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Nature in our lives: Examining the human need for nature relatedness as a basic psychological need

Jane Hurly  and Gordon J. Walker

Faculty of Kinesiology, Sport, and Recreation, University of Alberta

ABSTRACT

Is the need for nature relatedness a basic psychological need? Using Baumeister and Leary's need criteria as comparators, we explored literature arcing across disciplines to find evidence that either supported or undermined our proposition that the human need for nature may be a fundamental psychological need. We found that while nature's salubrious effects benefited humans across the lifespan, and largely transcended cultural boundaries, socioeconomic status, age, and state of health, the benefits of being in nature depended on choice, perception of safety, and absence of fear. Race, ethnicity, and gender tended to impede leisure in natural environments. In concluding that the need for nature relatedness is a basic psychological need, we discuss practical implications for leisure and recreation professionals, researchers, educators, architects, and city planners and proffer several practical interventions in several domains to benefit both the environment and humanity.

KEYWORDS

Green space; human–nature interactions; leisure; nature relatedness; psychological need; well-being

According to a nationwide report by Kellert et al. (2017) examining attitudes toward nature among adults across the lifespan and children aged 8–12 years, approximately 40% of Americans spent an hour or more per day in nature (not including time spent in organized sports). When asked about their favorite nature-based activities, the majority of responses were leisure oriented. Nature-based leisure appears both relatively popular and often preferred (Abbott-Chapman & Robetson, 2009; Knopf, 1987, 1988; Korpela, Ylén, Tyrväinen, & Silvennoinen, 2008), but what accounts for our attraction to nature?

In 1984, biologist E. O. Wilson proposed the biophilia hypothesis, arguing that humans have a primal bond with the plant and animal kingdoms because of our shared evolutionary development. A torrent of theories ensued. Two renowned frameworks promoting the beneficial effects of nature connectedness are attention restoration theory (ART; Kaplan & Kaplan, 1989) and stress recovery theory (SRT; Ulrich et al., 1991). These theories intersect in their assumption that natural environments that do not threaten the individual and comprise peaceful, beautiful nature scenes can help to alleviate stress and restore optimal cognitive functioning.

Mounting empirical evidence abounds underscoring the efficacy of benign nature in restoring calm (Frumkin, 2001), promoting well-being (Grinde & Patil, 2009; Pretty

et al., 2007), encouraging good behavior in children (Roe & Aspinall, 2011), and ameliorating posttraumatic stress disorder (Varning Poulson, 2017). These positive effects have been found among a diverse range of individuals, for example, among expectant mothers (Donovan, Michael, Butry, Sullivan, & Chase, 2011), elderly people with hypertension (Mao et al., 2012), prisoners (Moore, 1981; Nadkarni, 2014), undergraduate students (Takayama et al., 2014), and preschoolers (Michek, Nováková, & Menclová, 2015). However, as Knopf (1987) and Keniger, Gaston, Irvine, and Fuller (2013) have contended, this research tends to downplay nature's negative impacts: it is not always benign and has the potential to evoke both positive and negative affect (Bixler & Floyd, 1997; Gatersleben & Andrews, 2013).

While the evidence of the positive impacts of nature seems both voluminous and compelling, and emanates from diverse fields, much of this research is atheoretical. Arguably, one reason for this may be that the biophilia hypothesis (Wilson, 1984) is too broad whereas ART (Kaplan & Kaplan, 1989) and SRT (Ulrich et al., 1991) are too narrow. To address this issue, we begin by discussing the various basic psychological need theories that have been proposed in the past. Next, we describe Baumeister and Leary's (1995) criteria for determining what constitutes such a need. We then broadly explore literature examining human–nature interactions and connections, whether positive or negative, to determine whether there is sufficient evidence to support the proposition that nature relatedness could, or indeed should, be deemed a basic psychological need.

Basic psychological need theories

Pittman and Zeigler (2007) examined six human needs theories that emerged in the twentieth century, explicating their commonalities and divergences to determine what were truly human fundamental psychological needs. Those theories included the hierarchy of needs (Maslow, 1943, as cited in Pittman & Zeigler, 2007), which argued that humans have both physiological needs (e.g., for food, water, and shelter) and psychological needs (e.g., for belongingness, esteem, and self-actualization). Fiske's (2004, as cited in Pittman & Zeigler, 2007) core social motives theory proposed five basic motives—belonging, understanding, controlling, enhancing self, and trusting—with belongingness anchoring those as a core need. A third needs theory, terror management theory (TMT) (Pyszczynski, Greenberg, & Solomon, 1997), holds that the need for self-preservation is primary, while all other needs are secondary. Bowlby's (1969, as cited in Schwartz, 2015) attachment theory explicated systems or processes of attachment that resonated with the need for belongingness (p. 479). Fifth, the cognitive-experiential self-theory (CEST) was proposed by Epstein (1992), who held that humans use a rational system (objective and affect-free) and an experiential system influenced “by emotions, relying on intuition and heuristic cues” (p. 480) to interpret information. The sixth, and most well-known and often-employed framework, is basic psychological needs theory (BPNT; Deci & Ryan, 2000; Ryan & Deci, 2017). BPNT posits that there are three fundamental needs: autonomy, competence, and (interpersonal) relatedness. According to Ryan and Deci (2017), *autonomy* “describes the need of individuals to experience self-endorsement and ownership of their actions” (p. 86). *Competence* describes the need to feel “effective in one's interactions with the social environment” (p. 86) and therefore a

sense of ability and mastery in how one experiences “opportunities and supports for the exercise, expansion, and expression of one’s capacities and talents” (p. 86). Interpersonal *relatedness* describes the need to relate to others; to be concerned, benevolent, and feel love for others and, in return, to perceive reciprocal love, understanding, and care. Ryan and Deci have proposed that lack of satisfaction of any of these needs would lead to ill-being.

BPNT (Deci & Ryan, 2000; Ryan & Deci, 2017) has its critics. For example, Sheldon, Elliot, Youngmee, and Kasser (2001) tested 10 candidate psychological needs with American and South Korean students and found that self-esteem loomed large in making life events satisfying for both groups. Conversely, lack of self-esteem, autonomy, and security were keenly felt during unsatisfactory life events, which suggested self-esteem be considered a basic psychological need—particularly given its cross-cultural salience (for a contrasting perspective, however, see Ryan & Brown, 2003). Others have also been proposed as salient for recognition as basic psychological needs, including the needs for novelty (González-Cutre, Sicilia, Sierra, Ferriz, & Hagger, 2016) and status (Anderson, Hildreth, & Howland, 2015). More recently, Ryan and Deci (2017) conceded that “meaningful exposure to living nature has a positive effect on subjective vitality relative to exposure to non-natural environments without living elements, and this relation is mediated in part by basic psychological needs” (p. 265). However, Ryan and Deci have stopped short of including the need for nature in their constellation of three. But are Ryan and Deci downplaying the role of nature connectedness in humans’ psychological well-being in favor of defending a more parsimonious theory?

Basic psychological need criteria and their application to nature relatedness

Of BPNT’s (Deci & Ryan, 2000; Ryan & Deci, 2017) three basic psychological needs, relatedness was the last to be fully recognized. This recognition may have resulted from Baumeister and Leary’s (1995) decision to test the hypothesis that the need to belong is also fundamental. What differentiated these researchers’ work from those who preceded them is that Baumeister and Leary were the first to specify what criteria must be met for something to be considered a basic psychological need. They identified nine standards: (a) it must apply across a variety of settings; (b) it must evoke an emotional response, or have affective consequences, for an individual; (c) it must direct cognitive processing; (d) it will cause ill-effects if unsatisfied; (e) a substitute need can be as satisfying if met; satiation means there is a point at which a need has been fully met; (f) it is universal, (g) it does not derive from other needs; (h) it affects a wide range of behaviors; and (i) it has “implications beyond psychological functioning” (p. 499). Ryan and Deci (2017) have argued that the needs for autonomy, competence, and relatedness meet Baumeister and Leary’s (1995) needs standards (Ryan & Deci, 2017, p. 85), though they do not refer to the standard of substitution or satiety.

Therefore, with Baumeister and Leary’s (1995) needs criteria as our guide, we examined the extant literature on nature relatedness to investigate whether the need for nature could indeed be considered a basic psychological need or is merely supportive of Ryan and Deci’s (2017) needs triumvirate. Note that our understanding of the term “nature relatedness” is aligned with Nisbet, Zelenski, and Murphy’s (2011) definition as

“the affective, cognitive, and experiential relationship individuals have with the natural world or a subjective sense of connectedness with nature” (p. 304). We consider this definition relevant to understandings of other ways in which nature relatedness is expressed (e.g., nature connectedness, human-nature interaction, etc.).

In examining the literature pertinent to each of Baumeister and Leary’s (1995) needs standards, we have reserved the first need standard—that it must readily evoke positive effects across a wide variety of settings—for last because it is most fitting for summing up our findings across all need standards. Hence, we begin with the second need standard: that it should evoke affective consequences.

Affective consequences

An important need standard is its propensity to evoke positive states of well-being that may result in an individual feeling happy, content, or at peace and foster personal growth (Frederickson, 2001). While many studies point to positive affect resulting from engagement with nature (see Ryan et al., 2010; Tyrväinen et al., 2014), there is a caveat: nature has a dark side that can result in negative affect (e.g., Knopf, 1987; Pretty et al., 2007). Negative affect is equally salient to consider for a balanced view of this need standard pertinent to human–nature interactions.

Much research has attempted to quantify nature relatedness. For example, Nisbet et al. (2011) conducted two identical studies using their nature-relatedness (NR) scale (Nisbet, Zelenski, & Murphy, 2009), one with undergraduate students and one with working people, to determine the relationships between NR and well-being. In both studies, NR was associated with positive affect, a sense of autonomy, and personal growth. Individuals who self-reported having high NR on surveys also reported greater purpose in life and acceptance of self. In a third study, Nisbet et al. (2011) found that undergraduate students who took environmental courses were happier at the end of term than students who did not. Ryan et al. (2010) discovered similarly energizing and vitalizing effects in five studies examining people’s subjective vitality after outdoor leisure. Ryan et al. concluded that there were positive, vitalizing impacts being outdoors and “around natural elements ... above and beyond the effects of physical activities or social interactions that can take place in natural settings” (p. 167).

These vivifying effects may transcend gender, culture, and age. For example, in a Finnish study with 95 mostly middle-aged women, Tyrväinen et al. (2014) examined the effects of experiencing three environmental settings (urban park, woodland park, and city center) on restoration, vitality, mood, and creativity. Participants preferred park environments and perceived the woodland area as most restorative. Tyrväinen et al. concluded that a minimum of 15 min in nature is needed to experience well-being effects.

However, the natural environment can also induce negative affect—depending on who is in it. For example, Mexican American youths feared crime in their neighborhood parks, and it deterred them from participating in outdoor recreation (Stodolska, Shinew, Acevedo, & Roman, 2013). Women feared sexual assault in wilderness areas (Bialeschki, 2005) and were concerned for their personal safety (Lovelock, Lovelock, Jellum, & Thompson, 2011). In one of the few studies from Africa, Murphy Michalopoulos et al.

(2017) found that Zambian women fish traders in the Kafue Flatlands suffered fear, anxiety, and stress because of violence, trauma, sexual exploitation, HIV/AIDS, poverty, and unsanitary conditions. Although aquatic environments are often considered a desirable, restorative space (White et al., 2010), these women were living near the river of necessity, not choice. Choice, it seems, makes a significant difference.

In these latter studies, it bears noting that it was not nature itself that caused negative affect, but perceptions or experience of threatening human presence that caused fear for safety and security (Knopf, 1987), potentially thwarting the need for nature relatedness. Insalubrious natural environments with unpleasant stimuli (e.g., mud, excrement, or slime) that arouse feelings of disgust or discomfort may also cause people to shy from leisure in natural environments (Bixler & Floyd, 1997).

Direct cognitive processing

Can nature change the way people think, or direct their motivations, so that they benefit—even unwittingly—from its impacts on their state of mind, feelings of well-being, or satisfaction with life? One of the most devastating impacts of war for both combatants and civilians is posttraumatic stress disorder (Varning Poulson, 2017). Nature-based therapies, however, may hold a key. For example, Israeli combat veterans with chronic posttraumatic stress disorder responded to a 12-month sailing course with significant improvements in managing stress (Gelkopf, Hasson-Ohayon, Bikman, & Kravetz, 2013). In addition, these veterans were better able to manage their depression; they reported greater quality of life, better daily functioning, and increased hope of controlling their illness and returning to normal life. Just a year earlier, Berman et al. (2012) discovered that human–nature interactions improved cognition and affect in people diagnosed with major depressive disorder (MDD), even when ruminating upon a painful, unresolved experience, while walking in a natural environment for 50–55 min. Similarly, Bratman, Daily, Levy, and Gross (2015) found that young adults performed better on verbal and visual memory tests after a 50-min nature walk. Overall, participants experienced less anxiety and maintained a positive outlook. A four-day, technology-free wilderness experience resulted in improved creativity, leading the authors to caution that a dearth of nature relatedness, and relentless exposure to technological stimuli in urban environments, could result in cognitive deficits (Atchley, Strayer, & Atchley, 2012).

While immersion in nature may buoy cognition, nature promotes prosociality whether viewing images of beautiful nature or surrounded by plants in a laboratory setting. Zhang, Piff, Iyer, Koleva, and Keltner (2014) found that participants were more generous and empathic in both scenarios. Viewing or experiencing nature evoked more intrinsic motivations and promoted generosity (Weinstein, Przybylski, & Ryan, 2009), spurred innovative, creative problem solving (Leong, Fischer, & McClure, 2014), and fostered recovery of stress-impaired cognitive acuity (Berto, 2014). Even very young children have benefited in terms of cognitive processing. Miché et al. (2015) found that preschoolers attending forest kindergarten in the Czech Republic engaged freely in creative play and demonstrated well-developed social skills and emotional coping skills, environmental concern, and caring and respect for other species. In addition, the children's active outdoor ventures helped them maintain a healthy body weight.

While many nature relatedness studies examine pleasant nature, it is unknown whether wild nature, such as a jungle, elicits prosocial behaviors, positive affect, cognitive benefits, or positive emotions, particularly considering the extent of biodiversity—some of it fanged and dangerous—in such habitats. It is, however, worth noting that humans do seek out interactions with wildlife—arguably an integral part of nature—through increasingly popular wildlife tourism (Cong, Wu, Morrison, Shu, & Wang, 2014; Curtin, 2009) or visits to zoos to view and be in the presence of exotic or endangered animals (Powell & Bullock, 2014). Proximity to wildlife has evoked feelings of wonderment and awe, empathy, and deep, positive emotional responses in visitors and tourists.

Unsatisfied needs

An unsatisfied basic psychological need will result in enduring ill effects encompassing the medical, psychological, or behavioral realm, according to Baumeister and Leary (1995). So how do humans experience nature deprivation? Prisons, where personal freedoms, agency, and volition to act autonomously are curtailed, seemed a fitting starting point. In 1981, architect Ernest Moore compared the design, orientation, and characteristics of prison cell blocks by monitoring sick calls. He did so because seeking medical attention afforded an inmate respite from the cell, boredom alleviation, and connection with others. Inmates occupying outward-facing cells could look out on farmlands and forest, while those in inward-facing cells faced the prison yard with no views of nature. Moore (1981) discovered that prisoners with no nature views tended to seek medical services more often than those in outside-facing cells. He concluded that the views of nature afforded inmates a modicum of restoration from the sensory overload—yelling, overcrowding, lack of privacy—common to prisons.

Further evidence in the correctional system came from a study of the Master Gardener program, a three-and-a-half-month, voluntary vocational horticulture program at a women's federal prison camp (FPC), Bryan, in Texas (Migura, Whittlesey, & Zajicek, 1997). The 36 women in the Master Gardener program reported significantly higher global self-esteem and global life satisfaction after the program than did those in the control group. Drug and alcohol abusers in the gardening group also scored higher on their internal-external locus of control and the satisfaction with life scale. After release, the longer-term benefits of the gardening program became clear. Numerous participants sent unsolicited cards and letters to FPC Bryan's Master Gardener coordinator with their success stories: some had found work in horticulture, had taken it up as a hobby, or were continuing their education in horticulture. Not only had the gardening program proved effective in raising self-esteem and life satisfaction, it had offered rehabilitative benefits as well.

Elderly people with dementia (Gigliotti, Jarrott, & Yorgason, 2004) and with intact cognitive function (Barnicle & Midden, 2003) also benefited from horticultural therapy (HT) programs. Gigliotti et al. (2004) compared an HT program to a standard adult day service program and found that just 30 min of HT resulted in greater positive affect than did more-traditional therapeutic activities. This finding was considered crucial given the ephemeral nature of the lifeworlds of people living with dementia. In fact, not

satisfying the need for nature relatedness for people with dementia or cognitive impairment might deprive them of the positive affect evoked by HT programs and potentially result in less life satisfaction.

The propinquity of nature is crucial for children's development. Wells (2000) conducted a longitudinal study of the cognitive functioning of 17 children from low-income families in the United States living in a variety of housing types. She found that when children moved to homes with nearby nature, their cognitive functioning improved—and it improved in relation to the proximity of green space to their new home, a benefit that lasted several months. Wells and Evans (2003) noted the buffering effect of nature in their study of young children living in a rural area in the United States. The authors noted that vulnerable children, and in particular those who experienced highly stressful lives, benefited most from the buffering effects of nearby nature. Being close to nature fostered both psychological well-being and positive affect in these children. In a spectrum of people across the human lifespan, in situations of poverty, cognitive decline, incarceration, or institutionalization, nature's presence has proved beneficial, and its absence detrimental, to human flourishing.

Substitution and satiation

Baumeister and Leary (1995) noted that motivation was marked by two known hallmarks: substitution and satiation. Though not mentioned as a need standard by Ryan and Deci (2017), we propose that the need for nature can meet this interwoven pair of need standards.

Substitution

Whether viewed through a window (Matsuoka, 2010; Ulrich, 1984), glimpsed through prison bars (Moore, 1981), pored over on slides in a laboratory setting (Gatersleben & Andrews, 2013), or watched on video (Mayer, McPherson Frantz, Bruehlman-Senecal, & Dolliver, 2009) or on television advertisements (Hartmann & Apaolaza-Ibáñez, 2008), virtual nature can have a powerful impact on humans. For example, Matsuoka (2010) studied the landscape features at 101 high schools in southeastern Michigan to determine what role they played in students' academic achievement and behavior. He found that views of nature, and the types of nature students observed from the cafeteria and from classrooms, impacted their academic performance, plans for the future, and behavior at school. The more natural the view, the greater the impact. Larger classroom windows were related to less criminal behavior and more students aspiring to attain undergraduate degrees. In the corrections domain, Nadkarni's (2014) Sustainability in Prisons Project in Washington State, which brought science lessons and horticulture programs to inmates, resulted in more positive social interactions among prisoners and feelings of hope and purpose. Even though the programs took place inside the prison, contact with nature, and nurturing plants indoors, induced psychological benefits.

It is not only healthy people who benefit. For postoperative patients in a hospital, having a bed that faced a window with a view of nature was associated with faster recovery, quicker discharge from hospital, fewer strong narcotics to manage pain, and

more positive notes about their progress written up by attending nurses, according to Ulrich (1984). What is noteworthy is that patients were not able to experience nature and had only a limited view of the natural environment, and yet they appeared to have strong positive reactions, both physiological and psychological, that speeded their recovery. Such findings beg the question of how artworks, photographs of nature settings—substitutions for nature itself—could be introduced into hospitals where design precludes a pleasant view of nature to promote well-being and healing.

Satiation

How much time does it take for the allure of nature to affect us? Hartmann and Apaolaza-Ibáñez (2008) found it takes the duration of an advertisement (typically seven, 15, or 30 s) to persuade people to buy a green-branded energy product. According to Lee, Williams, Sargent, Williams and Johnson (2015), 40 s of a nature view can restore attention; looking at tall trees for a minute fostered feelings of well-being and prosocial behaviors (Piff, Feinberg, Dietze, Stancato, & Keltner, 2015). It took 6 min for older adults to experience psychological benefits after viewing nature images (Gamble, Howard, & Howard, 2014). Barton and Pretty (2010) found that 5 min of moderately paced green exercise produced restorative benefits. Tyrväinen et al. (2014) identified that 20–30 min produced psychological benefits. Mao et al. (2012) determined that 3 hours a day at a forest site for 7 days reduced hypertension and blood pressure in elderly people, while Berman et al. (2012) deduced that a 50–55 min walk in nature was restorative for people with MDD. Among inmates in a Master Gardener program, 3 hours a day for 3.5 months on horticultural activities was beneficial (Migura et al., 1997), while children in forest preschool typically spent 2 to 5 hours outdoors daily (Lerstrup & Dahl Refshauge, 2016)—all to good benefit. While there is no agreed-upon time to be spent in nature to achieve benefits, there appears some agreement that even small doses of nature can be restorative (Barton & Pretty, 2010; Kaplan & Kaplan, 2011).

Universal

According to Baumeister and Leary (1995), for a need to be regarded as fundamental or innate, it cannot be limited to only particular groups of people or rarefied situations. Furthermore, a need should transcend cultural bounds and be found to be as true in one country or society as another. North American, European, and Asian studies tend to dominate the human–nature connectedness literature (Keniger et al., 2013); the findings are nonetheless compelling. For example, Cervinka, Röderer, and Hefler (2012) explored the connection between connectedness to nature (CN) and well-being among 547 Austrians. Cervinka et al. (2012) found the highest correlation between CN and meaningfulness in those who experienced fulfilling, autonomous lives as well as social acceptance and relatedness with others. Ryan and Deci (2017) have also affirmed the concept of a meaningful life, drawing attention to the importance of awareness and mindfulness as facilitators of needs satisfaction and greater well-being.

In a Finnish study, Korpela, Borodulin, Neuvonen, Paronen and Tyrväinen (2014) found that restoration was the most important mediator between time spent in outdoor leisure and emotional well-being. Korpela et al. noted that Finns tended to prefer peacefulness, quietude, and solitude and were motivated to achieve these in their outdoor leisure, underscoring the individualistic cultural ethos prevalent among Finnish outdoor recreationists and a cultural characteristic that may not be the case among more collectivistic cultures. However, in a Japanese study investigating the well-being effects of forest versus urban environments, Takayama et al. (2014) discovered that forest environments evoked greater feelings of well-being and positive affect among their participants than did urban environments. Takayama et al. concluded that “forest bathing” had four important “recovery effects” (p. 7226) including experiencing (a) improved mood, (b) increased positive affect, (c) feelings of restoration, and (d) vitality, echoing earlier findings of psychological benefit by Lee et al. (2011).

In a Dutch study, van den Berg, Maas, Verheij, and Groenewegen (2010) examined how the presence and proximity of green space within a 1-Km or 3-Km radius of individuals’ residences might buffer their stress levels and affect their mental health and their perceived general physical health. Findings revealed that green space within the 3-Km radius—but not for the 1-Km radius—around the home significantly reduced stress and evoked more positive perceptions of overall health. The authors theorized this might be because expanses of further away nature afforded more opportunities for deeper contemplation and rejuvenation than could nearby nature. This was a surprising outcome considering the many studies pointing to the importance of nearby urban green space in human well-being and health (e.g., Crouse et al., 2017; Mitchell & Popham, 2008). Therefore, it appears that while human–nature connections may transcend cultural borders, the experience of nature may be overlaid with cultural patinas.

Evolutionary, non-derivative of other behaviors

Why is there a human–nature connection? Some research has suggested that humans’ attraction for nature may be evolutionary (Falk & Balling, 2010; Frumkin, 2001; Wilson, 1984). According to Frumkin (2001), humans’ elemental connection with nature is primordial and took root when humans first evolved and began to use the natural resources around them to flourish. Furthermore, he argued that humans’ attraction to nature is embedded in our species’ evolving experience of the world that enabled them to find sustenance and shelter. Pointing to Wilson’s (1984) biophilia hypothesis, which argues for humans’ innate, evolutionary affinity for nature, Frumkin (2001) emphasized the role of animals in health care settings, such as pet therapy programs, which have evoked positive affective consequences for patients of all ages. Moreover, gardening and therapeutic horticultural programs (Gigliotti et al., 2004; Migura et al., 1997) have proved beneficial in settings from long-term care facilities (Barnicle & Midden, 2003) to prisons (Migura et al., 1997; Moore, 1981) to schools (Kweon, Ellis, Lee, & Jacobs, 2017; O’Brien, 2009; Matsuoka, 2010) and other communities in evoking calm, restoration (Kaplan & Kaplan, 2011), positive affect (Mayer et al., 2009), and well-being (Barnicle & Midden, 2003; Cervinka et al., 2012; Korpela et al., 2014).

Frumkin (2001) pondered whether the salutary landscapes reminiscent of the savannah-like environments of Africa, with copses of trees near lakes and rivers and considered to be humans' preferred landscapes (Falk & Balling, 2010; Hagerhall, Purcell, & Taylor, 2004), could be evolutionarily inspired. However, in the absence of any studies that prove concretely that the human connection to nature truly is evolutionary, recent research points to a more pragmatic view, though Hagerhall et al., (2004) caution against thinking this might be *the* answer. For example, Joye and van den Berg (2011) argued against the evolutionary hypothesis of nature connection proposed by Ulrich (1993). Joye and van den Berg (2011) contended that nature is not necessarily restorative, particularly if it contains dangerous elements—an argument supported by Gatersleben and Andrews (2013) in their study of humans' perceptions of prospect versus refuge landscapes. Instead, Joye and van den Berg (2011) have proposed a different nature-affinity theory underpinned by the idea of processing fluency. Fluency describes the ease of our “reading” and sense-making of the scene or stimuli presented that results in positive affect. Perceptual fluency account (PFA) states that when humans perceive unthreatening natural scenes, they are more likely to experience positive affect than they are when observing unthreatening urban scenes. This is because our visual system is more capable of processing natural scenes, and with greater ease, than urban ones. This visual fluency or ease of processing natural scenes over urban ones can be explained by the perceived visual coherence of natural environments that are more readily cognitively processed. The reason for this is nature's “fractal” characteristics—a concept describing “the mathematical ‘language’ underlying the visual aspects of natural forms and processes” (p. 267). In their study of the role of fractal characteristics in landscape preference, Hagerhall et al. (2004) described the importance of considering the fractal dimension because it relates to the way the eye views an object. In elucidating this concept further, Joye and van den berg (2011) described how elements of nature appear to replicate themselves so that a forest may present many versions of a tree from large to small, across tree species, and this creates coherence in the mind of the viewer that allows the individual to be able to interpret the scene more easily than the built environment where many objects lack perceptual coherence. These divergent elements in the landscape draw the attention in many directions and are harder for the brain to interpret. If this is indeed the case, then humans' need for nature relatedness may be biologically, rather than evolutionarily, derived. However, we posit that though nature relatedness and understanding of the natural environment were essential for survival to hominins, later in the evolutionary journey nature relatedness also served to meet psychological needs—needs that may be met by experiencing leisure in salubrious natural environments.

Affects a wide range of behaviors

According to Baumeister and Leary (1995), for a need to be considered fundamental it should produce effects broadly. Nature relatedness appears to impact a wide range of behaviors in a diverse range of population groups and settings. For example, forest schools, which afford opportunities for school-aged children to engage in woodland activities, have been incorporated into many schools' curricula in Scandinavia and

Europe as a way to connect children to nature and to instill appreciation for it (Knight, 2013). In Roe and Aspinall's (2011) study of 11-year-olds living in a deprived area of Scotland, forest school activities improved students' mood and students reported feeling more competent to actualize their personal goals. However, students with poor behavior experienced the biggest restorative changes; forest school activities effectively reversed the negative consequences of in-class experiences and helped students manage their anger.

What is it about nature relatedness that induces these good behaviors? According to Piff et al. (2015), it is the experience of awe that inspires, allowing individuals to experience their "small selves" (e.g., feeling humbled in the presence of something greater than themselves). In one of their series of studies, Piff et al. hypothesized that viewing magnificent nature would conduce to prosocial behaviors, and they found that individuals looking up at tall trees for only a minute reported greater well-being and acted generously toward others.

The presence of trees and vegetation around buildings can evoke prosociality in other ways, even to reduce criminal behaviors. For example, Kuo and Sullivan (2001) studied police crime reports in one of Chicago's poorest, inner-city neighborhoods to examine the association between vegetation presence and crime. These authors found that the presence of high-canopy trees and grass reduced crime of all types, including property and violent crimes. Buildings surrounded by vegetation reported 52% fewer crimes in total over those with minimal vegetation. This study attests to the significant, positive impact of the presence of urban nature in low-income neighborhoods.

Not only does vegetation discourage criminality, it can promote healthy lifestyles. Nearby nature (Kaplan & Kaplan, 1989) may encourage physically active behaviors in children, helping them to maintain healthy body weights. In Wolch and colleagues' (2011) longitudinal study of 3,173 children in 12 California communities, proximity to green space, parks, and outdoor recreational programs predicted healthier body weights. However, the researchers noted that such effects varied by race and ethnicity, with Hispanic and African American children faring more poorly than non-Hispanic White and Asian children and boys benefitting from proximity to green space more than girls. The authors suggested that the walkability of neighborhoods, and feeling safe getting to green spaces and parks, affected girls' usage or nonusage of the parks.

Echoing the findings of Wolch et al. (2011) with respect to girls' concerns about safety, Bialeschki (2005) reported that women's desires for outdoor leisure were tempered by fear of harm and sexual assault. This fear was mirrored in Lovelock and colleagues' (2011) study examining newcomers' use of national parks in New Zealand, where women avoided going into wilderness and forest areas alone if they felt unsafe. Self-exclusion because of fear points to the need for nature relatedness being unmet, which may result in dissatisfaction and have negative consequences for well-being.

What is seen and sensed in nature also has affective consequences (e.g., Bixler & Floyd, 1997). Gatersleben and Andrews (2013) used Appleton's (1975, as cited in Gatersleben & Andrews, 2013) prospect-refuge theory to examine whether and how people experienced restoration in a variety of landscapes, from those with clear sightlines (high prospect) to those dominated by places for concealment (high refuge). Viewing slides of green landscapes and walking in green landscapes revealed similar

results: study participants perceived environments with clear fields of vision (high prospect) as more restful and comfortable landscapes to inhabit than those with plenty of places for concealment (high refuge). Gatersleben and Andrews suggested that high-prospect/low-refuge natural landscapes could also induce greater energy and foster rejuvenation by positively altering an individual's state of mind. However, negative perceptions of nature resulting from encounters (seeing, touching, smelling) with objects (e.g., slime, excrement, mud) or landscape features (e.g., nettles) and wildlife (e.g., spiders, cougars) that evoked disgust, fear, or discomfort caused adolescents to prefer more-managed, or even built environments over wildlands (Bixler & Floyd, 1997). These findings led Bixler and Floyd to caution that it was important to consider such variables when determining what factors might influence environmental preferences. It appears that much depends on the type of natural environment (e.g., Wyles et al., 2019), factors of gender, race, and ethnicity (e.g., Lovelock et al., 2011), and the quality of sensory experience (Bixler & Floyd, 1997), as to whether positive psychological benefits accrue from nature relatedness.

Beyond psychological implications: Positive effects

Baumeister and Leary (1995) have suggested that a truly fundamental human need should “have implications that go beyond psychological functioning” (p. 499). Avoiding premature death could certainly be considered to be one such implication (Crouse et al., 2017; Mitchell & Popham, 2008).

Crouse et al. (2017) examined the data from the 2001 Canadian Census Health and Environment Cohort to determine whether proximity to urban green space (500 m from residences) would have an impact on mortality rates stemming from six common cardiovascular-related diseases. Crouse et al. found that proximity to green space correlated with a marked decrease in mortality (8%–12%) from cardiovascular disease, with men benefitting more than women, as did individuals with higher education and higher incomes.

Improved physical health has been found in other natural settings. In a Chinese study examining the impacts of forest bathing on hypertension in elderly people, Mao et al. (2012) randomly assigned 24 people, diagnosed with hypertension, to a 7-day physical activity intervention at either a forest site or an urban one. Participants walked for 3 hours per day at their own pace. People who experienced the forest site showed a significant reduction in blood pressure—well below that of those in the urban group and lower than their baseline blood pressure reading. In a Canadian study, individuals with Alzheimer's disease, who were living in care facilities with special care gardens, found these spaces soothing and frequently walked there without confusion. Nursing staff also recorded fewer violent incidents among patients in institutions with gardens (Mooney & Nicell, 1992). However, institutions without gardens reported a 681% increase in violent incidents over those in garden institutions over the duration of the study, underscoring the importance of nature relatedness even for those with severe cognitive impairment.

Children benefit from access to natural environments for exploration and play in terms of increased physical activity, lower body mass index (McCurdy, Winterbottom,

Mehta, & Roberts, 2010; Wolch et al., 2011), and well-being. Ineichen and Hooper (1974) discovered that children living in high-rise apartments in Bristol, U.K., exhibited more behavioral problems than children living in low-rise apartment buildings or residences with gardens. However, quantity, quality, and proximity of green space are vital not only for children but for the health and well-being of all people no matter their socioeconomic status. Kuo, Bacaicoa, and Sullivan (1998) found that residents of an inner-city Chicago neighborhood strongly preferred landscape enhancements that included well-kept lawns and trees and vegetation that did not block their view. The presence of these natural elements contributed to residents' sense of safety and community. Further to Kuo and colleagues' findings, people in a depressed Scottish neighborhood experienced less stress depending on the proximity of green space to their homes and its extent (Ward Thompson et al., 2012). Similar findings in the Netherlands reported both mental and physical health gains, particularly for stay-at-home parents and the elderly, fostered by nearby nature (de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003).

The presence of tree canopy within 50 m of homes in Portland, Oregon, predicted a lower incidence of low birth weight babies in those areas (Donovan et al., 2011). Even taking socioeconomic status of mothers into account and speculating on the salutary impacts of nearby nature in reducing stress, or its promotion of increased physical activity and socialization opportunities, the presence of trees seemed to have an inexplicable, salubrious impact on unborn babies. Nature as a need has been shown to have benefits well beyond psychological implications, reaching with compelling ease—and evidence—into the domain of physical health across the lifespan and transcending cultural boundaries, from birth to death.

Positive effects across a wide variety of settings

Although Baumeister and Leary (1995) listed this need criterion first, this is a fitting place to underscore and summarize the bountiful empirical evidence of the positive benefits of nature across a range of settings and across the lifespan as presented throughout this study.

Human-nature interactions have been found to evoke affective consequences (Keniger et al., 2013; Nisbet et al., 2011; Ryan et al., 2010; Tyrväinen et al., 2014), direct cognitive processing (Berman et al., 2012; Bratman et al., 2015; Michek et al., 2015; Weinstein et al., 2009), and affect a range of behaviors (Gatersleben & Andrews, 2013; Kuo & Sullivan, 2001; Piff et al., 2015; Roe & Aspinall, 2011; Wolch et al., 2011). These benefits have occurred in settings ranging from schools (Matsuoka, 2010; Roe & Aspinall, 2011) and kindergartens (Michek et al., 2015) to elder-care facilities (Barnicle & Midden, 2003; Gigliotti et al., 2004), hospitals (Ulrich, 1984), and prisons (Migura et al., 1997; Moore, 1981). Nature has been found to transcend cultural borders across the globe, from North America (Crouse et al., 2017; Wells, 2000; Wells & Evans, 2003) to Europe (Pretty et al., 2007; van den Berg et al., 2010) to Oceania (Lovelock et al., 2011) and Asia (Lee et al., 2011; Mao et al., 2012; Takayama et al., 2014). The effects of nature have manifested in diverse population groups, from babies (Donovan et al., 2011) to school-aged children (Michek et al., 2015; Wells, 2000; Wolch et al., 2011) and high school students (Matsuoka, 2010) as well as among university students (Sheldon

et al., 2001; Zelenski, Dopko, & Capaldi, 2015), inmates (Moore, 1981; Nadkarni, 2014), adults (Crouse et al., 2017; González-Cutre et al., 2016), and the elderly (Barnicle & Midden, 2003; Gigliotti et al., 2004). People with a range of conditions, from dementia or cognitive impairment (Gigliotti et al., 2004) to students manifesting criminality and antisocial behaviors at school (Matsuoka, 2010; Roe & Aspinall, 2011), have benefited from nature connectedness. Moreover, nature relatedness has evoked an array of pro-social behaviors (Zelenski et al., 2015), feelings of well-being, and restoration (e.g., Piff et al., 2015; Tyrväinen et al., 2014).

Conclusion

The goal of this article was to examine the literature on nature relatedness to explore whether there was sufficient evidence to show that nature relatedness meets Baumeister and Leary's (1995) basic psychological need standards. In the face of persuasive evidence—though admittedly this review is by no means complete—we propose that nature relatedness should be considered a basic psychological need and a worthy addition to Ryan and Deci's (2017) triumvirate.

We offer this caveat though: Nature is not always benign, and factors of culture (Buijs, Elands, & Langers, 2009; Lovelock et al., 2011), race and ethnicity (Stodolska et al., 2013), and gender (Bialeschki, 2005; Lovelock et al., 2011) can provoke negative affect, such as fear and anxiety. Furthermore, not every natural landscape brings pleasure. Natural environments may induce fear (Murphy Michalopoulos et al., 2017; Stodolska et al., 2013). Therefore, we cannot assume that nature relatedness is a human psychological need in all cases, across the human spectrum. In addition, as Keniger et al. (2013) found in their review of the human–nature interactions literature, the absence of studies in the South American and African contexts represents a monumental gap in our knowledge that is imperative to fill.

However, despite these shortcomings, the evidence for well-being, a plethora of positive psychological effects, and physiological benefits stemming from nature relatedness as evidenced throughout this study are compelling. Having stated this, we acknowledge this proposition is compelling rather than convincing, and consequently, we recommend cross-sectional, longitudinal, experimental, and other types of research be conducted.

Implications

Our research, forged in the spirit of this special issue of the *Journal of Leisure Research* to explore contemporary issues and trends impacting leisure and to propose new directions and ideas for leisure research that affect humanity and the environment, has presented a significant body of evidence of the human need for nature, in meeting all of Baumeister and Leary's (1995) need standards. As such, we offer several practical interventions to benefit both the environment and humanity.

Leisure and recreation scholars

We emphasize that leisure and recreation scholars should not underestimate the need for nature relatedness and should seek more ways in which to include this fundamental psychological need in future studies. For example, research might employ and expand upon BPNT (Ryan & Deci, 2017) to explore how leisure, both inclusive and deprived of nature, might impact participants' well-being. There is a need for further research on leisure involving urban wildlife; leisure spent watching birds has been associated with feelings of well-being, time suspended, wonder, awe, and spiritual uplifting (Cox & Gaston, 2016; Curtin, 2009). The relationship between humans and animals (domestic, wild, endangered, therapy) in terms of their mutual well-being offers the leisure and recreation fields intriguing new avenues for future research.

Educators

In terms of pedagogy, we suggest that undergraduate students of recreation and leisure studies be required to take at least one environmental psychology course, in addition to a course on the sociopsychological dimensions of leisure. Doing so will reinforce and entrench deeper understanding of the basic human psychological need for nature, thereby benefiting the environment, the leisure and recreation field, and future generations.

Leisure and recreation professionals

Leisure and recreation professionals and practitioners must consider designing programs that include more nature-based opportunities, such as forest schools (e.g., Roe & Aspinall, 2011), forest bathing (e.g., Mao et al., 2012; Takayama et al., 2014), and nature-based interventions for all population groups, as these have been found to benefit and be restorative to people of all ages, in states of wellness and ill-being, and to profoundly, positively affect their mental, physical, and physiological well-being (e.g., Crouse et al., 2017; Gigliotti et al., 2004).

Furthermore, we suggest that recreational therapy professionals promote the benefits of leisure gardening, tending plants, and working the soil as a resource for promoting well-being for individuals (e.g., Migura et al., 1997; Ulrich, 1984) and to consider and include such nature-based activities as essential to effective programming.

Urban planners, architects

Schools, office buildings, hospitals, long-term care facilities, penitentiaries, gymnasiums, and recreation and leisure center designs should incorporate large window arrays. Furthermore, in light of the evidence presented here, buildings and leisure spaces should, wherever possible, look out on pleasing natural environments to afford optimal calmate and healing benefits and to promote restful states of mind and spark creativity, elevated mood, and vitality among people using or inhabiting those spaces (e.g., Matsuoka, 2010).

Finally, in undertaking this interdisciplinary study exploring nature relatedness as a basic psychological need, we did not find answers only in one discipline or field. We examined literature spanning the realms of medicine, psychology, leisure, recreation, tourism, environmental psychology, urban planning, architecture, and beyond to determine whether there was evidence enough to meet each of Baumeister and Leary's (1995) need standards to affirm the place of nature relatedness among the basic psychological needs posited by Ryan and Deci (2017). These need standards have been met, but mainly because of our interdisciplinary focus. For these reasons, we encourage leisure scholars to take an interdisciplinary approach to furthering knowledge in this multifaceted, multilayered, and intricately nuanced domain.

ORCID

Jane Hurly  <http://orcid.org/0000-0002-9412-3014>

References

- Abbott-Chapman, J., & Robertson, M. (2009). Adolescents' favorite places: Redefining the boundaries between private and public space. *Space and Culture*, 12(4), 419–434. doi:10.1177/1206331209348091
- Anderson, C., Hildreth, J. A. D., & Howland, L. (2015). Is the desire for status a fundamental human motive? A review of the empirical literature. *Psychological Bulletin*, 141(3), 1–28. doi:10.1037/a0038781
- Atchley, R. A., Strayer, D. L., & Atchley, P. (2012). Creativity in the wild: Improving creative reasoning through immersion in natural settings. *PLoS One*, 7(12), e51474. doi:10.1371/journal.pone.0051474
- Barnicle, T., & Midden, K. S. (2003). The effects of a horticulture activity program on the psychological well-being of older people in a long-term care facility. *HortTechnology*, 13(1), 81–85. doi:10.21273/HORTTECH.13.1.0081
- Barton, J., & Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environmental Science & Technology*, 44(10), 3947–3955. doi:10.1021/es903183r
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497–529. doi:10.1037/0033-2909.117.3.497
- Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., ... Jonides, J. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of Affective Disorders*, 140(3), 300–305. doi:10.1016/j.jad.2012.03.012
- Berto, R. (2014). The role of nature in coping with psycho-physiological stress: A literature review on restorativeness. *Behavioral Sciences*, 4(4), 394–409. doi:10.3390/bs4040394
- Bialeschki, M. D. (2005). Fear of violence: Contested constraints by women in outdoor recreation activities. In E. J. Jackson (Ed). *Constraints to leisure* (pp. 103–114). State College, PA: Venture.
- Bixler, R. D., & Floyd, M. F. (1997). Nature is scary, disgusting, and uncomfortable. *Environment and Behavior*, 29(4), 443–467. doi:10.1177/001391659702900401
- Bratman, G. N., Daily, G. C., Levy, B. J., & Gross, J. J. (2015). The benefits of nature experience: Improved affect and cognition. *Landscape and Urban Planning*, 138, 41–50. doi:10.1016/j.landurbplan.2015.02.005

- Buijs, A. E., Elands, B. H. M., & Langers, F. (2009). No wilderness for immigrants: Cultural differences in images of nature and landscape preferences. *Landscape and Urban Planning*, 91(3), 113–123. doi:[10.1016/j.landurbplan.2008.12.003](https://doi.org/10.1016/j.landurbplan.2008.12.003)
- Cervinka, R., Röderer, K., & Hefler, E. (2012). Are nature lovers happy? On various indicators of well-being and connectedness with nature. *Journal of Health Psychology*, 17(3), 379–388. doi:[10.1177/1359105311416873](https://doi.org/10.1177/1359105311416873)
- Cong, L., Wu, B., Morrison, A. M., Shu, H., & Wang, M. (2014). Analysis of wildlife tourism experiences with endangered species: An exploratory study of encounters with giant pandas in Chengdu, China. *Tourism Management*, 40, 300–310. doi:[10.1016/j.tourman.2013.07.005](https://doi.org/10.1016/j.tourman.2013.07.005)
- Cox, D. T., & Gaston, K. J. (2016). Urban bird feeding: Connecting people with nature. *PloS One*, 11(7), e0158717. doi:[10.1371/journal.pone.0158717](https://doi.org/10.1371/journal.pone.0158717)
- Crouse, D. L., Pinault, L., Balram, A., Hystad, P., Peters, P. A., Chen, H., ... Villeneuve, P. J. (2017). Urban greenness and mortality in Canada's largest cities: A national cohort study. *The Lancet Planetary Health*, 1(7), e289–e297. doi:[10.1016/S2542-5196\(17\)30118-3](https://doi.org/10.1016/S2542-5196(17)30118-3)
- Curtin, S. (2009). Wildlife tourism: The intangible, psychological benefits of human–wildlife encounters. *Current Issues in Tourism*, 12(5–6), 451–474. doi:[10.1080/13683500903042857](https://doi.org/10.1080/13683500903042857)
- de Vries, S., Verheij, R. A., Groenewegen, P. P., & Spreeuwenberg, P. (2003). Natural environments—healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment and Planning A: Economy and Space*, 35, 1717–1731. doi:[10.1068/a35111](https://doi.org/10.1068/a35111)
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268. doi:[10.1207/S15327965PLI1104_01](https://doi.org/10.1207/S15327965PLI1104_01)
- Donovan, G. H., Michael, Y. L., Butry, D. T., Sullivan, A. D., & Chase, J. M. (2011). Urban trees and the risk of poor birth outcomes. *Health and Place*, 17(1), 390–393. doi:[10.1016/j.healthplace.2010.11.004](https://doi.org/10.1016/j.healthplace.2010.11.004)
- Epstein, S. (1992). Coping ability, negative self-evaluation, and overgeneralization: Experiment and theory. *Journal of Personality and Social Psychology*, 62(5), 826–836. doi:[10.1037/0022-3514.62.5.826](https://doi.org/10.1037/0022-3514.62.5.826)
- Falk, J. H., & Balling, J. D. (2010). Evolutionary influence on human landscape preference. *Environment and Behavior*, 42(4), 479–493. doi:[10.1177/0013916509341244](https://doi.org/10.1177/0013916509341244)
- Frederickson, B. L. (2001). The role of positive emotions in positive psychology. *American Psychologist*, 56(3), 218–226. doi:[10.1037/0003-066X.56.3.218](https://doi.org/10.1037/0003-066X.56.3.218)
- Frumkin, H. (2001). Beyond toxicity: Human health and the natural environment. *American Journal of Preventive Medicine*, 20(3), 234–240. doi:[10.1016/S0749-3797\(00\)00317-2](https://doi.org/10.1016/S0749-3797(00)00317-2)
- Gamble, K. R., Howard, J. H., & Howard, D. V. (2014). Not just scenery: Viewing nature pictures improves executive attention in older adults. *Experimental Aging Research*, 40(5), 513–530. doi:[10.1080/0361073X.2014.956618](https://doi.org/10.1080/0361073X.2014.956618)
- Gatersleben, B., & Andrews, M. (2013). When walking in nature is not restorative—the role of prospect and refuge. *Health and Place*, 20, 91–101. doi:[10.1016/j.healthplace.2013.01.001](https://doi.org/10.1016/j.healthplace.2013.01.001)
- Gelkopf, M., Hasson-Ohayon, I., Bikman, M., & Kravetz, S. (2013). Nature adventure rehabilitation for combat-related posttraumatic chronic stress disorder: A randomized control trial. *Psychiatry Research*, 209(3), 485–493. doi:[10.1016/j.psychres.2013.01.026](https://doi.org/10.1016/j.psychres.2013.01.026)
- Gigliotti, C. M., Jarrott, S. E., & Yorgason, J. (2004). Harvesting health: Effects of three types of horticultural therapy activities for persons with. *Dementia*, 3(2), 161–180. doi:[10.1177/1471301204042335](https://doi.org/10.1177/1471301204042335)
- González-Cutre, D., Sicilia, A., Sierra, A. C., Ferriz, R., & Hagger, M. S. (2016). Understanding the need for novelty from the perspective of self-determination theory. *Personality and Individual Differences*, 102, 159–169. doi:[10.1016/j.paid.2016.06.036](https://doi.org/10.1016/j.paid.2016.06.036)
- Grinde, B., & Patil, G. (2009). Biophilia: Does visual contact with nature impact on health and well-being? *International Journal of Environmental Research and Public Health*, 6(9), 2332–2343. doi:[10.3390/ijerph6092332](https://doi.org/10.3390/ijerph6092332)

- Hagerhall, C. M., Purcell, T., & Taylor, R. (2004). Fractal dimension of landscape silhouette as a predictor of landscape preference. *Journal of Environmental Psychology*, 24(2), 247–255. doi:[10.1016/j.jenvp.2003.12.004](https://doi.org/10.1016/j.jenvp.2003.12.004)
- Hartmann, P., & Apaolaza-Ibáñez, V. (2008). Virtual nature experiences as emotional benefits in green product consumption. *Environment and Behavior*, 40(6), 818–842. doi:[10.1177/0013916507309870](https://doi.org/10.1177/0013916507309870)
- Ineichen, B., & Hooper, D. (1974). Wives' mental health and children's behaviour problems in contrasting residential areas. *Social Science and Medicine*, 8(6), 369–374. doi:[10.1016/0037-7856\(74\)90083-3](https://doi.org/10.1016/0037-7856(74)90083-3)
- Joye, Y., & van den Berg, A. (2011). Is love for green in our genes? A critical analysis of evolutionary assumptions in restorative environments research. *Urban Forestry and Urban Greening*, 10, 261–268. doi:[10.1016/j.ufug.2011.07.004](https://doi.org/10.1016/j.ufug.2011.07.004)
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. New York, NY: Cambridge University Press.
- Kaplan, R., & Kaplan, S. (2011). Well-being, reasonableness and the natural environment. *Applied Psychology: Health and Well-Being*, 3(3), 304–321. doi:[10.1111/j.1758-0854.2011.01055.x](https://doi.org/10.1111/j.1758-0854.2011.01055.x)
- Kellert, S. R., Case, D. J., Escher, D., Witter, D. J., Mikels-Carrasco, J., & Seng, P. T. (2017). *The nature of Americans: Disconnection and recommendations for reconnection* (The Nature of Americans National Report). Mishawaka, IN: DJ Case and Associates. Retrieved from <https://natureofamericans.org>
- Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the benefits of interacting with nature? *International Journal of Environmental Research and Public Health*, 10(3), 913–935. doi:[10.3390/ijerph10030913](https://doi.org/10.3390/ijerph10030913)
- Knight, S. (2013). *International perspectives on forest school: Natural spaces to play and learn*. Thousand Oaks, CA: SAGE.
- Knopf, R. C. (1987). Human behavior, cognition, and affect in the natural environment. In D. Stokols and I. Altman (Eds.), *Handbook of environmental psychology* (pp. 783–825). New York, NY: John Wiley & Sons.
- Knopf, R. C. (1988). Human experience of wildlands: A review of needs and policy. *Western Wildlands*, 14(3), 2–7.
- Korpela, K. M., Borodulin, K., Neuvonen, M., Paronen, O., & Tyrväinen, L. (2014). Analyzing the mediators between nature-based outdoor recreation and emotional well-being. *Journal of Environmental Psychology*, 37, 1–7. doi:[10.1016/j.jenvp.2013.11.003](https://doi.org/10.1016/j.jenvp.2013.11.003)
- Korpela, K. M., Ylén, M., Tyrväinen, L., & Silvennoinen, H. (2008). Determinants of restorative experiences in everyday favorite places. *Health & Place*, 14, 636–652. doi:[10.1016/j.healthplace.2007.10.008](https://doi.org/10.1016/j.healthplace.2007.10.008)
- Kuo, F. E., Bacaicoa, M., & Sullivan, W. C. (1998). Transforming inner-city landscapes: Trees, sense of safety, and preference. *Environment and Behavior*, 30(1), 28–59. doi:[10.1177/0013916598301002](https://doi.org/10.1177/0013916598301002)
- Kuo, F. E., & Sullivan, W. C. (2001). Environment and crime in the inner city: Does vegetation reduce crime? *Environment and Behavior*, 33(3), 343–367. doi:[10.1177/0013916501333002](https://doi.org/10.1177/0013916501333002)
- Kweon, B. S., Ellis, C. D., Lee, J., & Jacobs, K. (2017). The link between school environments and student academic performance. *Urban Forestry and Urban Greening*, 23, 35–43. doi:[10.1016/j.ufug.2017.02.002](https://doi.org/10.1016/j.ufug.2017.02.002)
- Lee, J., Park, B.-J., Tsunetsugu, Y., Ohira, T., Kagawa, T., & Miyazaki, Y. (2011). Effect of forest bathing on physiological and psychological responses in young Japanese male subjects. *Public Health*, 125(2), 93–100. doi:[10.1016/j.puhe.2010.09.005](https://doi.org/10.1016/j.puhe.2010.09.005)
- Lee, K. E., Williams, K. J. H., Sargent, L. D., Williams, S. G., & Johnson, K. A. (2015). 40-second green roof views sustain attention: The role of micro-breaks in attention restoration. *Journal of Environmental Psychology*, 42, 182–189. doi:[10.1016/j.jenvp.2015.04.003](https://doi.org/10.1016/j.jenvp.2015.04.003)
- Leong, L. Y. C., Fischer, R., & McClure, J. (2014). Are nature lovers more innovative? The relationship between connectedness with nature and cognitive styles. *Journal of Environmental Psychology*, 40, 57–63. doi:[10.1016/j.jenvp.2014.03.007](https://doi.org/10.1016/j.jenvp.2014.03.007)

- Lerstrup, I., & Dahl Refshauge, A. (2016). Characteristics of forest sites used by a Danish pre-school. *Urban Forestry and Urban Greening*, 20, 387–396. doi:[10.1016/j.ufug.2016.09.010](https://doi.org/10.1016/j.ufug.2016.09.010)
- Lovelock, K., Lovelock, B., Jellum, C., & Thompson, A. (2011). In search of belonging: Immigrant experiences of outdoor nature-based settings in New Zealand. *Leisure Studies*, 30(4), 513–529. doi:[10.1080/02614367.2011.623241](https://doi.org/10.1080/02614367.2011.623241)
- Mao, G. X., Cao, Y. B., Lan, X. G., He, Z. H., Chen, Z. M., Wang, Y. Z., ... Yan, J. (2012). Therapeutic effect of forest bathing on human hypertension in the elderly. *Journal of Cardiology*, 60(6), 495–502. doi:[10.1016/j.jjcc.2012.08.003](https://doi.org/10.1016/j.jjcc.2012.08.003)
- Matsuoka, R. (2010). Student performance and high school landscapes: Examining the links. *Landscape and Urban Planning*, 97(4), 273–282. doi:[10.1016/j.landurbplan.2010.06.011](https://doi.org/10.1016/j.landurbplan.2010.06.011)
- Mayer, F. S., McPherson Frantz, C., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior*, 41(5), 607–643. doi:[10.1177/0013916508319745](https://doi.org/10.1177/0013916508319745)
- McCurdy, L. E., Winterbottom, K. E., Mehta, S. S., & Roberts, J. R. (2010). Using nature and outdoor activity to improve children's health. *Current Problems in Pediatric and Adolescent Health Care*, 40(5), 102–117. doi:[10.1016/j.cppeds.2010.02.003](https://doi.org/10.1016/j.cppeds.2010.02.003)
- Michék, S., Nováková, Z., & Menclová, L. (2015). Advantages and disadvantages of forest kindergarten in Czech Republic. *Procedia Social and Behavioral Sciences*, 171, 738–744. doi:[10.1016/j.sbspro.2015.01.186](https://doi.org/10.1016/j.sbspro.2015.01.186)
- Migura, M. M., Whittlesey, L. A., & Zajicek, J. M. (1997). Effects of a vocational horticulture program on the self-development of female inmates. *HortTechnology*, 7(3), 299–304. doi:[10.21273/HORTTECH.7.3.299](https://doi.org/10.21273/HORTTECH.7.3.299)
- Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: An observational population study. *The Lancet*, 372(9650), 1655–1660. doi:[10.1016/S0140-6736\(08\)61689-X](https://doi.org/10.1016/S0140-6736(08)61689-X)
- Mooney, P., & Nicell, P. L. (1992). The importance of exterior environment for Alzheimer residents: Effective care and risk management. *Healthcare Management Forum*, 5(2), 23–29. doi:[10.1016/S0840-4704\(10\)61202-1](https://doi.org/10.1016/S0840-4704(10)61202-1)
- Moore, E. O. (1981). A prison environment's effect on health care service demands. *Journal of Environmental Systems*, 11(1), 17–34. doi:[10.2190/KM50-WH2K-K2D1-DM69](https://doi.org/10.2190/KM50-WH2K-K2D1-DM69)
- Murphy Michalopoulos, L. T., Baca-Atlas, S., Simona, S. J., Jiwatram-Negrón, T., Ncube, A., Chery, M. B., & Michalopoulos, L. T. M. (2017). “Life at the river is a living hell”: A qualitative study of trauma, mental health, substance use and HIV risk behavior among female fish traders from the Kafue flatlands in Zambia. *BMC Women's Health*, 17, 1–15. doi:[10.1186/s12905-017-0369-z](https://doi.org/10.1186/s12905-017-0369-z)
- Nadkarni, N. (2014). Into the light: Bringing science education to the incarcerated. *Dimensions* (1528820X), 16(5), 52–54. Retrieved from <https://www.astc.org/publications/>
- Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). Linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior*, 41(5), 715–740. doi:[10.1177/0013916508318748](https://doi.org/10.1177/0013916508318748)
- Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2011). Happiness is in our nature: Exploring nature relatedness as a contributor to subjective well-being. *Journal of Happiness Studies*, 12(2), 303–322. doi:[10.1007/s10902-010-9197-7](https://doi.org/10.1007/s10902-010-9197-7)
- O'Brien, L. (2009). Learning outdoors: The forest school approach. *Education*, 37(1), 45–60.
- Piff, P. K., Feinberg, M., Dietze, P., Stancato, D. M., & Keltner, D. (2015). Awe, the small self, and prosocial behavior. *Journal of Personality and Social Psychology*, 108(6), 883–899. doi:[10.1037/pspi0000018](https://doi.org/10.1037/pspi0000018)
- Pittman, T. S., & Zeigler, K. R. (2007). Basic human needs. In A. W. Kruglanski & E. T. Higgins (Eds.). *Social psychology: Handbook of basic principles* (pp. 473–489). New York, NY: Guilford Press.
- Powell, D. M., & Bullock, E. V. (2014). Evaluation of factors affecting emotional responses in zoo visitors and the impact of emotion on conservation mindedness. *Anthrozoös*, 27(3), 389–405. doi:[10.2752/175303714X13903827488042](https://doi.org/10.2752/175303714X13903827488042)

- Pretty, J., Peacock, J., Hine, R., Sellens, M., South, N., & Griffin, M. (2007). Green exercise in the UK countryside: Effects on health and psychological well-being, and implications for policy and planning. *Journal of Environmental Planning and Management*, 50(2), 211–231. doi:[10.1080/09640560601156466](https://doi.org/10.1080/09640560601156466)
- Pyszczynski, T., Greenberg, J., & Solomon, S. (1997). Why do we need what we need? A terror management perspective on the roots of human social motivation. *Psychological Inquiry*, 8(1), 1–20. doi:[10.1207/s15327965pli0801_1](https://doi.org/10.1207/s15327965pli0801_1)
- Roe, J., & Aspinall, P. (2011). The restorative outcomes of forest school and conventional school in young people with good and bad behaviour. *Urban Forestry and Urban Greening*, 10, 205–212. doi:[10.1016/j.ufug.2011.03.003](https://doi.org/10.1016/j.ufug.2011.03.003)
- Ryan, R. M., & Brown, K. W. (2003). Why we don't need self-esteem: On fundamental needs, contingent love, and mindfulness. *Psychological Inquiry*, 14(1), 71–76.
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. New York, NY: Guilford.
- Ryan, R. M., Weinstein, N., Bernstein, J., Brown, K. W., Mistretta, L., & Gagné, M. (2010). Vitalizing effects of being outdoors and in nature. *Journal of Environmental Psychology*, 30(2), 159–168. doi:[10.1016/j.jenvp.2009.10.009](https://doi.org/10.1016/j.jenvp.2009.10.009)
- Schwartz, J. (2015). The unacknowledged history of John Bowlby's attachment theory. *British Journal of Psychotherapy*, 31(2), 251–266. doi:[10.1111/bjp.12149](https://doi.org/10.1111/bjp.12149)
- Sheldon, K. M., Elliot, A. J., Youngmee, K., & Kasser, T. (2001). What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of Personality and Social Psychology*, 80(2), 325–339. doi:[10.1037//0022-3514.80.2.325](https://doi.org/10.1037//0022-3514.80.2.325)
- Stodolska, M., Shinew, K. J., Acevedo, J. C., & Roman, C. G. (2013). “I was born in the hood”: Fear of crime, outdoor recreation and physical activity among Mexican-American urban adolescents. *Leisure Sciences*, 35(1), 1–15. doi:[10.1080/01490400.2013.739867](https://doi.org/10.1080/01490400.2013.739867)
- Takayama, N., Korpela, K., Lee, J., Morikawa, T., Tsunetsugu, Y., Park, B.-J., ... Kagawa, T. (2014). Emotional, restorative and vitalizing effects of forest and urban environments at four sites in Japan. *International Journal of Environmental Research and Public Health*, 11(7), 7207–7230. doi:[10.3390/ijerph110707207](https://doi.org/10.3390/ijerph110707207)
- Tyrväinen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., & Kagawa, T. (2014). The influence of urban green environment on stress relief measures: A field experiment. *Journal of Environmental Psychology*, 38, 1–9. doi:[10.1016/j.jenvp.2013.12.005](https://doi.org/10.1016/j.jenvp.2013.12.005)
- Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224(4647), 420–421. doi:[10.1126/science.6143402](https://doi.org/10.1126/science.6143402)
- Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. In S. R. Kellert and E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 73–137). Washington, DC: Shearwater.
- Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, 11(3), 201–230. doi:[10.1016/S0272-4944\(05\)80184-7](https://doi.org/10.1016/S0272-4944(05)80184-7)
- van den Berg, A. E., Maas, J., Verheij, R. A., & Groenewegen, P. P. (2010). Green space as a buffer between stressful life events and health. *Social Science and Medicine*, 70(8), 1203–1210. doi:[10.1016/j.socscimed.2010.01.002](https://doi.org/10.1016/j.socscimed.2010.01.002)
- Varning Poulson, D. (2017). Nature-based therapy as a treatment for veterans with PTSD: What do we know? *Journal of Public Mental Health*, 16(1), 15–20. doi:[10.1108/JMPH-08-2016-0039](https://doi.org/10.1108/JMPH-08-2016-0039)
- Ward Thompson, C., Roe, J., Aspinall, P., Mitchell, R., Clow, A., & Miller, D. (2012). More green space is linked to less stress in deprived communities: Evidence from salivary cortisol patterns. *Landscape and Urban Planning*, 105(3), 221–229. doi:[10.1016/j.landurbplan.2011.12.015](https://doi.org/10.1016/j.landurbplan.2011.12.015)
- Weinstein, N., Przybylski, A. K., & Ryan, R. M. (2009). Can nature make us more caring? Effects of immersion in nature on intrinsic aspirations and generosity. *Personality and Social Psychology Bulletin*, 35(10), 1315–1329. doi:[10.1177/0146167209341649](https://doi.org/10.1177/0146167209341649)
- Wells, N. M. (2000). At home with nature: Effects of “greenness”. *On Children's Cognitive Functioning. Environment and Behavior*, 32(6), 775–795. doi:[10.1177/00139160021972793](https://doi.org/10.1177/00139160021972793)
- Wells, N. M., & Evans, G. W. (2003). Nearby nature: A buffer of life stress among rural children. *Environment and Behavior*, 35(3), 311–330. doi:[10.1177/0013916503035003001](https://doi.org/10.1177/0013916503035003001)

- White, M., Smith, A., Humphries, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*, 30(4), 482–493. doi:[10.1016/j.jenvp.2010.04.004](https://doi.org/10.1016/j.jenvp.2010.04.004)
- Wilson, E. O. (1984). *Biophilia: The human bond with other species*. London, UK: Harvard University Press.
- Wolch, J., Jerrett, M., Reynolds, K., McConnell, R., Chang, R., Dahlmann, N., ... Berhane, K. (2011). Childhood obesity and proximity to urban parks and recreational resources: A longitudinal cohort study. *Health and Place*, 7, 207–214. doi:[10.1016/j.healthplace.2010.10.001](https://doi.org/10.1016/j.healthplace.2010.10.001)
- Wyles, K. J., Hattam, C., Austen, M., White, M. P., Pahl, S., & King, H. (2019). Are some natural environments more psychologically beneficial than others? The importance of type and quality on connectedness to nature and psychological restoration. *Environment and Behavior*, 51(2), 111–143. doi:[10.1177/0013916517738312](https://doi.org/10.1177/0013916517738312)
- Zelenski, J. M., Dopko, R. L., & Capaldi, C. A. (2015). Cooperation is in our nature: Nature exposure may promote cooperative and environmentally sustainable behavior. *Journal of Environmental Psychology*, 42, 24–31. doi:[10.1016/j.jenvp.2015.01.005](https://doi.org/10.1016/j.jenvp.2015.01.005)
- Zhang, J. W., Piff, P. K., Iyer, R., Koleva, S., & Keltner, D. (2014). An occasion for unselfing: Beautiful nature leads to prosociality. *Journal of Environmental Psychology*, 37, 61–72. doi:[10.1016/j.jenvp.2013.11.008](https://doi.org/10.1016/j.jenvp.2013.11.008)