



Mindfulness and connectedness to nature: A meta-analytic investigation

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ABSTRACT

The traits of mindfulness and connectedness to nature may have a reciprocal relationship. Mindfulness, which consists of non-evaluative awareness, may allow individuals to feel more connected to nature, and connection to natural environments may help foster mindfulness. A number of studies have investigated the association between trait mindfulness and connectedness with nature. The current meta-analytic investigation consolidated the findings from these studies. Across 12 samples, which included 2435 individuals, there was a significant relationship between mindfulness and connectedness to nature, with a weighted effect size of $r = 0.25$. Moderator analyses indicated that studies with older participants and studies with community participants rather than students found significantly stronger associations between mindfulness and connectedness to nature. Associations between mindfulness and connectedness with nature varied significantly depending on measures of mindfulness used. These meta-analytic findings provide a foundation for (1) future intervention programs aimed at drawing on nature exposure to increase mindfulness and (2) intervention programs intended to enhance connectedness to nature through mindfulness.

1. Introduction

1.1. Mindfulness

Mindfulness consists of a focus on the present moment in a state of non-judgmental awareness (Brown & Ryan, 2003; Kohls, Sauer, & Walach, 2009). Mindfulness can be a relatively stable individual-difference characteristic or trait as well as a transitory state (Brown & Ryan, 2003; Kohls et al., 2009). Trait and state mindfulness may interact. A higher level of trait mindfulness may translate into more frequent mindful states. Practices that lead to mindful states may result over time in increased dispositional or trait mindfulness (Grossman, Niemann, Schmidt, & Walach, 2004).

A higher level of trait mindfulness is associated with a variety of beneficial characteristics. These characteristics include more positive affect, less negative affect, greater life satisfaction, and greater autonomy and competence (Brown & Ryan, 2003; Giluk, 2009). Meta-analyses of mindfulness interventions have found that increases in mindfulness are associated with a variety of beneficial well-being outcomes (Grossman et al., 2004; Khoury et al., 2013). Mindfulness interventions can also ameliorate distress, such as symptoms of post-traumatic stress (Hopwood & Schutte, 2017).

1.2. Connectedness to nature

Humans may have an intrinsic tendency, shaped by evolution, to want connections to nature and to benefit from these connections (Kahn, 2011; Wilson, 1984). As well as being a universal tendency, desire for nature connectedness may be stronger in some individuals than others and can comprise a relatively stable individual-difference characteristic (Tam, 2013).

Connectedness to nature has beneficial psychological and health effects (Capaldi, Dopko, & Zelenski, 2014; McMahan & Estes, 2015; Richardson, Maspero, Golightly, Sheffield, & Staples, 2017). For example, in a meta-analysis of findings from 30 samples, Capaldi et al. (2014) found that a higher level of connectedness to nature was associated with more positive affect, greater vitality, and higher life satisfaction.

The non-judgmental awareness and presence that is central to mindfulness may facilitate the development of a sense of connectedness to nature. Such awareness may allow individuals to engage with nature experiences more fully, resulting in the building of a sense of connection to or oneness with nature. In a reciprocal relationship, contact with natural environments may restore attention capability (Passmore & Holder, 2016) and may allow an effortless sense of presence in an environment to which humans are adapted through evolution (Kahn, 2011; Wilson, 1984). Thus, a cycle of interaction between nature and mindfulness may result in an association between the traits of

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mindfulness and connectedness to nature.

A number of studies have examined the association between mindfulness and connection to nature. These studies have varied in that they examined this association in different populations, such as students (e.g., Wolsko & Lindberg, 2013) and community members (e.g., Unsworth, Palicki, & Lustig, 2016), in samples with older (e.g., Richardson & Sheffield, 2015) and younger (e.g., Tipsord, 2009) mean ages, and in samples with different proportions of women and men. These studies have also varied in approach to assessment of mindfulness through use of different measures such as the Five Facet Mindfulness Questionnaire (Baer et al., 2008) or the Mindful Attention Awareness Scale (MacKillop & Anderson, 2007) and assessment of connection to nature through use of different measures such as the Connectedness to Nature Scale (Mayer & Frantz, 2004) or the Allo Inclusive Nature Scale (Leary, Tipsord, & Tate, 2008). Finally, these studies found varying effect sizes for the association between mindfulness and connectedness to nature. Because the magnitude of the effect size of the association between mindfulness and connectedness to nature has varied between studies, the overall effect size of the association is unknown. A meta-analysis can provide useful information regarding such an overall effect size.

1.3. Purpose of the investigation

The purpose of the present meta-analytic investigation was to consolidate the results of studies investigating the association between mindfulness and connection to nature. The meta-analysis tested the hypothesis that across studies a higher level of mindfulness would be associated with more connectedness to nature. Exploratory meta-analytic moderator analyses investigated features of studies that might relate to the strength of the association between mindfulness and connectedness to nature.

2. Materials and methods

2.1. Identification of studies and extraction of data

The inclusion criteria for studies were that they (a) measured both level of mindfulness and level of connectedness to nature and (b) provided sufficient statistical results to allow the calculation of an association effect size suitable for meta-analysis. We searched the data bases Embase, Cochrane, Clinical Key, CINAHL Complete, Pubmed, Psyc INFO, Proceedings of the National Academy of Sciences and Google Scholar using the terms mindful, mindfulness and nature. We also searched the reference lists of articles relating to mindfulness and connection to nature for possible other studies for inclusion. Fig. 1 shows the search process and the number of resulting samples.

Two raters independently coded the studies included in the meta-analysis on (1) the effect size for the association between mindfulness and connection to nature, (2) *N*, (3) mean age of the sample, (4) percent of females in the sample, (5) nature of the population comprising the sample (university students, community, or mixed), (6) the mindfulness scale used in the study, and (7) the connectedness to nature scale used in the study. Effect sizes for all studies were based on cross-sectional designs, convenience samples, and reliable and valid measures of mindfulness and connectedness to nature; thus, study quality was similar for studies and was not coded. Inter-rater agreement for coding was 97%. The ratings on which there was not initial agreement were discussed and consensus reached on the final rating.

2.2. Data analyses

The meta-analysis used *r* as the effect size. When more than one effect size for the association between mindfulness and connectedness to nature was reported for the same sample, the effect sizes were averaged. Comprehensive Meta-Analysis Version 3.3 (CMA; Borenstein,

Hedges, Higgins, & Rothstein, 2014) was used to calculate the overall weighted effect size for the association between mindfulness and connectedness to nature. The CMA software was also used to perform meta-regressions and moderator analyses for these effects. According to Borenstein, Hedges, Higgins, and Rothstein (2009), a random effects model should be used when one cannot assume that the true effect will remain stable across studies. Because the sample populations differed and the effect sizes were expected to vary, we used a random effects model.

3. Results

3.1. Overall effect size for the association between mindfulness and connectedness to nature

To test the hypothesis that across studies a higher level of mindfulness would be associated with greater connectedness to nature, a mean effect size was calculated for all samples included in the meta-analysis ($k = 12$), which comprised a total of 2435 individuals. Table 1 shows the effect sizes for each study (reported as *r*). The overall mean weighted effect size was $r = 0.25$, 95% CI [0.17, 0.33], $p < 0.001$, indicating that across samples higher mindfulness was associated with greater connectedness to nature. Fig. 2 shows the forest plot of effect sizes for studies.

3.2. Publication bias

A classic fail-safe *N* test, Orwin's fail-safe *N* and Duval and Tweedie's trim and fill procedure with funnel plot tested publication bias. The fail-safe *N* of 407 indicated that 407 studies finding no association between mindfulness and connectedness to nature would be needed to bring the meta-analytic effect size to a non-significant result. Orwin's fail-safe *N* suggested that 16 studies with a 0.00 correlation would be needed to bring the meta-analysis *r* to a small correlation of 0.1. The funnel plot was slightly asymmetrical, and Duval and Tweedie's trim and fill, which produces an unbiased adjusted effect size through trimming and imputing to create a symmetrical funnel plot, resulted in an adjusted *r* of 0.24.

3.3. Heterogeneity analysis

Heterogeneity statistics showed a significant Q-Statistic, $Q(11) = 45.6$, 95% CI (18, 0.35), $p < 0.001$ and an I^2 index of 76. These results indicate heterogeneity, with the effect sizes across studies varying significantly. The I^2 index indicates that 76% of the dispersion of effect sizes is due to difference between the true effects, rather than sampling error. The results indicate that across studies effect sizes varied adequately to warrant moderator analyses.

3.4. Moderator analyses

3.4.1. Meta-regression analyses

Method of moments meta-regression assessed the moderating effect of the continuous variables of mean age of samples and percent of female participants in samples on the association between mindfulness and connectedness to nature. Samples in which participants had a higher mean age showed significantly greater effect sizes (slope = 0.012, $SE = 0.003$, 95% CI [0.006, 0.018], $p = 0.0001$). The percentage of females in samples was not significantly associated with the effect size (slope = -0.001 , $SE = 0.004$, 95% CI [-0.009 , 0.006], $p = 0.74$).

3.4.2. Categorical moderator analyses

Categorical moderator analyses examined the impact of type of population comprising samples, the scale used to assess mindfulness, and the scale used to assess connectedness with nature on the

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