

# Happiness comes Naturally: Engagement with Nature as a Route to Positive Subjective Well-Being

By Ethan A. McMahan, Western Oregon University

## Citation:

McMahan, E. A. (2018). Happiness comes naturally: Engagement with nature as a route to positive subjective well-being. In E. Diener, S. Oishi, & L. Tay (Eds.), *Handbook of well-being*. Salt Lake City, UT: DEF Publishers. DOI:nobascholar.com

## Abstract:

Empirical research consistently indicates that contact with the natural world is associated with broad psychological and physical benefit. Of particular interest are findings indicating that exposure to natural environments improves subjective well-being, suggesting that interacting with nature may be one route by which individuals may achieve and maintain a durable sense of happiness. In the current chapter, key concepts and influential theories concerning the effects of nature on well-being are described. Empirical research detailing the salutogenic effects of nature is then reviewed, with emphasis placed on four main areas of inquiry: (1) exposure to natural environments; (2) connectedness to nature and well-being; (3) physical proximity to nature; and (4) green exercise. Current limitations in the extant literature are discussed, and priorities for future research are outlined. Based on the present state of research in this domain, it is concluded that ample evidence documents the positive effects of nature on subjective well-being. However, additional research examining group differences in responses to nature, causal mechanisms accounting for the relationship between nature and well-being, and environmental factors impacting the effects of nature on well-being, among other topics, is necessary to develop a comprehensive and more nuanced understanding of the myriad ways in which happiness may be achieved through engagement with the natural world.

**Keywords:** Nature, Natural environments, Subjective well-being, Happiness

---

A large body of literature examining subjective well-being now exists, and scholars and laypeople alike are becoming more familiar with the factors that contribute to individual happiness. Of these factors, contact with nature and natural entities seems to be a particularly powerful route by which subjective well-being can be improved. For centuries, it has been observed that people experience happiness and, more broadly, positive feeling and functioning through connection with nature. Indeed, the notion that engaging with nature improves both psychological and physical well-being has been articulated in numerous ways by many notable individuals across recent history (Selhub & Logan, 2012). For example, John Muir, American naturalist and author, encouraged people to “Climb the mountains and get their good tidings,” and by doing so “nature’s peace will flow into you,” (1901). Frederick Law Olmstead, architect of Central Park in New York City, espoused the importance of nature for optimal psychological functioning, stating that “the enjoyment of [natural] scenery employs the mind without fatigue and yet exercises it; tranquilizes it and yet enlivens it,” (1865). Henry David Thoreau suggested that “we need the tonic of wilderness,” (1854) explicitly recognizing the healing powers of nature, while Edward Abbey similarly articulated a need for natural environments, noting that “wilderness is not a luxury but a necessity of the human spirit,” (1968).

Complementing and building upon the qualitative sentiments provided by well-known authors, scholars, and others regarding the importance of nature, a robust and growing body of scientific literature also indicates that contact with nature has salutary value for individual well-being. This research indicates that engaging with the natural environment is associated with increased positive affect and decreased negative affect (McMahan & Estes, 2015), higher levels of satisfaction with life (Biedenweg, Scott, &

Scott, 2017), improved cognitive functioning (Berman et al., 2012), a sense of meaning in life (Passmore & Howell, 2014a), improved physiological functioning and physical health (Bowler, Buyung-Ali, Knight, & Pullin, 2010), and increased self-esteem (Zhang, Howell, & Iyer, 2014), among other positive outcomes. Thus, although contact with nature is of course not a panacea for all ills, evidence suggests that engagement with the natural environment exerts broad positive effects on human functioning, and further empirical investigation of the effects of nature would thus seem to be an important area of positive psychological inquiry.

Despite the seeming relevance of research on the beneficial effects of contact with nature for positive psychology, development of these two areas has occurred largely in parallel with little systematic exchange or explicitly identified connection between the two fields. Research on the effects of nature has been conducted largely within the areas of environmental psychology, public health, urban planning, landscape aesthetics, and medicine (Bratman, Hamilton, & Daily, 2012), and has thus been guided by and interpreted with reference to the dominant theoretical perspectives in those fields. And although positive psychological research has focused heavily on interventions, activities, and behaviors that improve subjective well-being (e.g., gratitude exercises, practicing mindfulness; see Sin & Lyubomirsky, 2009), a dearth of this research recognizes contact with nature as a route by which individuals can increase well-being. The current chapter emphasizes the relevance of nature research for positive psychology and, more specifically, research on subjective well-being. By explicitly recognizing and integrating these two areas of research, a more comprehensive, nuanced, and accurate understanding of the role that nature plays in facilitating human well-being can be achieved.

In what follows, a brief overview of the primary theories regarding the effects of nature on psychological functioning is provided. Existing empirical literature on the effects of nature on subjective well-being is reviewed, with focus placed on four primary areas of inquiry: (1) exposure to natural environments; (2) connectedness to nature and well-being; (3) physical proximity to nature; and (4) green exercise. Limitations of the extant literature are then identified, and opportunities for research that will move the study of the beneficial effects of nature forward are described. Before turning to the above, however, working definitions of nature and subjective well-being are provided.

### **Definitions of Terms and Scope of Review**

The concept of “natural” and the more narrow definition of what makes a natural environment differ depending on history, culture, and the individual doing the defining (see Bratman et al., 2012; Proctor, 1998). Evidence suggests that what is considered to be natural is largely subjectively determined, and there is no widely-agreed upon definition of this construct. Because of this lack of clarity, the majority of research in this area has avoided explicitly labeling environments as natural versus unnatural in favor of a comparative approach whereby one environment is compared to another, with one of these environments being clearly more natural within the context of the research (e.g., a nature preserve versus a city center). Thus, “naturalness” is typically operationally defined as a matter of degree, rather than being categorically determined.

A common, perhaps key attribute of natural environments is that they contain elements of living systems, including flora and fauna. Beyond this commonality, however, natural environments are a broad and heterogeneous class of environments that can differ along several important dimensions (see Hartig, Mitchell, de Vries, & Frumkin, 2014). Natural environments can vary in their degree of human contact, management, and influence, with some natural environments being relatively free of human impact (e.g., wilderness areas) and others being created and heavily managed by humans (e.g., urban green spaces; McMahan, Cloud, Josh, & Scott, 2016). Moreover, by incorporating natural elements within built environments (e.g., placing potted plants within an office space), even artificial environments (i.e., those created by humans) can be more or less natural. To accommodate this heterogeneity, a broad definition of natural environments is adopted in the current review, where natural environments are defined as those that include a relatively high concentration of living systems, including those of both human and non-human origin, that exist across a range of scales and level of human development.

Whereas definitions of nature vary and are in some cases nebulous, definitions of subjective well-being are widely agreed upon, consistent, and precise. Subjective well-being involves subjective assessments of the nature and quality of individuals’ lives and includes both affective and cognitive components (Diener, 1984). In practice, subjective well-being is typically defined as a combination of the relative frequency of positive and negative affect and self-reported life satisfaction, with a preponderance of positive over negative affect and high life satisfaction being indicative of high subjective well-being (Diener, 2000; Diener, Suh, Lucas, & Smith, 1999). Notably, subjective well-being is domain-general in the sense that it typically concerns the quality of one’s life as a whole, rather than being reflective of satisfaction with a specific domain of functioning, and is often considered to be roughly synonymous with

the less formal term “happiness.”

Few studies have examined the effect of contact with natural environments on subjective well-being per se and instead typically focus on the effects of contact with nature on the factors that constitute subjective well-being (e.g., positive affect). Accordingly, the current review includes studies that have addressed these factors, either as a sole indicator of well-being or in combination with other positive outcomes. Additionally, while focusing on studies that assessed positive and negative affect and life satisfaction, the current review also includes literature that assessed positive outcomes that are clearly relevant to affective states (e.g., vitality), as well as cognitive assessments of well-being that are in some way conceptually similar to life satisfaction (e.g., subjective happiness).

### **Contact with Nature and Well-Being: Primary Theories**

Three primary theories provide the foundation for the majority of research examining the effects of contact with nature on well-being: the biophilia hypothesis, psychoevolutionary stress reduction theory, and attention restoration theory. The biophilia hypothesis states that ancestral humans’ well-being was integrally tied to engaging with the natural environment (e.g., for obtaining resources such as food and water), and in result, the desire to be in contact with nature was selected during our evolutionary history (Kellert & Wilson, 1995; Wilson, 1984). Despite the fact that modern humans no longer need to directly interact with nature in order to ensure survival, it is believed that we retain this deeply-engrained, biologically-based desire. Moreover, because the majority of human history took place in natural environments and regular contact with built environments is only a relatively recent development, it is predicted that people will tend to prefer and respond more positively to natural versus built environments. A number of studies provide indirect support for the biophilia hypothesis, finding that people prefer visual representations of natural environments over built environments (Kaplan, Kaplan, & Wendt, 1972; Ulrich, 1983; van den Berg, Koole, & van der Wulp, 2003) and that the preference for natural environments is observed across cultures (Newell, 1997; Ulrich, 1993) and evident from an early age (Balling & Falk, 1982; Falk & Balling, 2010; Kahn, 1997).

Psychoevolutionary stress reduction theory (SRT) similarly posits that humans evolved to respond positively to nature and states that contact with the types of environments that contain evolutionarily significant resources (e.g., those with vegetation, water sources, and expansive views) elicits a physiological and psychological response characteristic of stress reduction (Ulrich, 1979; 1981). Because natural environments, relative to built environments, contain a greater concentration of features that signal the presence of these resources, people should evince this response when in contact with nature. In support, empirical research indicates that short-term exposure to natural environments is associated with increased positive affect and decreased negative affect (Hartig, Evans, Jamner, Davis, & Garling, 2003), lower heart rate, reduced cortisol levels, and improved immune functioning (Tsunetsugu, Park, & Miyazaki, 2010), and more rapid recovery from stress inductions (Ulrich et al., 1991). Further, evidence suggests that these salutogenic effects of nature also operate over extended periods, as more positive health profiles are observed among those with a history of regular and frequent contact with nature (Korpela et al., 2017a) and those who have greater access to nature (Maas, Verheij, de Vries, Spreeuwenberg, Schellevis, & Groenewegen, 2009; Maas, Verheij, Groenewegen, de Vries, Spreeuwenberg, 2006).

Finally, attention restoration theory (ART; Kaplan, 1995) focuses primarily on cognition and proposes that modern urban environments tax directed attentional systems, which leads to cognitive fatigue and higher levels of stress and irritability. In contrast, natural environments contain a high concentration of elements that are inherently fascinating, draw on directed attentional systems only modestly, reducing cognitive load and thus allowing for both cognitive and affective restoration (see also Kaplan, 2001). In support, empirical work indicates that those exposed to natural environments show greater improvements in various aspects of both cognitive and affective functioning relative to those exposed to urban environments (Berman, Jonides, & Kaplan, 2008; Berman et al., 2012; Berto, 2005). ART also draws from evolutionary perspectives and proposes that the well-documented human preference for natural over built environments is the result of nature’s ability to reduce attentional fatigue, a process which would presumably aid in survival (Joye & van den Berg, 2011).

Although the above theories differ in several respects, they each converge on the notion that humans evolved to respond positively to nature. Notably, each of the theories predicts that contact with nature either directly or indirectly impacts aspects of subjective well-being (e.g., by increasing positive affect), suggesting that engaging and connecting with nature may be one route by which happiness can be cultivated. Evidence supporting this suggestion is provided perhaps most directly by research examining the effects of exposure to natural environments via nature interventions.

### **Empirical Findings**

**Exposure to nature and nature interventions.** Much of the research examining the various positive effects of nature has focused on the affective consequences of exposure to natural environments. As indicated by a recent meta-analysis of over 30 experimental studies conducted within the last 50 years (McMahan & Estes, 2015), exposure to natural environments, relative to built environments, is associated with both moderate increases in positive affect ( $r = .31$ ) and smaller, but consistent decreases in negative affect ( $r = -.12$ ). Similar findings were observed in a meta-analysis comparing the effects of exercise in nature versus in built environments (e.g., a gymnasium), with consistently higher levels of positive affect and lower negative affect observed among those exercising in nature (Bowler et al., 2010). More generally, each of these meta-analyses, as well as several other systematic reviews (e.g., Barton & Pretty, 2010), indicate that being in nature is associated with more positive emotional outcomes.

Importantly, findings from this area of research have been replicated under a variety of experimental conditions and within a variety of contexts. For example, positive affective outcomes have been observed following brief exposure to natural environments (Hartig et al., 2003; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; McMahan, Estes, Murfin, & Bryan, 2017; Nisbet & Zelenski, 2011), as well as after longer-term exposure to nature (Korpela et al., 2017a; Passmore & Holder, 2017; Passmore & Howell, 2014b). Similar effects have been observed among those exposed to both manicured natural environments (e.g., parks, green spaces; Berman et al., 2008; Johansson, Hartig, & Staats, 2011) and wilder, less managed environments (e.g., nature preserves; Lee, Park, Tsunetsugu, Kagawa, & Miyazaki, 2009; Lee et al., 2011). Findings further suggest that in addition to improving affective states in non-clinical samples, nature may have a therapeutic effect among those diagnosed with depression (e.g., Berman et al., 2012). Moreover, empirical evidence indicates that technologically-mediated or virtual exposure to nature (e.g., viewing images of nature or nature simulations) is also associated with improved affect (e.g., McMahan et al., 2017; Valtchanov & Ellard, 2010), although effect sizes are generally smaller than those observed following in-person exposure to real natural environments (see Kahn, Severson, & Ruckert, 2009; McMahan & Estes, 2015).

Although the bulk of the research in this area has focused on the effects of exposure to natural environments on affective state, several studies have examined other positive outcomes that result from engagement with nature. For example, engagement in outdoor activity has been found to be positively associated with satisfaction with life in multiple independent studies (e.g., Biedenweg et al., 2017; Mert, Zurnaci, C., & Akgün, 2015; Wolsko & Lindberg, 2013). In a recent study utilizing experience sampling methodology in a group of 20,000 participants, higher levels of subjective happiness were reported when participants were in natural environments versus built environments (MacKerron & Mourato, 2013). Additionally, Ryan and colleagues (2010) observed higher levels of vitality – subjective feelings of energy and vigor – when participants engaged in activities that involved nature. Notably, Ryan and colleagues also found increased vitality among participants who were instructed to simply imagine themselves in nature. Further, participation in wilderness-immersion programs has been associated with increased self-esteem, among other positive outcomes (e.g., Passarelli, Hall, & Anderson, 2010).

Given strong empirical support for the benefits of engaging with natural environments, nature-based intervention programs have been developed recently, and initial evidence suggests these programs are effective at promoting well-being. As one of the largest of such interventions, the David Suzuki Foundation's 30x30 Nature Challenge is a month-long program encouraging participants to spend 30 minutes per day in nature. Evaluations of this program indicate significant reductions in stress and improved mood and vitality among participants (Nisbet, 2014). On a smaller scale, Passmore and Holder (2017) found increased positive affect, sense of connectedness, and prosocial orientation among participants in a two-week intervention program encouraging increased attention to natural environments. The Mood Walks Initiative is a nature hiking program for older adults with serious mental illness, and preliminary findings regarding the outcomes of the program indicate higher levels of happiness and decreased anxiety among those participating in the program (Mood Walks, 2015). Additionally, a number of nature-based youth development programs have been developed, and much of the evidence suggests that these programs are effective at improving multiple facets of well-being (e.g., Collado, Staats, & Corraliza, 2013; Norton & Watt, 2014; Passarelli et al., 2010). In general, findings regarding the effectiveness of nature-based intervention programs at improving well-being are promising. However, these programs are relatively few in number, and a priority for future work should be to develop additional empirically-based programs aimed at utilizing nature as a means for promoting well-being among multiple populations.

**Connectedness to nature and subjective well-being.** A great deal of research documents the benefits of direct contact with the natural world. Complementing this research are findings indicating that the degree to which individuals report feeling connected to the natural environment is also associated with well-being. Nature connectedness is a trait-level construct reflecting the degree to which one feels this subjective connection to the natural world (Capaldi, Dopko, & Zelenski, 2014). Like other trait-level

constructs, nature connectedness is relatively stable across time and situations (Mayer & Frantz, 2004) and consistently predicts relevant outcomes, such as endorsement of pro-environmental attitudes and engagement in pro-environmental behaviors (Mayer & Frantz, 2004; Nisbet, Zelenski, & Murphy, 2009; Tam, 2013). Notably, the term nature connectedness is used broadly in the current chapter to refer to several constructs that have been offered in previous literature, such as connectedness to nature (Mayer & Frantz, 2004), nature relatedness (Nisbet et al., 2009), inclusion of nature in self (Schultz, 2001), emotional affinity towards nature (Kals, Schumacher, & Montada, 1999), connectivity to nature (Dutcher, Finley, Luloff, & Johnson, 2007), and environmental identity (Clayton & Opatow, 2003), among others (see also Capaldi et al., 2014). Although the above constructs differ in their specifics, there exists considerable conceptual overlap, and empirical findings suggest an underlying common construct (Tam, 2013).

Numerous studies have found nature connectedness to be associated with higher levels of subjective well-being. For example, when developing the Connectedness to Nature Scale (CNS), Mayer and Frantz (2004) found higher levels of life satisfaction among those who feel more connected to nature and, in later work, that nature connectedness mediated the effects of contact with nature on positive affect (Mayer et al., 2009). Zelenski and Nisbet (2014) found that after controlling for feelings of connectedness to other entities (e.g., connectedness to family, to friends), nature connectedness was positively associated with multiple indicators of well-being, such as positive affect, subjective happiness, satisfaction with life, and vitality. Similarly, while Howell, Passmore, and Buro (2013) found higher levels of happiness and emotional well-being, as well as greater meaning in life and psychological well-being, among those reporting feeling strongly connected to nature, Tam (2013) observed that multiple indicators of nature connectedness (e.g., nature relatedness, emotional affinity toward nature, etc.) were positively associated with subjective happiness, affect balance, and satisfaction with life. Indeed, the general finding that nature connectedness is positively associated with indicators of positive feeling and functioning has been replicated multiple times (e.g., Cervinka, Roderer, & Hefler, 2012; Korpela, Savonen, Anttila, Pasanen, & Ratcliffe, 2017b; Wolsko & Lindberg, 2013), and correspondingly, a recent systematic review of the relevant literature found a small, but significant association between nature connectedness and indicators of subjective well-being ( $r = .18$ ; Capaldi et al., 2014).

Given the connection between nature connectedness and subjective well-being, a number of investigators have attempted to elucidate the factors that facilitate and contribute to the development of a strong sense of connection to the natural world. One such factor seems to be early childhood experiences in nature, as those who report spending more time in nature as children tend to show higher levels of nature connectedness as adults (e.g., Ward Thompson, Aspinall, & Montarzino, 2008). For instance, research indicates that those who grew up in rural environments report higher levels of nature connectedness than their urban-raised counterparts (Hinds & Sparks, 2008). In fact, the consistently found association between childhood nature experiences and nature connectedness has led some investigators to suggest that childhood may be a sensitive period for the development of strong connections to the natural world (e.g., Orr, 1993). If this is the case, encouraging children to interact with nature and providing them with the resources to do so may be an effective strategy to increase nature connectedness and, in turn, the positive outcomes associated with feeling connected to nature.

However, the effect of frequent contact with nature on nature connectedness is not unique to earlier developmental periods, and even brief exposure to natural environments has been found to temporarily increase self-reported nature connectedness among samples of adults (e.g., Nisbet & Zelenski, 2011; Schultz, 2001; Zelenski & Nisbet, 2014). Moreover, Mayer and colleagues (2009) found that the salubrious effects of nature exposure are mediated by short-term increases in nature connectedness, indicating that feeling that one is connected to the natural world may be one mechanism by which nature positively impacts subjective well-being. Findings such as these highlight the importance of regular and frequent contact with natural environments for the development and maintenance of a strong connection to nature and, in turn, positive well-being. But, ready access to natural environments is not equally distributed, with some areas providing greater access to nature while others less so (e.g., rural versus urban environments). This disparity in nature accessibility is a critical factor in determining whether individuals can take advantage of the benefits of nature exposure, a point we now turn to in the following section.

**Nearby nature: Physical proximity to natural environments.** For many years, it has been believed that access to natural environments promotes well-being. Indeed, this belief was a primary factor motivating the development of urban park systems in many Western nations during the 19<sup>th</sup> and 20<sup>th</sup> centuries (Forbes & Kendle, 2013; Hamilton-Smith & Mercer, 1991; Walker & Duffield, 1983), and the development of green spaces within built and urban environments in the 21<sup>st</sup> century is largely the result of an increased understanding of the role that natural environments play in the facilitation of public health (Ward Thompson & Travlou, 2007). Moreover, the idea that contact with nature promotes health, broadly

conceived, has been used as justification for the preservation of natural areas outside of cities as well (Maller, Townsend, Pryor, Brown & St. Leger, 2006). In short, proposals for the development of natural areas within built environments and the preservation of natural areas outside of built environments are largely predicated on the notion that having access to and utilizing these environments will in some way improve the quality of life of nearby populations.

Given the empirical research indicating that even brief contact with nature promotes well-being, a number of studies conducted in multiple locations across the world have examined whether having ready access to natural areas, such as green spaces, parks, and wilderness reserves, is associated with positive outcomes (see Maller et al., 2006). Much of this research is epidemiological in nature and indicates in general that people with access to nearby natural settings enjoy higher levels of well-being than those without easy access to nature (Kaplan & Kaplan, 1989). For example, in a large sample of Dutch survey respondents, de Vries, Verheij, Groenewegen, and Spreeuwenberg (2003) found that percentage of greenspace (e.g., urban greenspace, agricultural greenspace, nature areas) and 'blue' space (i.e., environments with a dominant natural water feature) within three kilometers of one's residence was positively associated with higher levels of perceived health and decreased psychiatric symptoms. Similarly, physical distance from local greenspace has been found to predict self-reported stress and health, with those living more than one kilometer away from the nearest greenspace reporting higher levels of stress and decreased health-related quality of life than those who are closer to these resources (Stigsdotter et al., 2010). Moreover, long-term relocation of one's residence to an area with greater access to greenspace is associated with increased health-related well-being, while, conversely, moving to a less green area has been found to be associated with decreased well-being (Alcock, White, Wheeler, Fleming, & Depledge, 2014).

Not surprisingly given its epidemiological roots, the bulk of empirical research examining associations between access to nature and well-being has focused primarily on physical health-related outcomes, mortality, and indicators of negative functioning. However, recent work examining associations between nearby nature and indicators of positive psychological functioning has generated results similar to those presented above. For instance, data drawn from the large-scale British Household Panel Survey (BHPS) indicates that those living in urban areas with more greenspace report high levels of life satisfaction than their urban counterparts with less greenspace (White, Alcock, Wheeler, & Depledge, 2013). Similar results were observed in Berlin, Germany (Bertram & Rehdanz, 2014) and Baltimore, Maryland (Vemuri, Grove, Wilson, & Burch, 2011), with residents living in greener neighborhoods of these urban centers reporting higher levels of life satisfaction. Thus, although research addressing associations between nearby greenspace and indicators of subjective well-being is in its infancy, existing findings parallel those found in health-related fields and suggest that people psychologically benefit from living close to nature.

**Green exercise.** The specific mechanisms that account for associations between access to greenspace and improved well-being are as-of-yet unclear (see Lee & Maheswaran, 2011). However, many outdoor recreation spaces are designed to promote physical activity, and existing empirical evidence consistently indicates that regular physical activity promotes both physical and psychological well-being (Biddle & Asare, 2011; Penedo & Dahn, 2005; Scully, Kremer, Meade, Graham, & Dudgeon, 1998). Those living close to nature may therefore enjoy improved physical and psychological functioning, at least in part, because they are more physically active than those who don't have easy access to these environmental resources (e.g., Coombes, Jones, & Hillsdon, 2010; Mytton, Townsend, Rutter, & Foster, 2012). Yet, research examining whether physical activity mediates associations between greenspace access and well-being has yielded mixed results (e.g., Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008; Richardson, Pearce, Mitchell, & Kingham, 2013), suggesting a more nuanced picture of this relationship, whereby the effects of greenspace access on both physical activity and health depend on various characteristics of both the environment (e.g., greenspace quality, safety) and the person (e.g., age, gender).

Despite this ambiguity, other research clearly indicates that simply being active in nature, whether walking, jogging, or engaging in strenuous physical activity, improves feeling and functioning (e.g., Mitchell, 2013; Pretty et al., 2007). Further, green exercise (i.e., exercising in the natural environment) has been found to yield greater benefits than exercising in built or synthetic environments (e.g., Pretty, Peacock, Sellens, & Griffin, 2005), and among natural environments, higher degrees of perceived environmental greenness are associated with more positive outcomes (Mackay & Neill, 2010). In one recent meta-analysis, Bowler and colleagues (2010) found small to moderate effects of physical activity environment on several distinct affective states (e.g., anger, sadness;  $d$  range = .23-.76), where exercising in nature was associated with more positive affective outcomes than exercising in built environments. Additionally, in a multistudy synthesis ( $n = 1252$ ) of research examining the effects of physical activity in nature using simple pretest-posttest designs, Barton and Pretty (2010) found that being active in nature was associated with moderate improvements in both self-esteem ( $d = .46$ ) and mood ( $d = .54$ ). In yet another systematic review, exercising in nature, relative to exercising indoors, was found to be associated with

increased feelings of revitalization, positive engagement, and energy, as well as decreased tension, confusion, anger, and depression (Thompson Coon et al., 2011). Findings such as these suggest a synergistic effect of exercise and exposure to nature, where being physically active and engaging with the natural environment produces more positive outcomes than participating in either activity alone (see Pretty et al., 2005).

Notably, the effects of green exercise on indicators of subjective well-being vary depending on environmental and individual characteristics and the nature of the activity (e.g., duration). For example, larger effects are observed in natural environments that include a prominent water feature, and some evidence suggests that the effects of green exercise are more pronounced among younger adults, men, and clinical populations (Barton & Pretty, 2010). Additionally, the effects of green exercise are particularly pronounced after short visits to natural environments (approximately 30 minutes), although further but more modest improvements in well-being are observed for visits of longer duration (Barton & Pretty, 2010; see also Shanahan et al., 2016). Despite requiring little time for marked improvements in well-being, those who exercise outside, relative to those who primarily exercise in synthetic environments, report greater frequency and duration of exercise (Hug, Hartig, Hansmann Seeland & Hornung, 2009). And, outdoor exercise is associated with higher levels of enjoyment and lower levels of perceived exertion when compared to indoor exercise, despite comparable levels of physiological activity (Akers et al., 2012; Kinnafick & Thøgersen-Ntoumani, 2014). In short, being active in nature requires little time commitment, is more enjoyable, and perceived as less physically taxing than exercising indoors. As a result, green exercise may be a relatively expedient and self-reinforcing activity that effectively improves both physical and psychological functioning, thus representing one promising avenue by which sustainable improvements in well-being can be achieved.

### **Remaining Questions and Opportunities for Future Research**

As the above review indicates, existing research now provides convincing evidence that contact with natural environments promotes positive psychological functioning and higher levels of subjective well-being. However, this area of inquiry suffers from several general limitations that should be addressed in future research in order to gain a more accurate understanding of the ways in which contact with nature produces its salubrious effects. These are (1) a lack of definitional clarity and measurement consistency of major relevant constructs, (2) limited knowledge of group differences, and (3) unclear causal mechanisms. Each of these limitations are described in turn below.

**Definitions and consistent measurement.** There is a lack of consensus with respect to defining of the primary constructs under investigation, and correspondingly, there exists a high degree of variability in how these constructs are manipulated and/or measured. This is perhaps most obvious, as noted previously, when it comes to defining what it means when we use the terms “nature” or “natural,” as these concepts have been defined in manifold ways. Although disagreements regarding appropriate definitions of these constructs might seem like academic squabbling, the absence of broad consensus has allowed the use of several different types of “natural” environments in the empirical literature (e.g., urban greenspace, wilderness areas, campus gardens), and there exists both theoretical and empirical evidence suggesting that exposure to different types of natural environments may differentially impact well-being (e.g., McMahan et al., 2016). However, a paucity of research has explicitly recognized these differences, thus leading to a state of relative ignorance concerning how different natural environments may impact well-being. Developing agreed-upon definitions of “nature” and “natural” that clearly delineate the key factors that constitute these concepts will facilitate more finely-tuned distinctions between different types of natural environments and a higher level of precision when assessing the effects of these environments. In result, a more nuanced understanding of what type of nature works best for improving well-being may be realized.

Relatedly, there exists a high degree of heterogeneity in how well-being and, in particular, indicators of positive psychological functioning are defined and measured in the relevant literature. For example, affective state has been assessed using a multitude of instruments, including the Profile of Mood States (POMS; see Norcross, Guadagnoli, & Prochaska, 1984), the Positive and Negative Affective Schedule (PANAS; Watson, Clark, & Tellegen, 1988), and the Zuckerman Inventory of Personal Reactions (ZIPERS; Zuckerman, 1977), among others. Critically, these instruments differ with respect to their emphasis on positive versus negative affect and the distinct affects assessed, and evidence suggests that associations between nature exposure and affect varies depending on which instrument is used (Capaldi et al., 2014; McMahan & Estes, 2015). This issue is compounded when examining broader constructs, such as psychological functioning, which have been operationalized in many different ways. This state of affairs introduces a high degree of variability in quantitative syntheses of the existing studies and precludes accurate and precise estimates of the size of the effect of nature on a particular outcome. Accordingly, future research should attempt to address this limitation by attempting to maintain consistency in the measurement of specific outcomes.

**Group differences.** A second limitation concerns the origins and demographics of the samples that are frequently used in this area of research. The majority of studies across all areas reviewed in the current chapter have been conducted on those from relatively affluent, industrialized, Western nations. This is problematic as evidence suggests that cultures differ in how they conceptualize the relationship between humans and nature (e.g., Bang, Medin, & Atran, 2007; Unsworth et al., 2012), and nation-level mean differences in nature connectedness have been observed (Tam, 2013). These culture-related differences no doubt impact how individuals respond to the natural environment and suggest that the benefit of exposure to nature may vary depending on cultural context. Accordingly, future research should attempt to replicate the current findings using samples from diverse cultural and national backgrounds.

Additionally, much of the research, particularly experimental studies examining the effects of contact with nature (e.g., Mayer et al., 2009) as well as studies examining associations between nature connectedness and well-being (e.g., Zelenski & Nisbet, 2014), has relied primarily on university student samples that are quite homogenous in demographic characteristics, thus limiting the ability to generalize corresponding findings to other populations. However, evidence from epidemiological research examining the effects of greenspace access suggests that some demographic groups may benefit from provision of and exposure to nature to a greater degree than others. For example, younger and older adults have been found to benefit more from greenspace access than middle-aged adults (Kaczynski, Potwarka, Smale, & Havitz, 2009; Maas et al., 2009), associations between greenspace exposure and health are stronger for non-Hispanic Whites relative to other ethnic groups (Kerr, Frank, Sallis, & Chapman, 2007; Scott, Dubowitz, & Cohen, 2009), greenspace access has a stronger impact on the health of lower income groups relative to those with higher incomes (Babey, Hastert, Yu, & Brown, 2008; Maas et al., 2006), and those living in urban areas seem to respond more positively to nearby nature than those living in rural environments (Lachowycz & Jones, 2013). Although suggestive, the above findings are limited in their emphasis on greenspace access, their correlational nature, and their focus on physical health-related outcomes, and corresponding findings generated from experimental research examining potential group differences in the effects of nature exposure on positive psychological outcomes does not exist. A priority for future research in this area is thus to examine how contact with nature psychologically benefits individuals from varying demographic groups.

**Causal mechanisms.** A dearth of research has addressed potential mechanisms that mediate the effects of nature on well-being, and in result, we know relatively little about how nature exerts its salubrious effects nor the routes by which it does so. Of course, the mechanisms by which nature might affect well-being are numerous and synergistic, and the conditions under which specific mechanisms are elicited and exert their effects likely varies depending on environmental context, an individual's current state of functioning, as well as personal dispositions. A key step moving forward is thus to investigate these potential mechanisms and the situations in which they take on significance in order to develop a more nuanced understanding of the ways in which nature does and doesn't impact psychological well-being.

With that said, several factors represent likely candidates for mechanisms that bridge the divide between nature and happiness. One such mechanism may be the emotion of awe. Awe is defined as an emotional response to perceptually vast stimuli that overwhelm current mental structures (Keltner & Haidt, 2003), and exposure to nature, particularly extraordinary nature (e.g., one involving an expansive view of a large mountain range) is suggested to be a key elicitor of this response (Shiota, Keltner, & Mossman, 2007). Critically, those who experience awe report higher levels of life satisfaction (Rudd, Vohs, & Aaker, 2012), and contact with natural environments may therefore improve life satisfaction via this emotional response. Indirect support for this prediction comes from research examining the differential effects of exposure to particularly beautiful or awesome natural scenes (i.e., those most likely to elicit awe) versus more mundane natural environments, where those exposed to extraordinary nature responded more positively than those exposed to mundane nature (Joye & Bolderdijk, 2015). However, additional research specifically addressing whether awe mediates the association between nature exposure and well-being is still needed.

A related potential mechanism is meaning in life. The experience of meaning in life involves an understanding of who we are, what the world is like, and how we fit in to the grand scheme of things (Steger, 2012) and is consistently associated with higher levels of multiple indicators of well-being (Steger, 2017; Zika & Chamberlain, 1992). Meaning in life results from transcendent experiences (Emmons, 2005) and believing that one's life fits in within a larger context or plan (Wong, 2010), and nature experiences likely facilitate a sense of meaning by providing a salient reminder of one's place in the world and a means by which individuals can connect to something larger than the self. In support, experiences in nature have been found to be a significant source of meaning among adults (O'Connor & Chamberlain, 1996; Reker & Woo, 2011). Additionally, meaning in life has been found to mediate associations between dispositional nature connectedness and well-being (Howell et al., 2013). However, to date, research has not addressed



whether the beneficial effects of contact with nature result, at least in part, from increased subjective sense of meaning, and additional experimental research addressing whether brief nature experiences elevate sense of meaning and, in turn, well-being should be pursued.

Positive social experiences are yet another likely mechanism mediating associations between nature and well-being. Several lines of research indicate that natural environments are one context in which social interactions are facilitated and existing relationships are strengthened (e.g., Coley, Kuo, & Sullivan, 1997), and the cultivation and maintenance of positive relationships with others is considered to be a key component of optimal human feeling and functioning (Keyes, 1998; Ryff & Singer, 1998). Indeed, feeling connected to others has been suggested to be a psychological need (Ryan & Deci, 2000). Importantly, the availability of high quality natural environments has been found to contribute to both social cohesion and self-reported health (de Vries, van Dillen, Groenewegen, & Spreeuwenberg, 2013), and one study conducted in the Puget Sound region of Washington State, indicated that positive social experiences mediated associations between frequency of outdoor recreation and self-reported life satisfaction (Biedenweg et al., 2017). Moreover, Zelenski, Dopko, and Capaldi (2015) found that brief nature exposure increased cooperative behavior, potentially identifying one mechanism by which nature may promote positive social interactions. Yet, as above, experimental research specifically examining whether positive social experiences mediate associations between contact with nature and subjective well-being are lacking, and addressing whether this is the case represents a potentially fruitful area of future inquiry.

Addressing the mechanisms that account for associations between greenspace accessibility and well-being is a particularly complicated task, as these areas could potentially serve many different functions for many different individuals. In fact, these spaces are often intentionally designed to serve a broad section of the local population by providing a diversity of resources and affordances (Eysenbach, 2008). For example, a greenspace may provide opportunities for physical activity (e.g., an extensive path system), quiet places to relax (e.g., solitary benches next to a pond), places to engage in social interaction (e.g., a picnic area), cultural experiences (e.g., a pavilion), and so forth. They may also provide less obvious but beneficial resources, such as better air quality (see Hartig et al., 2014). Utilizing these resources may then in turn positively influence both physical and psychological functioning to varying degrees, depending on the nature of the activity in question. Additionally, it is likely that individual-level characteristics (e.g., dispositions, acute states of functioning) impact the significance and utilization of these resources. For instance, a quiet place to relax may be particularly valuable for an individual who is experiencing significant work-related stress, and utilization of this resource may be particularly important and impactful for stressed individuals versus those who are not experiencing significant stress. In support, a number of empirical studies indicate that the positive effects of passive nature exposure are particularly pronounced for those in need of psychological restoration (see van den Berg, Hartig, & Staats, 2007). Taken together, the above indicates that not only should research consider the mechanisms by which nature improves well-being, but also the conditions under which it does so.

**Other questions.** The above identifies a few major limitations in the current literature concerning the effect of natural environments on well-being. But, this is by no means an exhaustive account of these limitations, and there exist many other questions that should be addressed in order to develop a more complete understanding of the role that nature plays in the promotion of positive human feeling and functioning. For example, most of the existing research has exposed participants to pleasant natural environments (e.g., nature preserves) or natural environments specifically designed for human use (e.g., urban greenspaces), and in result, less is known about how unpleasant natural environments and those that are not well-suited to human use and habitation affect well-being. Similarly, how individuals' well-being is affected by different natural environs (e.g., boreal forests, deserts, temperate rainforests) is unclear. While a substantial amount of research documents preferences among different natural environments, finding that individuals tend to prefer savannah-like environments, those that contain water features, and familiar natural environments (e.g., Falk & Balling, 2010), little research has addressed whether exposure to these environments differentially benefits individuals. In a related vein, a dearth of research examines variability in outcomes associated with exposure to different built environments. Like natural environments, built environments are a heterogeneous class of environments that differ in many respects (e.g., a parking lot versus an outdoor mall). These differences are likely of practical import when investigating the manner in which a given built environment may or may not impact psychological functioning.

While a great deal of research documents the short-term effects of nature exposure on indicators of subjective well-being, limited research has addressed the potential long-term effects of repeated or frequent nature exposure. That which does exist has done so using retrospective or cross-sectional research designs, thus precluding firm conclusions regarding causality. Relatedly, at current, we know relatively little regarding how long the effects of nature last, the ideal dose of nature, the degree to which person-related factors impact the effects of nature, or how more specific elements within natural environments (e.g., low-

level visual features) enhance or perhaps hinder these effects. The rigorous investigation of these questions, as well as those presented above, should take the forefront in future research in this area.

### Final Remarks

Despite the above-listed gaps in relevant research, the existing empirical evidence unambiguously indicates that contact with natural environments in some way positively impacts human feeling and functioning. These findings thus validate the literary and artistic sentiments of those who have across history espoused the importance of nature for our happiness. Relative to previous generations however, people are now spending less time in nature (Clements, 2004; Hofferth, 2009; Soga & Gaston, 2016) and the majority of their daily lives indoors (MacKerron & Mourato, 2013). In result, the myriad benefits of interacting with nature go largely unrecognized and thus unrealized (see Nisbet & Zelenski, 2011). The vast majority of individuals have access to some form of nature, be it a local park, a large urban greenspace, or a national forest, and utilizing these resources seems to be a relatively easy and low-cost means by which subjective well-being can be improved. Indeed, mental health practitioners are becoming increasingly aware of the potential clinical importance of natural environments, and applied research focusing on the promotion of mental health via exposure to nature is therefore likely to be in increasing demand (Mantler & Logan, 2015). Moreover, evidence suggests that interaction with nature promotes conservation-oriented behaviors (e.g., Zelenski et al., 2015). Engaging the natural world and regularly visiting natural environments may therefore promote positive behaviors aimed at improving the well-being of our planet, in addition to providing an effective route by which individual happiness and positive human health can be achieved.

### References

- Abbey, E. (1968). *Desert solitaire: A season in the wilderness*. New York, NY: McGraw-Hill.
- Akers, A., Barton, J., Cossey, R., Gainsford, P., Griffin, M., & Micklewright, D. (2012). Visual color perception in green exercise: Positive effects on mood and perceived exertion. *Environmental Science & Technology*, 46(16), 8661-8666. doi:10.1021/es301685g
- Alcock, I., White, M. P., Wheeler, B. W., Fleming, L. E., & Depledge, M. H. (2014). Longitudinal effects on mental health of moving to greener and less green urban areas. *Environmental Science & Technology*, 48(2), 1247-1255. doi:10.1021/es403688w
- Babey, S. H., Hastert, T. A., Yu, H., & Brown, E. R. (2008). Physical activity among adolescents: When do parks matter?. *American Journal of Preventive Medicine*, 34(4), 345-348. <https://doi.org/10.1016/j.amepre.2008.01.020>
- Balling, J. D., & Falk, J. H. (1982). Development of visual preference for natural environments. *Environment and Behavior*, 14(1), 5-28. doi:10.1177/0013916582141001
- Bang, M., Medin, D. L., & Atran, S. (2007). Cultural mosaics and mental models of nature. *Proceedings of the National Academy of Sciences*, 104(35), 13868-13874. doi:10.1073/pnas.0706627104
- 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
- Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, 19(12), 1207-1212. doi:10.1111/j.1467-9280.2008.02225.x
- 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. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology*, 25(3), 249-259. <https://doi.org/10.1016/j.jenvp.2005.07.001>
- Bertram, C., & Rehdanz, K. (2014). The role of urban green space for human well-being. *Kiel Working Paper, 1911*. <http://hdl.handle.net/10419/94356>
- Biddle, S. J. H., & Asare, M. (2011). Physical activity and mental health in children and adolescents: A review of reviews. *British Journal of Sports Medicine*, 45, 886-895. <http://dx.doi.org/10.1136/bjsports-2011-090185>
- Biedenweg, K., Scott, R. P., & Scott, T. A. (2017). How does engaging with nature relate to life satisfaction? Demonstrating the link between environment-specific social experiences and life satisfaction. *Journal of Environmental Psychology*, 50, 112-124. <https://doi.org/10.1016/j.jenvp.2017.02.002>

- Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*, *10*, 456. doi:10.1186/1471-2458-10-456
- Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences*, *1249* (1), 118-136. doi:10.1111/j.1749-6632.2011.06400.x
- Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in Psychology*, *5*, 976. doi:10.3389/fpsyg.2014.009762524999210.3389/fpsyg.2014.00976
- Cervinka, R., Röderer, K., & Hefler, E. (2012). Are nature lovers happy? On various indicators of well-being and connectedness with nature. *Journal of Health Psychology*, *17*(3), 379-388. <https://doi.org/10.1177/1359105311416873>
- Clayton, S. D., & Opatow, S. (Eds.). (2003). *Identity and the natural environment: The psychological significance of nature*. Boston, MA: MIT Press.
- Clements, R. (2004). An investigation into the status of outdoor play. *Contemporary Issues in Early Childhood*, *5*, 68-80. doi: 10.2304/ciec.2004.5.1.10
- Coley, R. L., Kuo, F. E., & Sullivan, W. C. (1997). Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior*, *29*(4), 468-494. doi:10.1177/001391659702900402
- Collado, S., Staats, H., & Corraliza, J. A. (2013). Experiencing nature in children's summer camps: Affective, cognitive and behavioural consequences. *Journal of Environmental Psychology*, *33*, 37-44. <https://doi.org/10.1016/j.jenvp.2012.08.002>
- Coombes, E., Jones, A. P., & Hillsdon, M. (2010). The relationship of physical activity and overweight to objectively measured green space accessibility and use. *Social Science & Medicine*, *70*(6), 816-822. <https://doi.org/10.1016/j.socscimed.2009.11.020>
- de Vries, S., van Dillen, S. M., Groenewegen, P. P., & Spreeuwenberg, P. (2013). Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. *Social Science & Medicine*, *94*, 26-33. <https://doi.org/10.1016/j.socscimed.2013.06.030>
- 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*, *35*(10), 1717-1731. <https://doi.org/10.1068/a35111>
- Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, *95*(3), 542-575. doi:10.1037/0033-2909.95.3.542
- Diener, E. (2000). Subjective well-being: The science of happiness and a proposal for a national index. *American Psychologist*, *55*(1), 34-43. doi:10.1037/0003-066X.55.1.34
- Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, *125*(2), 276. doi:10.1037/0033-2909.125.2.276
- Dutcher, D. D., Finley, J. C., Luloff, A. E., & Johnson, J. B. (2007). Connectivity with nature as a measure of environmental values. *Environment and Behavior*, *39*(4), 474-493. <https://doi.org/10.1177/0013916506298794>
- Emmons, R. A. (2005). Striving for the sacred: Personal goals, life meaning, and religion. *Journal of Social Issues*, *61*(4), 731-745. doi:10.1111/j.1540-4560.2005.00429.x
- Eysenbach, M. (2008). Park system function and services. *From recreation to re-creation*. American Planning Association. Retrieved from: <https://www.planning.org/publications/report/9026875/>
- Falk, J. H., & Balling, J. D. (2010). Evolutionary influence on human landscape preference. *Environment and Behavior*, *42*(4), 479-493. doi:10.1177/0013916509341244
- Forbes, S., & Kendle, T. (2013). *Urban nature conservation: Landscape management in the urban countryside*. Oxford, UK: Taylor & Francis.
- Hamilton-Smith, E., & Mercer, D. (1991). *Urban parks and their visitors*. The Parks Division, Melbourne and Metropolitan Board of Works. pp. 1-79.
- Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology*, *23*(2), 109-123. doi:10.1016/S0272-4944(02)00109-3

- Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health, 35*, 207-228.
- Hinds, J., & Sparks, P. (2008). Engaging with the natural environment: The role of affective connection and identity. *Journal of Environmental Psychology, 28*(2), 109-120. <https://doi.org/10.1016/j.jenvp.2007.11.001>
- Hofferth, S. L. (2009). Changes in American children's time – 1997 to 2003. *Electronic International Journal of Time Use Research, 6*, 26-47. doi: 10.1016/S1040-2608(01)80011-3
- Howell, A. J., Passmore, H. A., & Buro, K. (2013). Meaning in nature: Meaning in life as a mediator of the relationship between nature connectedness and well-being. *Journal of Happiness Studies, 14*(6), 1681-1696. <https://doi.org/10.1007/s10902-012-9403-x>
- Hug, S. M., Hartig, T., Hansmann, R., Seeland, K., & Hornung, R. (2009). Restorative qualities of indoor and outdoor exercise settings as predictors of exercise frequency. *Health & Place, 15*(4), 971-980. <https://doi.org/10.1016/j.healthplace.2009.03.002>
- Johansson, M., Hartig, T., & Staats, H. (2011). Psychological benefits of walking: Moderation by company and outdoor environment. *Applied Psychology: Health and Well-Being, 3*(3), 261-280. doi:10.1111/j.1758-0854.2011.01051.x
- Joye, Y., & Bolderdijk, J. W. (2015). An exploratory study into the effects of extraordinary nature on emotions, mood, and prosociality. *Frontiers in Psychology, 5*, 1577. <https://doi.org/10.3389/fpsyg.2014.01577>
- 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. <https://doi.org/10.1016/j.ufug.2011.07.004>
- Kaczynski, A. T., Potwarka, L. R., Smale, B. J., & Havitz, M. E. (2009). Association of parkland proximity with neighborhood and park-based physical activity: Variations by gender and age. *Leisure Sciences, 31*(2), 174-191. <https://doi.org/10.1080/01490400802686045>
- Kahn Jr., P. H. (1997). Developmental psychology and the biophilia hypothesis: Children's affiliation with nature. *Developmental Review, 17*, 1-61. <http://dx.doi.org/10.1006/drev.1996.0430>
- Kahn Jr., P. H., Severson, R. L., & Ruckert, J. H. (2009). Technological nature—and the problem when good enough becomes good. In M. Drenthen, F. Keulartz, & J. Proctor (Eds.) *New visions of nature* (pp. 21-40). Springer Netherlands. [https://doi.org/10.1007/978-90-481-2611-8\\_2](https://doi.org/10.1007/978-90-481-2611-8_2)
- Kals, E., Schumacher, D., & Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environment and Behavior, 31*(2), 178-202. <https://doi.org/10.1177/00139169921972056>
- Kaplan, R. (2001). The nature of the view from home: Psychological benefits. *Environment and Behavior, 33*(4), 507-542. doi:10.1177/00139160121973115
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. New York, NY: Cambridge University Press.
- Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169-182. doi:10.1016/0272-4944(95)90001-2
- Kaplan, S., Kaplan, R., & Wendt, J. S. (1972). Rated preference and complexity for natural and urban visual material. *Perception and Psychophysics, 12*, 354-356. <http://dx.doi.org/10.3758/BF03207221>
- Kellert, S. R., & Wilson, E. O. (Eds.) (1995). *The biophilia hypothesis*. Washington, DC: Island Press.
- Keltner, D., & Haidt, J. (2003). Approaching awe, a moral, spiritual, and aesthetic emotion. *Cognition & Emotion, 17*(2), 297-314. <https://doi.org/10.1080/02699930302297>
- Kerr, J., Frank, L., Sallis, J. F., & Chapman, J. (2007). Urban form correlates of pedestrian travel in youth: Differences by gender, race-ethnicity and household attributes. *Transportation Research Part D: Transport and Environment, 12*(3), 177-182. <https://doi.org/10.1016/j.trd.2007.01.006>
- Keyes, C. M. (1998). Social well-being. *Social Psychology Quarterly, 61*(2), 121-140. doi:10.2307/2787065
- Kinnafick, F. E., & Thøgersen-Ntoumani, C. (2014). The effect of the physical environment and levels of activity on affective states. *Journal of Environmental Psychology, 38*, 241-251. <https://doi.org/10.1016/j.jenvp.2014.02.007>
- Korpela, K., Nummi, T., Lipiäinen, L., De Bloom, J., Sianoja, M., Pasanen, T., & Kinnunen, U. (2017a). Nature exposure predicts well-being trajectory groups among employees across two years. *Journal of*

- Environmental Psychology*, 52, 81-91. <https://doi.org/10.1016/j.jenvp.2017.06.002>
- Korpela, K., Savonen, E. M., Anttila, S., Pasanen, T., & Ratcliffe, E. (2017b). Enhancing wellbeing with psychological tasks along forest trails. *Urban Forestry & Urban Greening*, 26, 25-30. <https://doi.org/10.1016/j.ufug.2017.06.004>
- Lachowycz, K., & Jones, A. P. (2013). Towards a better understanding of the relationship between greenspace and health: Development of a theoretical framework. *Landscape and Urban Planning*, 118, 62-69. <https://doi.org/10.1016/j.landurbplan.2012.10.012>
- Lee, A. C., & Maheswaran, R. (2011). The health benefits of urban green spaces: A review of the evidence. *Journal of Public Health*, 33(2), 212-222. <https://doi.org/10.1093/pubmed/fdq068>
- Lee, J., Park, B., Tsunetsugu, Y., Kagawa, T., & Miyazaki, Y. (2009). Restorative effects of viewing real forest landscapes, based on a comparison with urban landscapes. *Scandinavian Journal of Forest Research*, 24, 227-234. doi:10.1080/02827580902903341
- Lee, J. J., Park, B. J., Tsunetsugu, Y. Y., Ohira, T. T., Kagawa, T. T., & Miyazaki, Y. 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
- Maas, J., Verheij, R. A., de Vries, S., Spreeuwenberg, P., Schellevis, F. G., & Groenewegen, P. P. (2009). Morbidity is related to a green living environment. *Journal of Epidemiology & Community Health*, 63(12), 967-973. <http://dx.doi.org/10.1136/jech.2008.079038>
- Maas, J., Verheij, R. A., Groenewegen, P. P., De Vries, S., & Spreeuwenberg, P. (2006). Green space, urbanity, and health: How strong is the relation?. *Journal of Epidemiology & Community Health*, 60(7), 587-592. <http://dx.doi.org/10.1136/jech.2005.043125>
- Maas, J., Verheij, R. A., Spreeuwenberg, P., & Groenewegen, P. P. (2008). Physical activity as a possible mechanism behind the relationship between green space and health: A multilevel analysis. *BMC Public Health*, 8(1), 206. <https://doi.org/10.1186/1471-2458-8-206>
- Mackay, G. J., & Neill, J. T. (2010). The effect of "green exercise" on state anxiety and the role of exercise duration, intensity, and greenness: A quasi-experimental study. *Psychology of Sport and Exercise*, 11(3), 238-245. <https://doi.org/10.1016/j.psychsport.2010.01.002>
- MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change*, 23(5), 992-1000. <https://doi.org/10.1016/j.gloenvcha.2013.03.010>
- Maller, C., Townsend, M., Pryor, A., Brown, P., & St Leger, L. (2006). Healthy nature healthy people: 'Contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International*, 21(1), 45-54. <https://doi.org/10.1093/heapro/dai032>
- Mantler, A., & Logan, A. C. (2015). Natural environments and mental health. *Advances in Integrative Medicine*, 2, 5-12. <http://dx.doi.org/10.1016/j.aimed.2015.03.002>
- Mayer, F. S., & Frantz, C. M. (2004). The Connectedness to Nature Scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, 24(4), 503-515. doi:10.1016/j.jenvp.2004.10.001
- Mayer, F., 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
- McMahan, E. A., Cloud, J. M., Josh, P., & Scott, M. (2016). Nature with a human touch: Human-induced alteration negatively impacts perceived naturalness and preferences for natural environments. *Ecopsychology*, 8(1), 54-63. <https://doi.org/10.1089/eco.2015.0068>
- McMahan, E. A., & Estes, D. (2015). The effect of contact with natural environments on positive and negative affect: A meta-analysis. *The Journal of Positive Psychology*, 10(6), 507-519. doi:10.1080/17439760.2014.994224
- McMahan, E. A., Estes, D., Murfin, J., & Bryan, C. (2017, under review). Nature connectedness moderates the effect of nature exposure on explicit and implicit measures of emotion.
- Mert, M., Zurnacı, C., & Akgün, E. (2015). An evaluation of outdoor activities on life satisfaction: An application of propensity score matching of a case in Turkey. *Journal of Life Economics*, 3, 1-20. doi: <http://dx.doi.org/10.15637/jlecon.51>
- Mitchell, R. (2013). Is physical activity in natural environments better for mental health than physical activity in other environments?. *Social Science & Medicine*, 91, 130-134. <https://doi.org/10.1016/j.socscimed.2012.04.012>

- Mood Walks. (2015). *Mood Walks for older adults: An Ontario pilot project*. Retrieved from: <http://www.moodwalks.ca/wordpress/wp-content/uploads/2015/04/CMHA-Mood-Walks-Evaluation-Summary.pdf>
- Muir, J. (1901). *Our national parks*. Boston, MA: Houghton, Mifflin, and Company.
- Mytton, O. T., Townsend, N., Rutter, H., & Foster, C. (2012). Green space and physical activity: An observational study using Health Survey for England data. *Health & Place, 18*(5), 1034-1041. <https://doi.org/10.1016/j.healthplace.2012.06.003>
- Newell, P. B. (1997). A cross-cultural examination of favorite places. *Environment and Behavior, 29*, 495-514. <http://dx.doi.org/10.1177/001391659702900403>
- Nisbet, E. K. (2014). *Canadians connect with nature and increase their well-being: Results of the 2014 David Suzuki Foundation 30x30 Nature Challenge*.
- Nisbet, E. K., & Zelenski, J. M. (2011). Underestimating nearby nature: Affective forecasting errors obscure the happy path to sustainability. *Psychological Science, 22*(9), 1101-1106. doi:10.1177/0956797611418527
- Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The Nature Relatedness Scale: Linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior, 41*(5), 715-740. doi:10.1177/0013916508318748
- Norcross, J. C., Guadagnoli, E., & Prochaska, J. O. (1984). Factor structure of the Profile of Mood States (POMS): Two partial replications. *Journal of Clinical Psychology, 40*(5), 1270-1277. doi:10.1002/1097-4679(198409)40:5<1270::AID-JCLP2270400526>3.0.CO;2-7
- Norton, C. L., & Watt, T. T. (2014). Exploring the impact of a wilderness-based positive youth development program for urban youth. *Journal of Experiential Education, 37*(4), 335-350. <https://doi.org/10.1177/1053825913503113>
- O'Connor, K., & Chamberlain, K. (1996). Dimensions of life meaning: A qualitative investigation at midlife. *British Journal of Psychology, 87*, 461-477. doi:10.1111/j.2044-8295.1996.tb02602.x
- Olmstead, F. L. (1865). *The Yosemite Valley and the Mariposa Grove of Big Trees: A preliminary report*. San Francisco, CA: The Yosemite Conservancy.
- Orr, D. W. (1993). Love it or lose it: The coming biophilia revolution. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 415-440). Washington, DC: Island Press.
- Passarelli, A., Hall, E., & Anderson, M. (2010). A strengths-based approach to outdoor and adventure education: Possibilities for personal growth. *Journal of Experiential Education, 33*(2), 120-135. <https://doi.org/10.1177/105382591003300203>
- Passmore, H. A., & Holder, M. D. (2017). Noticing nature: Individual and social benefits of a two-week intervention. *The Journal of Positive Psychology, 12*(6), 537-546. <http://dx.doi.org/10.1080/17439760.2016.1221126>
- Passmore, H., & Howell, A. J. (2014a). Eco-existential positive psychology: Experiences in nature, existential anxieties, and well-being. *The Humanistic Psychologist, 42*, 370-388. <http://dx.doi.org/10.1080/08873267.2014.920335>
- Passmore, H., & Howell, A. J. (2014b). Nature involvement increases hedonic and eudaimonic well-being: A two-week experimental study. *Ecopsychology, 6*(3), 148-154. <https://doi.org/10.1089/eco.2014.0023>
- Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*(2), 189-193.
- 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. <https://doi.org/10.1080/09640560601156466>
- Pretty, J., Peacock, J., Sellens, M., & Griffin, M. (2005). The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research, 15*(5), 319-337. <https://doi.org/10.1080/09603120500155963>
- Proctor, J. D. (1998). The social construction of nature: Relativist accusations, pragmatist and critical realist responses. *Annals of the Association of American Geographers, 88*(3), 352-376. <http://dx.doi.org/10.1111/0004-5608.00105>
- Reker, G. T., & Woo, L. C. (2011). Personal meaning orientations and psychosocial adaptation in older

adults. *SAGE Open*. doi:10.1177/2158244011405217.

Richardson, E. A., Pearce, J., Mitchell, R., & Kingham, S. (2013). Role of physical activity in the relationship between urban green space and health. *Public Health*, 127(4), 318-324. <https://doi.org/10.1016/j.puhe.2013.01.004>

Rudd, M., Vohs, K. D., & Aaker, J. (2012). Awe expands people's perception of time, alters decision making, and enhances well-being. *Psychological Science*, 23(10), 1130-1136. <https://doi.org/10.1177/0956797612438731>

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68. <http://dx.doi.org/10.1037/0003-066X.55.1.68>

Ryan, R. M., Weinstein, N., Bernstein, J., Brown, K., 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

Ryff, C. D., & Singer, B. (1998). The contours of positive human health. *Psychological Inquiry*, 9(1), 1-28. doi:10.1207/s15327965pli0901\_1

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology*, 21(4), 327-339. <https://doi.org/10.1006/jevp.2001.0227>

Scott, M. M., Dubowitz, T., & Cohen, D. A. (2009). Regional differences in walking frequency and BMI: What role does the built environment play for Blacks and Whites?. *Health & Place*, 15(3), 897-902. <https://doi.org/10.1016/j.healthplace.2009.02.010>

Scully, D., Kremer, J., Meade, M. M., Graham, R., & Dudgeon, K. (1998). Physical exercise and psychological well-being: A critical review. *British Journal of Sports Medicine*, 32(2), 111-120. <http://dx.doi.org/10.1136/bjism.32.2.111>

Selhub, E. M., & Logan, A. C. (2012). *Your brain on nature: The science of nature's influence on your health, happiness, and vitality*. Mississauga, Ontario: Wiley.

Shanahan, D. F., Bush, R., Gaston, K. J., Lin, B. B., Dean, J., Barber, E., & Fuller, R. A. (2016). Health benefits from nature experiences depend on dose. *Scientific Reports*, 6, 28551. doi:10.1038/srep28551

Shiota, M. N., Keltner, D., & Mossman, A. (2007). The nature of awe: Elicitors, appraisals, and effects on self-concept. *Cognition & Emotion*, 21(5), 944-963. <https://doi.org/10.1080/02699930600923668>

Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of Clinical Psychology*, 65(5), 467-487. doi: 10.1002/jclp.20593

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

Steger, M. F. (2012). Experiencing meaning in life: Optimal functioning at the nexus of well-being, psychopathology, and spirituality. In P. P. Wong, P. P. Wong (Eds.), *The human quest for meaning: Theories, research, and applications* (pp. 165-184). New York, NY, US: Routledge/Taylor & Francis Group.

Steger, M. F. (2017). Meaning in life and wellbeing. In M. Slade, L. Oades, A. Jarden, M. Slade, L. Oades, A. Jarden (Eds.), *Wellbeing, recovery and mental health* (pp. 75-85). New York, NY, US: Cambridge University Press. doi:10.1017/9781316339275.008

Stigsdotter, U. K., Ekholm, O., Schipperijn, J., Toftager, M., Kamper-Jørgensen, F., & Randrup, T. B. (2010). Health promoting outdoor environments-Associations between green space, and health, health-related quality of life and stress based on a Danish national representative survey. *Scandinavian Journal of Social Medicine*, 38(4), 411-417. <https://doi.org/10.1177/1403494810367468>

Tam, K. (2013). Concepts and measures related to connection to nature: Similarities and differences. *Journal of Environmental Psychology*, 34, 64-78. doi:10.1016/j.jenvp.2013.01.004

Thompson Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., & Depledge, M. H. (2011). Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. *Environmental Science & Technology*, 45(5), 1761-1772. doi:10.1021/es102947t

Thoreau, H. D. (1854). *Walden; or, life in the woods*. Boston, MA: Ticknor and Fields.

Tsunetsugu, Y., Park, B. J., & Miyazaki, Y. (2010). Trends in research related to "Shinrin-yoku" (taking in

- the forest atmosphere or forest bathing) in Japan. *Environmental Health and Preventive Medicine*, 15, 27-37. <http://dx.doi.org/10.1007/s12199-009-0091-z>
- Ulrich, R. S. (1979). Visual landscapes and psychological well-being. *Landscape Research*, 4, 17-23. <http://dx.doi.org/10.1080/01426397908705892>
- Ulrich, R. S. (1981). Natural versus urban scenes: Some psychophysiological effects. *Environment and Behavior*, 13, 523-556. <http://dx.doi.org/10.1177/0013916581135001>
- Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. In I. Altman, & J. Wohlwill (Eds.), *Behavior and the natural environment* (pp. 85-125). New York, NY: Plenum Press.
- Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 73-137). Washington, D.C.: Island Press.
- 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, 201-230. [http://dx.doi.org/10.1016/S0272-4944\(05\)80184-7](http://dx.doi.org/10.1016/S0272-4944(05)80184-7)
- Unsworth, S. J., Levin, W., Bang, M., Washinawatok, K., Waxman, S. R., & Medin, D. L. (2012). Cultural differences in children's ecological reasoning and psychological closeness to nature: Evidence from Menominee and European American children. *Journal of Cognition and Culture*, 12(1-2), 17-29. doi:10.1163/156853712X633901
- Valtchanov, D., & Ellard, C. (2010). Physiological and affective responses to immersion in virtual reality: Effects of nature and urban settings. *Journal of Cybertherapy and Rehabilitation*, 3(4), 359-374.
- Van den Berg, A. E., Hartig, T., & Staats, H. (2007). Preference for nature in urbanized societies: Stress, restoration, and the pursuit of sustainability. *Journal of Social Issues*, 63(1), 79-96. doi:10.1111/j.1540-4560.2007.00497.x
- van den Berg, A. E., Koole, S. L., & van der Wulp, N. Y. (2003). Environment preference and restoration: (How) are they related?. *Journal of Environmental Psychology*, 23(2), 135-146. doi:10.1016/S0272-4944(02)00111-1
- Vemuri, A. W., Morgan Grove, J., Wilson, M. A., & Burch Jr, W. R. (2011). A tale of two scales: Evaluating the relationship among life satisfaction, social capital, income, and the natural environment at individual and neighborhood levels in metropolitan Baltimore. *Environment and Behavior*, 43(1), 3-25. doi:10.1177/0013916509338551
- Walker, S. E., & Duffield, B. S. (1983). Urban parks and open spaces—An overview. *Landscape Research*, 8(2), 2-12. <http://dx.doi.org/10.1080/01426398308706060>
- Ward Thompson, C., Aspinall, P., & Montarzino, A. (2008). The childhood factor: Adult visits to green places and the significance of childhood experience. *Environment and Behavior*, 40(1), 111-143. <https://doi.org/10.1177/0013916507300119>
- Ward Thompson, C., & Travlou, P. (Eds.). (2007). *Open space: People space*. London, UK: Taylor & Francis.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063-1070. doi:10.1037/0022-3514.54.6.1063
- White, M. P., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013). Would you be happier living in a greener urban area? A fixed-effects analysis of panel data. *Psychological Science*, 24(6), 920-928. <https://doi.org/10.1177/0956797612464659>
- Wilson, E. O. (1984). *Biophilia*. Cambridge: Harvard University Press.
- Wolsko, C., & Lindberg, K. (2013). Experiencing connection with nature: The matrix of psychological well-being, mindfulness, and outdoor recreation. *Ecopsychology*, 5(2), 80-91. <https://doi.org/10.1089/eco.2013.0008>
- Wong, P. T. (2010). Meaning therapy: An integrative and positive existential psychotherapy. *Journal of Contemporary Psychotherapy*, 40(2), 85-93. <https://doi.org/10.1007/s10879-009-9132-6>
- 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*, 4224-31. doi:10.1016/j.jenvp.2015.01.005
- Zelenski, J. M., & Nisbet, E. K. (2014). Happiness and feeling connected: The distinct role of nature relatedness. *Environment and Behavior*, 46(1), 3-23. <https://doi.org/10.1177/0013916512451901>



Zhang, J. W., Howell, R. T., & Iyer, R. (2014). Engagement with natural beauty moderates the positive relation between connectedness with nature and psychological well-being. *Journal of Environmental Psychology*, 38, 55-63. <https://doi.org/10.1016/j.jenvp.2013.12.013>

Zika, S., & Chamberlain, K. (1992). On the relation between meaning in life and psychological well-being. *British Journal of Psychology*, 83(1), 133-145. doi:10.1111/j.2044-8295.1992.tb02429.x

Zuckerman, M. (1977). Development of a situation-specific trait-state test for the prediction and measurement of affective responses. *Journal of Consulting and Clinical Psychology*, 45(4), 513-523. doi:10.1037/0022-006X.45.4.513



© 2018 Ed Diener. Copyright Creative Commons: Attribution, noncommercial, no derivatives