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Nature connectedness: Associations with well-being and mindfulness

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ABSTRACT

Wilson's (1984) *biophilia hypothesis* predicts that people's psychological health is associated with their relationship to nature. Two studies examined associations among nature connectedness, well-being, and mindfulness in samples of undergraduate students while socially desirable responding was controlled. Significant associations emerged among measures of nature connectedness and indices of well-being (in Study 1 and Study 2) and mindfulness (in Study 2). Results are discussed in relation to possible mediators and moderators of the association between nature connectedness and mental health.

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1. Introduction

"Appreciating the beauty of a blossom, the loveliness of a lilac, or the grace of a gazelle are all ways in which people can, in some small measure, fill their daily lives with evolutionarily inspired epiphanies of pleasure" (Buss, 2000, p. 22).

It has been over 25 years since Wilson (1984) wrote *Biophilia*, in which he argued for an evolved inclination among humans to affiliate with nature. A substantial research base concerning biophilia has accrued within the field of environmental psychology, including the seminal work of Stephen and Rachel Kaplan and of Roger Ulrich. As reviewed by Joye (2007), supportive findings include human preference for savannah-like landscapes, favorable responses to natural environments relative to "built" environments, and restored cognitive functioning following immersion in nature. Wilson (1984) also spoke of an association between nature and psychological health, a position stated unequivocally by his colleague, Kellert (1993, p. 60): "The pursuit of 'the good life' is through our broadest valuational experience of nature". Experiences in nature have recently emerged as an interest within positive psychology; for example, Shiota, Keltner, and Mossman (2007) identified nature as an elicitor of awe.

1.1. Nature and well-being

Researchers have manipulated exposure to nature in order to examine nature's impact on well-being. Saraglou, Buxant, and Tilquin (2008) showed that exposure to a nature-oriented film boosted levels of positive emotions such as enjoyment and

wonder. Mayer, Frantz, Bruehlman-Senecal, and Dolliver (2009) showed that immersion in a nature preserve boosted positive affect. Weinstein, Przybylski, and Ryan (2009) showed that exposure to nature-oriented slides or a plant-laden laboratory increased endorsement of intrinsic goals. And, Ryan et al. (2010) showed that immersion in either simulated or actual nature boosted vitality.

In the Mayer et al. (2009) and Weinstein et al. (2009) studies, the temporary state of *nature connectedness* partially mediated effects of nature exposure on well-being. Nature connectedness has also been viewed as a *trait*, defined as "individuals' experiential sense of oneness with the natural world" (Mayer & Frantz, 2004, p. 504). Establishing associations between trait nature connectedness and well-being is important as such work complements experimental work by trading-off the strengths and weaknesses of each research approach.

Mayer and Frantz (2004) demonstrated a significant correlation between trait nature connectedness and life satisfaction. Mayer et al. (2009) showed no associations between trait nature connectedness and positive affect in three studies. Leary, Tipsord, and Tate (2008) showed no association between a measure of nature connectedness and a measure of life satisfaction.

Facets of well-being beyond positive affect and life satisfaction may be most associated with trait nature connectedness. Theorists have distinguished between aspects of well-being described as hedonic (e.g., feeling good) and those described as eudaimonic (e.g., living a fulfilled life; Ryan & Deci, 2001; Waterman, 1993). Given that nature connectedness involves a sense of meaningful involvement in something larger than oneself, it may relate most strongly to eudaimonic aspects of well-being. In this vein, Nisbet, Zelenski, and Murphy (2011) showed that nature connectedness was consistently associated with autonomy, personal growth, and purpose in life; nature connectedness was also associated with positive affect but not with life satisfaction.

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The current work builds upon these recent findings by examining the relationship between nature connectedness and a comprehensive conceptualization of mental health which incorporates scales of emotional, psychological, and social well-being (Keyes, 2005). This allowed us to examine whether trait nature connectedness was associated with feeling well (i.e., hedonic well-being, as assessed with the emotional well-being scale) and with functioning well (i.e., eudaimonic well-being, as assessed with the psychological and social well-being scales; Keyes, 2005; Keyes & Annas, 2009). In addition, we examined relations among nature connectedness and a second index of positive mental health, mindfulness.

1.2. Nature connectedness and mindfulness

Mindfulness, as defined by Brown and Ryan (2003), is “being attentive to and aware of what is taking place in the present” (p. 822). Mindfulness enhances the richness and vitality of moment-to-moment experiences (Brown & Ryan, 2003; see also Brown, Ryan, & Creswell, 2007). The enhanced sensory impact of experiences in nature fostered by mindfulness may strengthen nature connectedness among mindful individuals. For example, Wilson (1984) wrote, in describing the state of mind of a naturalist, “He goes alone into a field or woodland and closes his mind to everything but that time and place, so that life around him presses in on all the senses and small details grow in significance” (p. 103). Brown and Ryan further discuss that mindfulness enhances self-regulated functioning; that is, mindfulness sensitizes individuals to intrinsic needs, allowing people to better regulate themselves toward meeting those needs. In this vein, Kellert (1997) argued that key psychological needs can be met through affiliating with nature, including autonomy, competence, and relatedness needs. These needs are central to self-determination theory (e.g., Deci & Ryan, 2000), and have been shown by Brown and Ryan to correlate with mindfulness. Therefore, if mindfulness fosters the meeting of important needs, and if these needs can be met, in part, through experiences in nature, mindfulness and nature connectedness should be positively associated.

No research has examined associations between mindfulness and nature connectedness. However, Nisbet, Zelenski, and Murphy (2009) showed that openness to experience is associated with nature connectedness; Mayer et al. (2009) showed that attentional capacity is related to nature connectedness; and Leary et al. (2008) showed that internal state awareness is related to nature connectedness.

1.3. The current research

In Study 1, we examined correlations between nature connectedness and the emotional, psychological, and social scales of Keyes (2005) index of well-being; we examined associations between mindfulness and nature connectedness; and we controlled for

the influence of social desirability. The hypothesis was that higher levels of nature connectedness would be associated both with higher levels of well-being and with greater mindfulness.

2. Study 1

2.1. Method

2.1.1. Participants and procedure

Participants were 452 introductory psychology students at an urban Canadian university who consented to participate and who received course credit. Females comprised 69.4% of the sample, and 81.8% of participants identified Canada as their country of birth. The average age was 22.17 (SD = 6.14). First- and second-year students comprised 66.6% and 21.7% of the sample, respectively.

2.1.2. Measures

Mayer and Frantz (2004) devised the 14-item Connectedness to Nature Scale. Items (e.g., “Like a tree can be part of a forest, I feel embedded within the broader natural world”) assess a sense of oneness with the natural world, and are rated on 5-point scales with endpoints 1 = *strongly disagree* and 5 = *strongly agree*. Higher total scores denote greater nature connectedness. Mayer and Frantz reported a coefficient α of 0.84 and evidence of scale validity (e.g., positive associations with environmental concern).

Keyes (2005) compiled a 40-item measure of well-being; emotional well-being is assessed via ratings of positive affect reflecting the preceding 30-day period and a rating of overall life satisfaction; psychological well-being is assessed via ratings of self-acceptance, positive relations with others, personal growth, purpose in life, environmental mastery, and autonomy (Ryff, 1989); and social well-being is assessed via ratings of social acceptance, social actualization, social contribution, social coherence, and social integration (Keyes, 1998). Research has supported the three-factor structure of the measure (Gallagher, Lopez, & Preacher, 2009), as well as its reliability and validity (e.g., Keyes, 2005).

The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) employs 15 items, rated on 6-point scales with endpoints 1 = *almost always* and 6 = *almost never*, which assess the extent to which an individual is aware of and attends to current experiences. Items describe mindless experiences (e.g., “I could be experiencing some emotion and not be conscious of it until sometime later”). Higher total scores denote greater mindfulness. Brown and Ryan established the internal consistency of the measure ($\alpha = 0.82$), its test-retest reliability ($r = 0.81$), and its validity.

Paulhus's (1994) Balanced Inventory of Desirable Responding is composed of two 20-item subscales: Self-deceptive enhancement reflects the tendency to provide unintentionally inflated self-descriptions and impression management reflects the tendency to present a deliberately favorable view of oneself to others. Items

Table 1
Descriptive statistics and correlations for all variables: Study 1.

Variable	N	M	SD	Observed range	Possible range	α	Correlations			
							1	2	3	4
1. Connectedness to nature	437	45.78	8.81	22.00–65.00	14.00–70.00	.84	–			
2. Emotional well-being	442	10.38	2.04	2.50–14.83	0.00–15.00	.90	.01 (–.02)	–		
3. Psychological well-being	416	32.40	4.57	19.00–41.33	6.00–42.00	.82	.15 [†] (.14 [†])	.57** (.51**)	–	
4. Social well-being	418	23.39	4.21	6.33–34.67	5.00–35.00	.82	.20** (.21**)	.42** (.39**)	.59 (.56**)	–
5. MAAS	427	57.99	11.17	27.00–88.00	15.00–90.00	.86	.03 (–.03)	.36** (.20**)	.42 (.25**)	.37** (.24**)

Note: Coefficients in parentheses are partial correlations controlling for self-deceptive enhancement and impression management. MAAS = Mindful Attention Awareness Scale.

[†] $p < .05$.

** $p < .001$.

are rated on 7-point scales, but we followed Paulhus' recommendation to use binary scoring for each item, such that extreme responses were scored as 1 and other responses were scored as 0. Scores within each scale were then summed, with higher scores reflecting greater self-deceptive enhancement or impression management.

3. Results

As shown in Table 1, nature connectedness correlated positively with psychological well-being and with social well-being. Nature connectedness did not correlate with emotional well-being, nor did it correlate with mindfulness.

Additional analyses examined whether relationships among variables reflected the influence of socially desirable responding. Partial correlations were conducted controlling for self-deceptive enhancement ($M = 5.58$, $SD = 3.45$, $\alpha = 0.70$) and impression management ($M = 5.71$, $SD = 3.75$, $\alpha = 0.70$). As shown in Table 1, all significant zero-order correlations remained significant when controlling for social desirability.

Relationships revealed in correlational analyses were simultaneously explored using confirmatory factor analysis (CFA) with AMOS 16.0.1 (Arbuckle, 2007). To facilitate comparisons with Study 2, Fig. 1 depicts the results for the full model with hypothesized correlations among nature connectedness, well-being, and mindfulness. Each of the three well-being scales loaded significantly on the well-being latent factor. Associations between nature connectedness and well-being and between well-being and mindfulness were significant; however, the association between nature connectedness and mindfulness was not. We examined the most commonly reported fit indices based on McDonald and Ho (2002). The results on these indices were: $\chi^2(5) = 24.65$, $p < .001$; CFI = .959; RMSEA = .093. The χ^2 statistic is highly sensitive to

large sample sizes such that it is uncommon to find a non-significant test value suggestive of a good fit; of the remaining indices, the CFI value suggested an acceptable fit (i.e., it was $>.90$) whereas the RMSEA did not (i.e., it was not $<.08$; McDonald & Ho, 2002). Removing the non-significant path associating nature connectedness and mindfulness improved the fit: $\chi^2(6) = 24.80$, $p < .001$; CFI = .960; RMSEA = .083. The inter-factor correlations between nature connectedness and well-being and between well-being and mindfulness remained unchanged.

4. Discussion

Study 1 revealed significant correlations between nature connectedness and both psychological and social well-being, thereby establishing correlations involving dispositional nature connectedness and aspects of well-being beyond life satisfaction or positive affect. These correlations remained when controlling for socially desirable response biases. Emotional well-being did not emerge as a significant correlate of nature connectedness, consistent with past mixed findings in this area. Also in contradiction to our hypothesis, mindfulness did not emerge as a significant correlate of nature connectedness. When CFA was used to simultaneously explore relationships among constructs, nature connectedness and well-being were significantly associated, as were well-being and mindfulness; the path between mindfulness and nature connectedness was non-significant.

The MAAS operationalizes mindfulness as attending to the present moment (Brown & Ryan, 2003). Alternative views of mindfulness include a twofold view in which mindfulness is conceptualized as "the tendency to be highly aware of one's internal and external experiences in the context of an accepting, non-judgmental stance toward those experiences" (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008, p. 205). Including a measure of the twofold conceptualization of mindfulness would afford the opportunity to examine whether separable facets of mindfulness relate differently to nature connectedness.

In Study 2, we more fully examined correlations among nature connectedness, well-being, and mindfulness by employing multiple indicators of each construct. We hypothesized, as in Study 1, that nature connectedness would correlate significantly with both well-being and mindfulness.

5. Study 2

5.1. Method

5.1.1. Participants and procedure

Participants were 275 introductory psychology students at an urban Canadian university who consented to participate and who received course credit. Females comprised 68% of the sample, and 89% of participants identified Canada as their country of birth. The average age was 20.39 ($SD = 3.80$). First- and second-year students comprised 68% and 27% of the sample, respectively.

5.1.2. Measures

We again employed the Connectedness to Nature Scale of Mayer and Frantz (2004). In addition, we employed Nisbet et al.'s (2009) 21-item Nature Relatedness scale, with items (e.g., "I feel very connected to all living things and the earth") rated on a scale with endpoints 1 = *disagree strongly* and 5 = *agree strongly*. Higher total scores denote greater nature connectedness. The scale has good internal reliability ($\alpha = 0.87$) and test-retest stability (0.85), and was validated against related measures (e.g., ecology scales; Nisbet et al.).

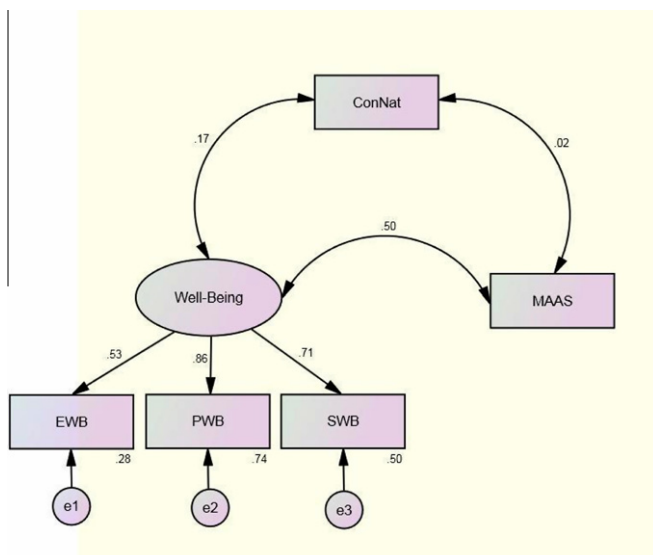


Fig. 1. Confirmatory factor analysis for Study 1 depicting relationships among nature connectedness, well-being, and mindfulness. Rectangles contain observed variables and ovals contain latent variables. Coefficients appearing alongside straight arrowheads are standardized path coefficients and those alongside curved arrowheads are correlations. The remaining coefficients give the squared multiple correlations indicating the portion of variance accounted for by the relationship between an observed variable and corresponding latent variable. Nature connectedness was measured with the Connectedness to Nature Scale (ConNat), well-being was measured with emotional (EWB), psychological (PWB), and social well-being (SWB) subscales, and mindfulness (MAAS) was measured with the Mindful Attention Awareness Scale. The letter "e" represents error in measured variables. Note: the correlation between mindfulness and Connectedness to Nature was non-significant.

We also used Leary et al.'s (2008) 16-item Allo-Inclusive Identity Scale. We scored the eight items concerning connectedness between oneself and nature. Items (e.g., "The connection between you and a tree") are rated by choosing one of seven diagrams depicting increasing degrees of overlap between a circle labeled "you" and one labeled "other". Leary et al. reported acceptable reliability ($\alpha > 0.75$) and evidence of the scale's validity (e.g., correlations with ecological concern).

We again employed Keyes (2005) measure of well-being and Brown and Ryan's (2003) measure of mindfulness. As an additional measure of mindfulness, we employed the Philadelphia Mindfulness Scale (Cardaciotto et al., 2008), a 20-item measure with Awareness and Acceptance subscales. A sample Awareness item is, "Whenever my emotions change, I am conscious of them immediately", and a sample Acceptance item is, "When I have a bad memory, I try to distract myself to make it go away". Items are rated on 5-point scales with endpoints 1 = *never* and 5 = *very often*. Higher subscale scores denote greater awareness or acceptance. Cardaciotto et al. evidenced the internal consistency and validity of both subscales. Finally, we again employed Paulhus's (1994) Balanced Inventory of Desirable Responding.

6. Results

Descriptive statistics for all variables are reported in Table 2. As shown in Table 3, the three nature connectedness scales correlated significantly with psychological well-being and with social well-being, while two of the three correlated significantly with emotional well-being. Nature connectedness also correlated significantly with mindfulness; specifically, MAAS scores were significantly associated with Connectedness to Nature Scale scores and with Nature Relatedness scores, whereas Philadelphia Mindfulness Scale – Awareness scores were significantly correlated with all three nature connectedness scales. In contrast, Philadelphia

Mindfulness Scale – Acceptance scores were not associated with nature connectedness.

Partial correlations were conducted controlling for self-deceptive enhancement ($M = 4.80$, $SD = 3.19$, $\alpha = 0.70$) and impression management ($M = 4.93$, $SD = 3.56$, $\alpha = 0.78$). As shown in Table 3, correlation coefficients were attenuated, but the vast majority of significant zero-order correlations remained significant.

Relationships revealed in correlational analyses were simultaneously explored using CFA (see Fig. 2). Fit indices were: $\chi^2(24) = 61.15$, $p < .001$; CFI = .946; and RMSEA = .075. All loadings of observed variables on latent factors were significant, and the three latent factors were all significantly inter-related.

7. Discussion

Nature connectedness positively correlated with both psychological and social well-being. Emotional well-being also emerged as a positive correlate of nature connectedness on two of three nature scales. Mindfulness emerged as a significant correlate of nature connectedness; this was true of scales which emphasize the awareness as opposed to the acceptance dimension of mindfulness. These patterns remained when controlling for socially desirable responding. Finally, when relations among latent factors of nature connectedness, well-being, and mindfulness were simultaneously examined using CFA, all three factors were significantly inter-related, such that higher degrees of connectedness to nature were associated with greater well-being and greater mindfulness.

8. General discussion

A consistent finding across the two studies was that significant positive associations emerged between nature connectedness and psychological well-being. These relationships emerged across all three measures of nature connectedness, and they remained when

Table 2
Descriptive statistics for all variables: Study 2.

Variable	N	M	SD	Observed range	Possible range	α
1. Connectedness to nature	265	45.77	7.64	20.00–66.00	14.00–70.00	.78
2. Nature relatedness	255	73.59	11.97	40.00–101.00	21.00–105.00	.85
3. Allo-Inclusive Identity – Nature	265	22.52	9.50	8.00–56.00	8.00–56.00	.88
4. Emotional well-being	267	10.54	2.13	3.33–15.00	0.00–15.00	.85
5. Psychological well-being	249	32.23	4.48	15.33–40.67	6.00–42.00	.81
6. Social well-being	264	22.77	4.30	10.00–33.33	5.00–35.00	.83
7. MAAS	260	55.75	10.69	28.00–85.00	15.00–90.00	.85
8. PMS – awareness	267	36.30	5.29	23.00–50.00	10.00–50.00	.75
9. PMS – acceptance	266	27.62	6.83	10.00–45.00	10.00–50.00	.84

Note: MAAS = Mindful Attention Awareness Scale; PMS = Philadelphia Mindfulness Scale.

Table 3
Correlations among all variables: Study 2.

Variable	1	2	3	4	5	6	7	8
1. Connectedness to nature	–							
2. Nature relatedness	.61** (.62**)	–						
3. Allo-Inclusive Identity – Nature	.49** (.49**)	.54** (.50**)	–					
4. Emotional well-being	.17* (.13*)	.26** (.21*)	.15* (.10)	–				
5. Psychological well-being	.27** (.22**)	.34** (.27**)	.25** (.20*)	.64** (.60**)	–			
6. Social well-being	.23** (.20**)	.29** (.24**)	.21** (.17*)	.50** (.45**)	.67** (.64**)	–		
7. MAAS	.19* (.13*)	.15* (.05)	.11 (.05)	.29** (.20*)	.42** (.28*)	.38** (.29**)	–	
8. PMS – awareness	.30** (.26**)	.29** (.24**)	.36** (.33**)	.23** (.25**)	.31** (.36**)	.23** (.23**)	.18* (.03)	–
9. PMS – acceptance	.10 (.06)	.09 (.04)	.02 (–.02)	.26** (.20*)	.38** (.32**)	.21** (.16*)	.42** (.38**)	–.03 (–.14*)

Note: Coefficients in parentheses are partial correlations controlling for self-deceptive enhancement and impression management. MAAS = Mindful Attention Awareness Scale; PMS = Philadelphia Mindfulness Scale.

* $p < .05$.
** $p < .001$.

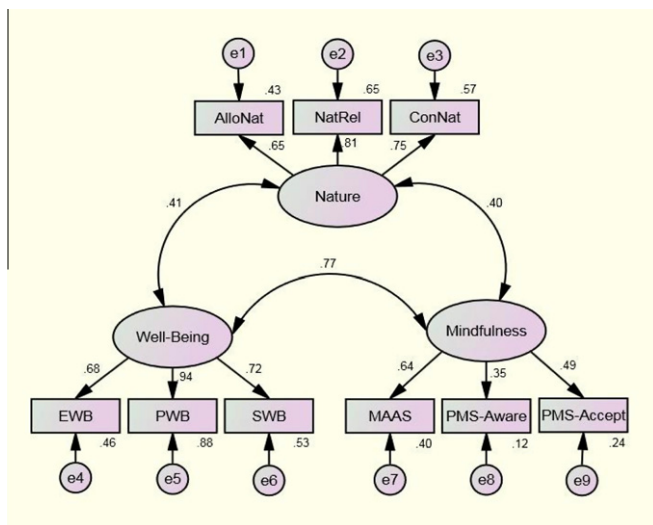


Fig. 2. Confirmatory factor analysis for Study 2 depicting relationships among nature connectedness, well-being, and mindfulness. Rectangles contain observed variables and ovals contain latent variables. Coefficients appearing alongside straight arrowheads are standardized path coefficients and those alongside curved arrowheads are correlations. The remaining coefficients give the squared multiple correlations indicating the proportion of variance accounted for by the relationship between an observed variable and corresponding latent variable. Nature connectedness was measured with the Connectedness to Nature Scale (ConNat), the Nature Relatedness scale (NatRel), and the Allo-Inclusive Identity – Nature subscale (AlloNat); well-being was measured with emotional (EWB), psychological (PWB), and social well-being (SWB) scales; and mindfulness was measured with the Mindful Attention Awareness Scale (MAAS) and the Awareness (PMS-Aware) and Acceptance (PMS-Accept) subscales of the Philadelphia Mindfulness Scale. The letter “e” represents error in measured variables.

controlling for social desirability. These findings suggest that nature connectedness is associated with the extent to which people are flourishing in their private, personal lives (Keyes, 2005). A second consistent finding was the association between nature connectedness and social well-being. Such associations emerged in Studies 1 and 2; they emerged across the various measures of nature connectedness in Study 2; and they persisted when controlling for social desirability. These findings suggest that nature connectedness is associated with the extent to which people are flourishing in their public, social lives (Keyes, 2005). Taken together, findings concerning psychological and social well-being from both studies are consistent with the argument that eudaimonic aspects of well-being are associated with nature connectedness.

An inconsistent pattern of findings characterized the association between nature connectedness and emotional well-being. No such association emerged in Study 1. In Study 2, emotional well-being related significantly to all three nature connectedness scales, but the magnitude of these associations was small. These findings echo the mixed findings of previous research examining associations between positive affect or life satisfaction and nature connectedness. Overall, then, our findings suggest that aspects of well-being which emphasize “feeling good” (i.e., emotional well-being) are less reliably related to nature connectedness than are aspects of well-being which emphasize “functioning well” (i.e., psychological and social well-being; Keyes & Annas, 2009).

Mindfulness emerged as a significant correlate of nature connectedness, although these findings were variable. Mindfulness as assessed with the MAAS correlated with nature connectedness in Study 2 but not in Study 1. Philadelphia Mindfulness Scale – Awareness scores correlated positively with all three nature connectedness measures in Study 2. Philadelphia Mindfulness Scale – Acceptance scores were consistent in *not* correlating with the nature connectedness scales, suggesting that it is enhanced

awareness of experiences in nature, rather than a nonjudgmental acceptance of such experiences, that is associated with nature connectedness. This is consistent with the argument that a major function of the acceptance facet of mindfulness is the allowance of increased contact with *negative* experiences (Cardaciotto et al., 2008). When it comes to positive experiences such as those involving nature, an attentive mind is more important than an accepting one.

8.1. Future directions and limitations

Future research could examine moderators and mediators of the relationship between nature connectedness and mental health, as well as antecedents to nature connectedness. Nature connectedness may relate more significantly to some aspects of positive emotional functioning than others, suggesting moderation of the relationship between emotional well-being and nature connectedness. Positive emotional states such as awe and vitality (not measured herein) may be more closely associated with trait nature connectedness than are such states as happiness and being satisfied with life. Research suggests that awe (Shiota et al., 2007) and vitality (Ryan et al., 2010) are significant correlates of experiences in nature; interestingly, both are defined in a manner which suggests that they are associated with eudaimonic aspects of experience and are differentiable from happiness or satisfaction.

Another possible moderating influence on associations between nature connectedness and well-being is one’s immediate environmental context. If ongoing conditions auger against nature involvement, even among those relatively high on trait nature connectedness, the extent to which nature connectedness and well-being are associated may be reduced. For example, Study 1 was conducted during the winter months in a northern Canadian city. The mean temperature during January in this region is -7°C (8°F). Inclement conditions may attenuate relationships evident during other seasons; this may account for non-significant associations between nature connectedness and emotional well-being in Study 1.

With respect to mediation, nature connectedness and well-being may be mediated by *meaning in life*. Those who are highly nature connected may derive a sense of meaningful existence from their closeness with nature, and this may in turn boost well-being. Indeed, Saraglou et al. (2008) evidenced significant associations between nature connectedness and spirituality. Nature connectedness and well-being may also be mediated by physical health functioning. Exposure to green spaces is associated with health and longevity (e.g., Mitchell & Popham, 2008). Perhaps exposure to public park areas and tree-lined streets (with concomitant increases in nature connectedness) improves physical health which, in turn, boosts mental well-being.

Future research could further examine antecedents of nature connectedness. Involvement in nature boosts state nature connectedness (Mayer et al., 2009; Weinstein et al., 2009), and involvement in environmental studies is associated with greater trait nature connectedness (Nisbet et al., 2011). Research could profitably examine dimensions of experiences in nature, such as outdoor versus indoor, active versus passive, secluded versus crowded, and plant-involved versus animal-involved, and their relationship to the development of nature connectedness. Finally, population-level fluctuations in nature connectedness as a function of societal changes such as urbanicity, technological advancements, or ongoing environmental degradation could be fruitful to examine.

The current studies were cross-sectional, which precludes the drawing of conclusions concerning the causal nature of emerging relationships. For example, while nature connectedness may conduce toward both mindfulness and well-being, nature connectedness may also result from greater mindfulness or well-being.

Nonetheless, evidence of positive effects for well-being of immersion in nature suggests that nature connectedness may have important consequences for well-being. Indeed, connectedness with nature, promoted through greater involvement in nature, may complement other *intentional activities* (Lyubomirsky, Sheldon, & Schkade, 2005) conducive to well-being.

References

- Arbuckle, J. L. (2007). *AMOS, Version 16.0.1*. Spring House, PA: Amos Development Corporation.
- Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*, 822–848.
- Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, *18*, 211–237.
- Buss, D. M. (2000). The evolution of happiness. *American Psychologist*, *55*, 15–23.
- Cardaciotto, L., Herbert, J. D., Forman, E. M., Moitra, E., & Farrow, V. (2008). The assessment of present-moment awareness and acceptance. The Philadelphia Mindfulness Scale. *Assessment*, *15*, 204–223.
- 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*, 227–268.
- Gallagher, M. W., Lopez, S. J., & Preacher, K. J. (2009). The hierarchical structure of well-being. *Journal of Personality*, *77*, 1025–1049.
- Joye, Y. (2007). Architectural lessons from environmental psychology: The case of biophilic architecture. *Review of General Psychology*, *11*, 305–328.
- Kellert, S. R. (1993). The biological basis for human values of nature. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis*. Washington: Island Press.
- Kellert, S. R. (1997). *Kinship to mastery: Biophilia in human evolution and development*. Shearwater: Washington.
- Keyes, C. L. M. (1998). Social well-being. *Social Psychology Quarterly*, *61*, 121–140.
- Keyes, C. L. M. (2005). Mental illness and/or mental health? Investigating the axioms of the complete state model of health. *Journal of Consulting and Clinical Psychology*, *73*, 539–548.
- Keyes, C. L. M., & Annas, J. (2009). Feeling good and functioning well: Distinctive concepts in ancient philosophy and contemporary science. *Journal of Positive Psychology*, *4*, 197–201.
- Leary, M. R., Tipsord, J. M., & Tate, E. B. (2008). Allo-inclusive identity: Incorporating the social and natural worlds into one's sense of self. In H. A. Wayment & J. J. Bauer (Eds.), *Transcending self-interest: Psychological explorations of the quiet ego* (pp. 137–147). Washington: APA.
- Lyubomirsky, S., Sheldon, K. M., & Schkade, D. (2005). Pursuing happiness: The architecture of sustainable change. *Review of General Psychology*, *9*, 111–131.
- 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*, 504–515.
- Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behavior*, *41*, 607–643.
- McDonald, R. P., & Ho, M.-H. R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods*, *7*, 64–82.
- Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environments on health inequalities: An observational population study. *Lancet*, *372*, 1655–1660.
- 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*, 715–740.
- 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*, 303–322.
- Paulhus, D. L. (1994). *Balanced inventory of desirable responding: Reference manual for BIDR Version 6*. British Columbia, Canada: Department of Psychology, University of British Columbia, Vancouver. Unpublished manuscript.
- Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, *52*, 141–166.
- Ryan, R. M., Weinstein, N., Bernstein, J., Brown, K. W., Mistretta, L., & Gagne, M. (2010). Vitalizing effects of being outdoors and in nature. *Journal of Environmental Psychology*, *30*, 159–168.
- Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, *57*, 1069–1081.
- Saraglou, V., Buxant, C., & Tilquin, J. (2008). Positive emotions as leading to religion and spirituality. *Journal of Positive Psychology*, *3*, 165–173.
- Shiota, M. N., Keltner, D., & Mossman, A. (2007). The nature of awe: Elicitors, appraisals, and effects on self-concept. *Cognition and Emotion*, *21*, 944–963.
- Waterman, A. S. (1993). Two conceptions of happiness: Contrasts of personal expressiveness (eudaimonia) and hedonic enjoyment. *Journal of Personality and Social Psychology*, *64*, 678–691.
- 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*, 1315–1329.
- Wilson, E. O. (1984). *Biophilia*. Cambridge: Harvard University Press.