer E. Conceptualizing adventurous nature sport: A positive psychology perspective. *Ann Leis Res*. 2020 Jan 1; 23(1):79–91.
137. Hirabayashi S. Technical specifications of urban forests for air purification: A case study in Tokyo, Japan. *Trees For People*. 2021 Jun 1; 4:100078.
138. Berman MG, Stier AJ, Akcelik GN. Environmental neuroscience. *Am Psychol*. 2019; 74(9):1039–52. <https://doi.org/10.1037/amp0000583> PMID: 31829683
139. Methorst J, Rehdanz K, Mueller T, Hansjürgens B, Bonn A, Böhning-Gaese K. The importance of species diversity for human well-being in Europe. *Ecol Econ*. 2021 Mar 1; 181:106917.
140. Aerts R, Honnay O, Van Nieuwenhuysse A. Biodiversity and human health: mechanisms and evidence of the positive health effects of diversity in nature and green spaces. *Br Med Bull*. 2018 Sep 1; 127(1):5–22. <https://doi.org/10.1093/bmb/ldy021> PMID: 30007287
141. Nghiem TPL, Wong KL, Jeevanandam L, Chang C c., Tan LYC, Goh Y, et al. Biodiverse urban forests, happy people: Experimental evidence linking perceived biodiversity, restoration, and emotional well-being. *Urban For Urban Green*. 2021 Apr 1; 59:127030.
142. Kühn S, Düzel S, Eibich P, Krekel C, Wüstemann H, Kolbe J, et al. In search of features that constitute an “enriched environment” in humans: Associations between geographical properties and brain structure. *Sci Rep*. 2017 Sep 20; 7(1):11920. <https://doi.org/10.1038/s41598-017-12046-7> PMID: 28931835
143. Neale C, Aspinall P, Roe J, Tilley S, Mavros P, Cinderby S, et al. The impact of walking in different urban environments on brain activity in older people. *Cities Health*. 2020 Jan 2; 4(1):94–106.
144. Bixler RD, Floyd MF, Hammitt WE. Environmental Socialization: Quantitative Tests of the Childhood Play Hypothesis. *Environ Behavior*. 2002 Nov 1; 34(6):795–818.
145. Phil Brown. Qualitative methods in environmental health research. *Environ Health Perspect*. 2003 Nov 1; 111(14):1789–98. <https://doi.org/10.1289/ehp.6196> PMID: 14594634
146. Burawoy M, Blum JA, George S, Gille Z, Thayer M. *Global Ethnography: Forces, Connections, and Imaginations in a Postmodern World*. University of California Press; 2000. 410 p.
147. More T, Stevens T. Do User Fees Exclude Low-income People from Resource-based Recreation? *J Leis Res*. 2000 Sep 1; 32(3):341–57.
148. Rixon A, Lomax H, O'Dell L. Childhoods past and present: anxiety and idyll in reminiscences of childhood outdoor play and contemporary parenting practices. *Child Geogr*. 2019 Sep 3; 17(5):618–29.
149. Valentine G, McKendrick J. Children's outdoor play: Exploring parental concerns about children's safety and the changing nature of childhood. *Geoforum*. 1997 May 1; 28(2):219–35.
150. Loukaitou-Sideris A, Sideris A. What Brings Children to the Park? Analysis and Measurement of the Variables Affecting Children's Use of Parks. *J Am Plann Assoc*. 2009 Dec 31; 76(1):89–107.