

**The Effects of Mindfulness Training on Nature Connectedness
Through States of Decentering and Self-Transcendence: A
Serial Mediation Analysis**

by

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Abstract

This study investigated whether mindfulness meditation (MM) enhances nature connectedness (NC) and whether changes in decentering and self-transcendence mediate this effect. Participants ($n = 169$) were randomly assigned to MM or an active listening control across six online sessions. Nature connectedness was measured using the Connectedness to Nature Scale; while decentering and self-transcendence were assessed via the Metacognitive Processes of Decentering and Nondual Awareness Dimensional state scales, respectively. Mindfulness meditation did not directly increase NC. However, MM significantly increased decentering and self-transcendence over time. Serial mediation revealed that these changes fully mediated MM's effect on NC. Additional analyses showed that trait mindfulness did not moderate MM's impact on NC, though baseline self-transcendence predicted initial NC levels. These findings suggest MM fosters NC indirectly through its influence on specific psychological states.

Table of Contents

Abstract.....	ii
Table of Contents.....	iii
List of Tables.....	vi
List of Figures.....	vii
1.0 INTRODUCTION.....	1
1.1 Nature Connectedness.....	1
1.2 Mindfulness.....	6
1.3 Mindfulness and Nature Connectedness.....	8
1.4 Decentering.....	11
1.4 Self-Transcendence.....	14
1.5 The Current Study.....	18
2.0 METHOD.....	20
2.1 Study Design.....	20
2.2 Participants.....	20
2.3 Material and Intervention.....	22
2.4 Measures.....	23
i Nature Connectedness.....	23
ii Decentering.....	25

iii Self-Transcendence	26
2.5 Procedure	26
2.6 Statistical Analyses	28
3.0 RESULTS	31
3.1 Outliers	32
3.2 H1: NC Will Increase in Response to Mindfulness Meditation	33
3.3 H2: Increases in NC in Response to MM Will Occur Through Decentering and Self-Transcendence	34
3.4 Exploratory Analyses	37
i The Effects of Meditation on Decentering and Self-Transcendence	31
ii The Influence of Trait Mindfulness on the effects meditation on NC..	31
ii Predictors of nature connectedness	31
4.0 – DISCUSSION	41
4.1 H1: Nature Conectedness Will Increase in Response to Mindfulness Training	41
4.2 H2: Decentering and Self-Transcendence Will Partially Mediate the Effect of Mindfulness on NatureConnectedness.....	48
4.3 Additional Exploratory Analyses.....	54
4.4 Implications for Theroy, Practice, and Policy	56
4.5 Strengths and Limitations	59

4.6 Suggestions for Future Research	62
5.0 – Conclusion	66
Bibliography	67
Appendix A.....	103
Appendix B.....	108
Appendix C	109
Appendix D.....	110
Appendix E	112
Appendix F.....	116
Curriculum Vitae	

List of Tables

Table 1	31
Table 2	32
Table 3	36
Table 4	40

List of Figures

Figure 1	29
Figure 2	34
Figure 3	35
Figure 4 A	38
B	39

1.0 Introduction

Lack of connectedness to the natural world can have detrimental effects on well-being, collective responsibility, and the environment. For instance, those who have little connection to nature have lower life satisfaction, feel less affected by environmental issues, perceive climate change as less severe, and engage less in pro-environmental behaviours (PEB; Barrable & Booth, 2022; Curll et al., 2024). Having just a moderate degree of connection to nature has been linked to greater pro-environmental concern, obligation, and behaviour (Curll et al., 2024), with greater connection being associated with better mental health (i.e., positive mood and feelings of vitality), well-being, less mental distress (Nisbet et al., 2020), and personal growth (Pritchard et al., 2019). Given the influence of nature connectedness (NC) on these individual, societal, and environmental outcomes, finding ways to enhance it is crucial.

1.1 Nature Connectedness

Nature connectedness (NC) refers to the degree to which one feels emotionally connected to nature (Mayer & Frantz, 2004), as well as the extent to which one perceives themselves as part of nature (Schultz, 2002). The concept of NC has its origins in Kellert and Wilson's (1993) biophilia hypothesis. The biophilia hypothesis states that over the course of evolution, human beings have acquired the innate tendency to affiliate with nature (Kellert & Wilson, 1993). This disposition has materialized over many millennia, in which some of earth's diverse landscapes provided refuge for human survival and flourishing. Within these landscapes are features that signify a propensity toward such flourishing, such as flora, fauna, and complete ecosystems. Due to its impact on the

success of the human species, humans have a need and desire to connect, interact, and integrate with the natural world (Kellert, 1993; Wilson, 1984).

Since Kellert and Wilson's (1993) introduction of the biophilia hypothesis, there has been a great deal of research that has explored the human-nature connection (Barragan-Jason et al., 2021; Capaldi et al., 2014; Mackay & Schmitt, 2019; Pritchard et al., 2019; Sheffield et al., 2022; Tam, 2013). As a result, various characterizations of NC have been established, which most commonly describe and measure affective (i.e., the degree to which one feels emotionally connected to nature) and/or cognitive (i.e., the extent to which one includes nature in self-concept) dimensions of connectedness (see Tam, 2013). For example, the connectedness to nature (CNS; Mayer & Frantz, 2004) and the emotional affinity toward nature (EATN; Kals et al., 1999) scales measure affective aspects, while the inclusion of nature in self scale (INS) assesses the cognitive dimension (Schultz, 2002). Other measures are multidimensional, such as the nature relatedness scale (NR), which draws on affective, cognitive, and behavioural components (Nisbet et al., 2009), and the environmental identity scale (EID), which captures both cognitive and behavioural aspects (Clayton & Myers, 2009).

In addition to facets of connection, a considerable amount of research has viewed NC as both an acquired personality *trait* that remains relatively stable across time (Mayer & Frantz, 2004; Nisbet et al., 2009) and a fluctuating mental *state* that varies in response to the surrounding environment (Mayer et al., 2009; Nisbet & Zelenski, 2011).

Interestingly, some researchers have argued that levels of trait NC may increase over time as your time in nature increases and your experiences of state connectedness with nature increase (Nisbet & Zelenski, 2011). Schultz and Tabanico (2007) have found evidence

for this claim, demonstrating that the ebb and flow experience of state-like connectedness (that occurs from each instance on contact with nature) can result in a stable, enduring trait-like connectedness through frequent contact with the natural environment.

Research has shown a strong link between NC and pro-environmental behaviour (PEB). For instance, a meta-analysis conducted by Mackay and Schmitt (2019) found a strong, robust correlation between NC and PEB across various measures of NC and PEB. The researchers concluded that NC may be a prospective approach in fostering PEB. Also, NC has been found to be more strongly associated with PEB than pro-environmental knowledge. For example, Otto and Pensini (2017) examined the relationship between environmental education and PEB and found that NC had a substantially larger effect (69% explained variance) than environmental knowledge (2% explained variance) on the relationship between environmental education and PEB. A recent global meta-analysis demonstrated the potential influence that NC has on PEB, finding a significant association between NC and PEB across 147 studies (Barragan-Jason et al., 2021).

Furthermore, research has demonstrated that NC is associated with factors known to enhance PEB, like pro-social values (Arya & Kumar, 2023; Weinstein et al., 2009), environmental concern (Mayer et al., 2009; Nguyen et al., 2016; Sothmann & Menzel, 2017), less materialistic values (Gatersleben et al., 2018; J. Wang & Huo, 2022), environmental knowledge (Masud et al., 2013; Otto & Pensini, 2017), biospheric values (Ateş, 2020; Martin & Czellar, 2017), and pro-environmental attitudes (Tiwari, 2022; Whitburn et al., 2018). According to these findings, and congruent with Mackay and

Schmitt's claim, NC appears to be a promising approach in promoting PEBs, which is why it is essential to explore, understand, and establish processes that enhance NC.

Beyond its ability to increase PEB, NC has been widely linked to positive mental health. For instance, connecting with nature is associated with greater hedonic well-being (see Capaldi et al., 2014 for review), eudaemonia (see Pritchard et al., 2019 for review), positive affect (Chan et al., 2021; Mayer et al., 2009; McMahan et al., 2018; Samus et al., 2022; Yeo et al., 2021), improved emotional and cognitive self-regulation (Bakir-Demir et al., 2019), positive body image (Swami et al., 2020), greater quality of life (Baceviciene & Jankauskiene, 2022), as well as less mental distress (Nisbet et al., 2020), negative affect (Chan et al., 2021), and psychosomatic symptoms (Piccininni et al., 2018). Nature connectedness has also been linked to social well-being (Howell et al., 2011) and creativity (Leong et al., 2014). Furthermore, research has shown that the psychological benefits associated with NC extend to clinical populations. For example, Keenan et al. (2021) found that increasing nature connectedness among those with anxiety and depression significantly improves their symptoms. To summarize, NC has been linked to PEB and many aspects of mental health.

The benefits associated with NC are evident, which is why researchers have explored potential ways to increase it. In their review, Lengieza and Swim (2021) emphasize several predictors of NC, such as positive affect, motivation, worldviews and environmental education, some of which have been manipulated and shown to directly increase NC. For instance, Yang et al. (2018) found that inducing awe, a positive emotion, led to greater NC, and that NC mediated the relationship between awe and PEB. Furthermore, Poon et al. (2015) found that provoking motivation resulted in a strong

desire to connect with nature which increased PEB. Lastly, other researchers have demonstrated that providing environmental education to school children results in greater NC, which for some, can persist over time (Liefländer et al., 2013).

The most examined predictor of NC is nature exposure. Nature exposure consists of *direct* contact (i.e., interaction with actual nature) and *indirect* contact (i.e., mediated contact through various modalities, such as videos, images, and virtual reality; Sheffield et al., 2022), as well as *active* interaction (i.e., engagement with intent and awareness) and *passive* interaction (i.e., inattentive engagement; Norwood et al., 2019). A recent meta-analysis compared the level of benefit among these forms of exposure on NC and found that there was no significant difference in levels of connectedness. Furthermore, the analysis revealed that all forms of exposure have both short-term and sustained medium sized effects on NC. These findings strongly suggest nature exposure as an instrumental approach in increasing NC, regardless of how one is exposed. However, some studies have found that the sustained benefits of NC one receives from nature exposure may be dose-dependent, i.e., longer and repeated exposure leads to more enduring levels of NC (Braun & Dierkes 2016; Wyles et al., 2017).

Furthermore, the meta-analysis categorized studies as passive exposure if there were no explicit instructions for participants to actively engage with nature, yet it is uncertain whether participants were not actively engaged on the basis of no instruction. Therefore, it is difficult to discern whether there is a difference between passive and active nature exposure on NC. It is also important to note that some studies in the passive category included mindfulness practice, which results in awareness of present moment

experience (Anālayo, 2003; Bhikkhu, 1996) and could therefore lead one to be more attentive to their environment, which in this case is nature.

For instance, being more aware of and reflecting on the emotions experienced from contact with nature (Passmore & Holder, 2016), as well as being actively engaged with sensory information generated from natural surroundings leads to greater NC than just merely spending time in nature (Richardson et al., 2022). In other words, being more *mindful* while in nature arguably plays a pivotal role in the development of NC.

Interestingly, some research also suggests that mindfulness itself enhances NC (see Barragan-Jason et al., 2021 for review).

1.3 Mindfulness

The conceptualization and cultivation of mindfulness through practice was derived through eastern Buddhist tradition more than 2500 years ago (Anālayo, 2003; Schmidt, 2011) and has established its presence and rise within western secular practices within the last 40–50 years (Schmidt, 2011). Within Buddhist theory and practice, mindfulness has been conceptualized as the *state* of present moment attention and awareness to subjective experience (Anālayo, 2003; Bhikkhu, 1996); this conceptualization was also adopted by western practice, with the addition of various mental processes (Bishop et al., 2004; Kabat-Zinn, 2003). For instance, research conducted by western scholar Kabat-Zinn (1990; 2003; 2005), has incorporated attitude toward one's experience and behaviour associated with such attention and awareness; including non-judgmental insight into one's own thoughts, in a non-reactive way. However, Bernstein et al. (2015) argue that mindfulness necessitates the cognitive process of meta-awareness (i.e., the conscious awareness of one's own thoughts and

contents of psychological processes; Segal et al., 2013; Smallwood & Schooler, 2015), which may or may not lead to non-reactivity.

In addition to expanding the definition of mindfulness, some researchers have completely redefined mindfulness altogether. This reconceptualization views mindfulness as a type of mental flexibility that allows for greater ability to divide attention among novel differences of objects (Langer & Piper, 1987; Langer, 1989; 2000). However, viewing mindfulness this way, i.e., as an information processing ability (e.g., Haigh et al., 2010), fails to capture the initial process of meta-awareness, which ultimately gives rise to cognitive flexibility (A. Moore & Malinowski, 2009).

Research has shown that mindfulness exists as a relatively stable psychological *trait*, (Baer et al., 2006), and a fluctuating mental *state* (e.g., Lau et al., 2006). These characteristics of mindfulness are similar in that they both consist of one's attending to, and awareness of, present moment experience. What sets them apart is the degree to which one's present attention and awareness is either relatively stable across time (i.e., *trait*) or fluctuates in response to one's current conditions (i.e., *state*; Burzler & Tran, 2022). Furthermore, *trait* mindfulness can be cultivated through practice, such as meditation (D'Antoni et al., 2021; Kiken et al., 2015), as well as clinical interventions (e.g., Kabat-Zinn, 1990; Segal et al., 2013), and although relatively stable, can vary in magnitude over time and context (e.g., Baer et al., 2006). Similarly, *state* mindfulness can fluctuate and arise through mindfulness practice, yet is a more volatile, acute, and temporal form of present moment attention and awareness (Bishop et al., 2004; Lau et al., 2006).

1.4 Mindfulness and Nature Connectedness

Compelling research has shown mindfulness to be an effective technique in enhancing nature's influence on NC (see Barragan-Jason et al., 2021 for review). For instance, Unsworth et al. (2016) found that over the course of a three-day outdoor nature trip, 15 min of instructed mindfulness meditation practice (i.e., being aware of present moment experience and focusing on the breath) each day led to greater NC than those on the same trip without instructed mindfulness. Similarly, Nisbet et al. (2019) found that a brief 20 min nature walk with instruction to focus and maintain attention on body movement, paying attention to some aspect of nature, then becoming fully absorbed in nature, led to less negative affect and greater NC than the same walk without instructed mindfulness or a 20 min indoor walk. Other studies have found comparable results, demonstrating that focusing attention on the emotional features and engaging with the sensory qualities of nature leads to greater NC (Passmore & Holder, 2016; Richardson et al., 2022). Researchers suggest that it is the focus and acceptance of present moment experience (i.e., mindfulness), as well as the effortless processing of sensory stimuli of the natural environment that function in a complimentary way that fosters greater NC (Schutte & Malouff, 2018).

Furthermore, a meta-analysis by Sheffield et al. (2022) has shown that the increased effect of mindfully enhanced nature exposure on NC extends beyond immediate to sustained increases. For instance, Choe et al. (2020a) found that mindfulness meditation in outdoor nature resulted in significant increases in NC, pro-reflective attitudes, and decreased perceived stress compared to the same practice in outdoor built and indoor environments and was sustained at 1 month follow-up. Another

study by the same researchers found that mindfulness in nature decreased levels of stress, which continued to improve at 1 week follow-up, compared to mindfulness in non-natural environments, or relaxation-based activities in the same environments. Yet, the difference in NC was only evident between natural and non-natural environments, such that those exposed to nature while being mindful or engaged in relaxation practice exhibited greater NC than either group in non-natural environments (Choe et al., 2020b). In other words, nature was instrumental in benefiting NC, not mindfulness.

Similarly, Macaulay et al. (2022) found that there was no significant difference or change in the degree of NC between- and within-groups of mindfulness and other forms of guided engagement (i.e., directed attention and mind wandering) in nature, as well as nature exposure itself. However, their meditation-based mindfulness group did show the strongest indirect effect on NC through increased state mindfulness, with all three intervention groups having significantly greater NC via state mindfulness than the control (i.e., nature exposure itself). The lack of direct effects in both Macaulay et al. and Choe et al. (2020b) may be explained by differences in their study designs. Choe et al. compared natural to non-natural environments using inward-focused meditation, which may have reduced participants' engagement with the natural environment, potentially explaining why no difference in NC was found between the groups. In contrast, Macaulay et al. compared all natural environment groups (mindfulness meditation, directed attention to nature, and mind wandering) where the nature exposure across all groups may have minimized differences in NC, particularly since both inward-focused meditation and directed attention to nature may have similarly constrained participants' full engagement with the environment. In contrast, other studies may have found that mindfulness

enhances NC because they included non-nature control groups and used mindfulness approaches that directed attention outward, toward sensory and perceptual features of the natural environment (e.g., Nisbet et al., 2019; Sheffield et al., 2022). However, and more importantly, a greater number of studies have found that mindfulness does enhance nature's impact on NC. Therefore, mindfulness largely appears to be a useful approach in enhancing nature's effect on NC (e.g., Barragan-Jason et al., 2021; Schutte & Malouff, 2018; Sheffield et al., 2022).

In addition to its enhancing effects on nature, a global meta-analysis by Barragan-Jason et al. (2021) found that mindfulness itself is conducive in fostering NC. In fact, the analysis found that mindfulness practice led to greater levels of NC ($r = .43$) than nature contact combined with mindfulness ($r = .34$), and nature exposure alone ($r = .21$). For instance, Adventure-Heart and Proeve (2017) showed that a single, brief mindfulness session led to greater connectedness than the control group. Similarly, X. Wang et al. (2016) found that those who completed a mindful learning task had higher levels of both implicit and explicit NC than those who completed a control task. However, it is important to note that the analysis by Barragan-Jason et al. (2021) included a relatively small number of mindfulness studies. Furthermore, Ray et al., (2020) found that meditation, in general, led to greater levels of mindfulness, NC, and PEB, and that those exposed to nature sounds while meditating had greater within-group increases in NC than those not exposed to nature sounds. The analyses showed that nature exposure approached significance ($p = .054$) in moderating the relationship between mindfulness and NC, and that mindfulness itself directly led to increases in PEB as well as indirect increases through NC. These results indicate the directional effect between mindfulness,

NC, and PEB, and the role of nature exposure as a moderator that influences the effect of mindfulness on NC. Essentially, several studies suggest that mindfulness enhances NC, but more research is needed.

1.5 Decentering

Several findings show that decentering is a direct outcome of mindfulness (Bernstein et al., 2015; Dorjee, 2016; Hanley, Dorjee, & Garland, 2020) and may be involved in the link between mindfulness and NC. Decentering is a metacognitive process that involves a shift from purely subjective experience of internal events to objective observation of such events. In other words, decentering (i.e., a distanced perspective) is the ability to observe mental events that appear in the mind (e.g., thoughts and feelings) as mere events, rather than being psychologically immersed in such experiences. In fact, it is common for people to become so subsumed by their thoughts and feelings to the degree that they believe them to be reliable reflections of their ultimate reality, which can lead to maladaptive behaviour (Dorjee, 2016). Yet, when one is able to change the relationship with their internal experience through a distanced, third-person perspective (i.e., a decentered point of view), they are able to respond to their thoughts and feelings more adaptively (Gecht et al., 2014; Hoge et al., 2014).

Bernstein et al. (2015; 2019) suggest that decentering emerges through three metacognitive processes: meta-awareness, disidentification from internal experience, and reduced reactivity to thought content. Meta-awareness refers to a state of voluntary attention toward subjective experience to evaluate the content and processes of such experience (Chin & Schooler, 2009). Disidentification from internal experience is a state of separation between internal states and the self. Reduced reactivity to thought content

refers to decreased influence of the constituents of thought on other cognitive processes, such as motivation, attention, and emotion. These high-level cognitive processes constitute the metacognitive processes model of decentering (see Bernstein et al., 2015), in which meta-awareness initiates disidentification and reduced reactivity, which ultimately impact each other and promote meta-awareness (Bernstein et al., 2015; 2019).

Interestingly, it has been argued that meta-awareness is an essential feature of both decentering (Bernstein et al., 2015; 2019) and mindfulness (e.g., Dunne et al., 2019). However, reduced reactivity to thought content and disidentification from internal experience are thought to be essential for only decentering, while only potential outcomes of mindfulness (Bernstein et al., 2015; 2019). Yet, some researchers consider decentering a core aspect of mindfulness (Carmody et al., 2009; Lau et al., 2006), which denies the existence of two distinct and separate processes.

In contrast, influential Buddhist writings delineate between various related yet distinct metacognitive processes, such as decentering and mindful awareness (Anālayo, 2003). Furthermore, several contemporary researchers agree with this distinction, while also arguing that decentering is a contiguous outcome of mindfulness (Hayes-Skelton & Graham, 2012; Shoham et al., 2017; Tanay et al., 2012). Gecht et al. (2014) sought to determine whether mindfulness and decentering are separate conceptualizations by conducting a mediation analysis that parsed out the effects of the two constructs in relation to depression. The researchers found that mindfulness and decentering are related, yet distinct concepts, as the correlation between them was significantly low (see Gecht et al., 2014, Table 1). They also found that decentering is an important proximal

mechanism of mindfulness as the effect of mindfulness on depression is mediated by decentering.

Several other studies have found comparable links between mindfulness, decentering and various psychological outcomes, such that decentering mediated the effect of mindfulness on anxiety (Hayes-Skelton & Lee, 2019), depression, substance use (Pearson et al., 2014), and reduced emotional arousal (Shoham et al., 2017). Decentering has also been found to explain the relationship between mindfulness and psychological well-being (Josefsson et al., 2012). Clinical research by Fessler et al. (2016) examined the effects of mindfulness practice on bodily awareness and decentering, and how they impact depressive symptoms among those with and without depression. They found that mindfulness training significantly reduced depression through increased interoceptive awareness and decentering.

Another clinical study by Hoge et al. (2014) found similar results. The results indicated that a clinical mindfulness-based program, i.e., mindfulness-based stress reduction (MBSR), led to decreased anxiety symptoms through mindfulness and decentering. Interestingly, mindfulness and decentering played a distinct role in this relationship, such that mindfulness was the underlying mechanism responsible for the effect of MBSR on psychological anxiety, whereas decentering explained the effects of MBSR on physical anxiety. Although this study did not investigate the sequential relationship between mindfulness and decentering, it provides valuable insight into their relation to mindfulness practice and their existence as distinct mechanisms.

Research has also shown the mediating role that decentering plays between the effects of mindfulness on social connection (Adair et al., 2017) and nature connectedness

(NC; Nisbet et al., 2019), and the relationship between mindfulness and NC (Hanley et al., 2019). In support of these findings, a recent study conducted by Sanyer et al. (2023) found that decentering was positively linked to NC. That study found that the link between decentering and NC was mediated by self-transcendence.

1.6 Self-Transcendence

In the context of altered states of consciousness, self-transcendence is a temporary mental or spiritual state that involves feelings of reduced self-salience and/or a profound sense of connectedness. The experience of decreased self-salience occurs through a sense of dissolution of bodily boundaries, which is referred to as annihilation transcendence. The profound feeling of interconnectedness, even to the degree of feeling complete unity, with something beyond oneself, such as other individuals or the surrounding environment, is conceptualized as relational transcendence. It is suggested that these two distinct, yet complimentary, subcomponents of self-transcendence can occur to varying degrees, independently of each other (Yaden et al., 2017). Ultimately, a self-transcendence is a non-ordinary state of consciousness that narrows the gap between the self (“I”) and object (“it”), a dichotomy in which everyday life is typically governed by (Sanyer et al., 2023); due to the process of the self and object (e.g., other people or the surrounding environment) merging (relational STE) or dissolving (annihilational STE) into one another (Yaden et al., 2017).

In their review, Yaden et al. (2017) suggest that self-transcendental experiences can arise under various psychological circumstances, such as states of mindfulness, flow, self-transcendent positive emotions (STPEs), peak experiences and mystical encounters. These experiences, the researchers state, exist along a continuum according to their level

on transcendental intensity, with mindfulness and flow residing on the less profound end, while peak or mystical experiences residing on the more intense end. There are also various contexts in which self-transcendental experiences transpire. For instance, STPEs (e.g., awe, gratitude, love, compassion, and bliss) and peak and mystical experiences have been linked to the use of serotonergic psychedelics, such as psilocybin (Barrett & Griffiths, 2017; Cummins & Lyke, 2013; Kähönen, 2023; Newton & Moreton, 2023), religious practices (Baker, 2009; Van Cappellen, 2017; Wulff, 2000), as well as being in the presence of awe-inspiring architectural structures and natural environments (Bethelmy & Corraliza, 2019; Joye & Verpooten, 2013; McDonald et al., 2009; Snell & Simmonds, 2015). Research has also demonstrated that reaching particular developmental stages allows for peak experiences (Ellermann & Reed, 2001), that states of flow transpire when engaging and becoming absorbed in a challenging task or activity of interest (Moral-Bofill et al., 2023; Moneta & Csikszentmihalyi, 1996), and that meditation is an effective practice in inducing states of mindfulness (Baer, 2016), which can lead to states of self-transcendence (Hanley, Dorjee, & Garland, 2020). It is important to note that these experiences are not synonymous with self-transcendence itself but rather represent distinct psychological phenomena. These experiences all involve self-transcendence qualities, but to varying degrees. While they each capture unique psychological aspects, the intensity and nature of their self-transcendental qualities differ, with some experiences embodying these qualities more profoundly than others (e.g., Yaden et al., 2017).

In addition to momentary states within various contexts, self-transcendence has been a topic of interest across several disciplines (Garcia-Romeu, 2010). This has led to a

range of similar, yet distinct, conceptualizations of self-transcendence, including worldview (Mifsud & Sammut, 2023), motivation for altruistic behaviour (Jacobs & McConnell, 2022; Stellar et al., 2017), developmental process (Tornstam, 1994), value orientation (Mifsud & Sammut, 2023; Schwartz, 1992), positive affective state (Abatista & Cova, 2023), and personality trait (Levenson et al., 2005). Importantly, self-transcendental experiences may be at the core of many of these conceptualizations.

For instance, a recent review by Kähönen (2023) provides an empirical framework that describes how profound states of self-transcendence, that transpire under the use of psychedelics, lead to enduring self-transcendent values. These values, in turn, have been positively associated with motivation to engage in altruistic behaviour (Rong et al., 2023), and linked to self-transcendent worldview (Mifsud & Sammut, 2023), trait (Wayment & Bauer, 2017), and development, with the latter also linked to states of self-transcendence (Maslow, 1970). Additionally, experiencing moments of STPEs has been associated with greater prosocial behaviour (Castelo et al., 2021; Chen et al., 2022; Guan et al., 2019; Jiang & Sedikides, 2022). In fact, some researchers have suggested these STPEs emerged throughout human evolution to connect us to others by fostering prosocial behaviour (Stellar et al., 2017).

Furthermore, numerous studies have linked self-transcendent values and emotions to NC in several ways. For example, a series of studies conducted by Jacobs and McConnell (2022) found that STPEs predicted both affective and cognitive dimensions of NC, as well as self-transcendent values and PEB. Interestingly, an earlier succession of studies by the same researchers found that NC uniquely predicted pro-environmental concern, behaviour, and beliefs, as well as self-transcendent values, beliefs in

anthropogenic climate change, and pro-social emotions (McConnell & Jacobs, 2020). The researchers argued that these findings emerged due to the prosocial nature and expanded self-concept associated with STPEs.

Other studies have shown similar results, demonstrating a link between STPEs and NC (Chen et al., 2022), that STPEs fully account for the relationship between self-transcendent values and NC (Moreton et al., 2019), and that NC explains the association between STPEs and PEB (Yang et al., 2018). Additionally, evidence suggests that the acute experience of STPEs during psychedelic experiences leads to more stable and enduring STPEs throughout one's day-to-day life, leading to greater NC (Newton and Moreton, 2023), and that STPEs predict prosocial tendencies (Guan et al., 2019) and PEB (see Zelenski and Desrochers, 2021 for review). In addition to STPEs, researchers have found that self-transcendent values significantly predict NC and concern for the environment (Dornhoff et al., 2019). Collectively, these studies demonstrate the unique interplay between STPEs, self-transcendent values, NC and PEB. However, much less is known about the link between mindfulness, decentering, self-transcendence and NC.

Sanyer et al. (2023) conducted a study that examined the relationship between decentering, self-transcendence, and NC, using the nondual awareness dimensional assessment (NADA), which captures both the annihilation and relational component of self-transcendence (e.g., Hanley et al., 2018). The researchers found a significant positive relationship between all three constructs, but more interestingly they found in separate path analyses (using two separate samples) that self-transcendence partially and fully mediated the relationship between decentering and NC. Despite providing an important and detailed understanding of the relationship between decentering, self-transcendence,

and NC, these findings do not contribute to our understanding of the causal pathway between these variables.

An experiment conducted by Hanley, Dorjee, and Garland (2020) found that mindfulness training led to greater decentering and self-transcendence, and that greater decentering at midpoint of training predicted greater self-transcendence at the end of training, relative to an active listening control. Similarly, a more recent single-arm study by Hanley, Mai, and Garland (2023) observed the relationship between a modified mindfulness-based stress reduction (MBSR) program, decentering and self-transcendence. The researchers found that decentering and self-transcendence scores significantly increased during single MBSR sessions, and that in-session increases in decentering were positively linked to increases in self-transcendence. Together, the results of these studies are valuable as they provide evidence for the causal pathway between mindfulness practice, decentering and self-transcendence.

While some of the relationships among mindfulness, decentering, self-transcendence, and NC have been explored, as discussed above, no research has considered them all within the same study. Further, some of the important evidence is correlational (e.g., Sanyer et al., 2023), and results are mixed on whether mindfulness training itself enhances NC (e.g., Barragan-Jason et al., 2021; Choe et al., 2020b).

1.7 The Current Study

The primary objective of the current study was to investigate whether participation in brief, mindfulness meditation (MM) sessions would lead to greater levels of NC. Based on some evidence, it was hypothesized (H1) that NC would increase in response to MM. For instance, Adventure-Heart and Proeve (2017) found that those

exposed to a brief mindfulness session had greater levels of NC than those who engaged in progressive muscle relaxation (active control). A later meta-analysis by Barragan-Jason et al. (2021) supports these findings, showing across a small number of studies that mindfulness meditation has a medium to large effect ($r = .43$) on levels of NC.

The second objective was to understand the mechanisms (i.e., decentering and self-transcendence) that explain the effect that MM has on NC. Considering that experimental research has found decentering to significantly mediate the effect of MM on self-transcendence (Hanley et al., 2023; Hanley, Dorjee, & Garland, 2020), and that correlational research has shown self-transcendence to explain the relationship between decentering and NC (Sanyer et al., 2023), it was hypothesized (H2) that increases in NC in response to mindfulness training would be, in part, explained by changes in states of decentering and self-transcendence.

2.0 Method

To achieve these aims, the present study exposed one (experimental) group of participants to five brief guided MM sessions, and another group (active listening control) to five short podcast episodes. Both groups completed all sessions over the course of ~2 weeks. Nature connectedness was measured pre- and post- experiment, while state measures of decentering and self-transcendence were measured after each session. The entire study was conducted online.

2.1 Study Design

The current study was conducted online using Qualtrics, an online research platform. This study consisted of a repeated measures experimental design that included between- and within-subjects factors. Nature connectedness was assessed at the beginning and end of a six-session period consisting of one baseline session followed by five experimental sessions in which participants were exposed to mindfulness training instructions or the control stimulus. After the baseline and each experimental session, decentering and self-transcendence were measured. The study was approved by UNB's Research Ethics Committee (REB 2024-148) and was conducted in compliance with Canada's Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.

2.2 Participants

A total of 231 psychology undergraduate students were recruited from the University of New Brunswick Saint John (UNB-SJ) using SONA Systems online recruiting platform, and through classroom advertisement. To reduce bias, such as demand characteristics, the study was communicated as an exploration into the effects of

mindfulness with no mention of the other variables in the study. This was to enhance the validity of the study. Only UNB-SJ psychology students who were at least 18 years of age, and not currently engaged in any form of meditation practice (due to internal validity concerns), were eligible to participate. Prospective participants were directed to SONA, which provided a description of the study. In exchange for their participation, psychology undergraduate students received up to 3 bonus points (i.e., 0.5 bonus points per session) toward their final grade in eligible psychology courses of their choice.

The appropriate sample size was calculated based on the serial mediation analysis using Monte Carlo Power Analysis for Indirect Effects: an online statistical software tool used to assess a priori statistical power for mediation models (Schoemann et al., 2017; https://schoemanna.shinyapps.io/mc_power_med/). This analysis was conducted using correlation values obtained from previous studies that examined pathways from MM to control on decentering, self-transcendence, and NC (see Adventure-Heart & Proeve, 2017; Garland et al., 2022; Hanley, Bernstein et al., 2020; Nisbet et al., 2019). Values from other pathways were taken from a correlational study by Sanyer et al. (2023) that examined individual relationships among decentering, self-transcendence, and NC. To detect the indirect effects of MM on NC through decentering (M_1 ; mediator 1) and self-transcendence (M_2 ; mediator 2) at a power level of .80, the Monte Carlo Power Analysis indicated that a sample size of 110 was required. Considering the possibility of incomplete responses and attrition (~20%; see Lam et al., 2022) over the course of the study, a total of 231 participants were recruited.

Fifteen participants were redirected out of (the first session of) the study as they indicated that they were currently engaged in meditation practice, and 1 participant

withdrew their consent to participate. A total of 215 participants (meditation group, $n = 108$; control, $n = 107$) completed the first session, in which 40 participants dropped out (50% meditation group). Listwise deletion was employed to remove 6 participants from the sample that were missing data for some of the primary variables across various sessions. A total of 169 participants (69.8% female; 25.4% male; 1.2% transgender female; 1.2% transgender male; 1.8% gender variant/nonconforming; 0.6% preferred not to specify) were included in the final sample (meditation group, $n = 85$; control condition, $n = 84$), with a mean age of 21.96 ($SD = 5.00$).

2.3 Material and Intervention

The mindfulness intervention consisted of 9–11 minute mindfulness meditation audio clips obtained from the introductory course on the Waking Up meditation app (<https://wakingup.com>). The app was created by neuroscientist, philosopher, and author Sam Harris, who has an extensive amount of meditation experience (>30 years) and has studied with a diverse range of Eastern and Western teachers in the United States and overseas. Each audio clip featured meditation guide Sam Harris offering clear, non-judgmental instruction on mindfulness techniques like present-moment awareness, mindful breathing, body scan practices, and questioning the reality of the self (Harris, 2025).

The study included an active listening control condition using the same app and narrator (Sam Harris), but instead of meditation practices, the audio clips were drawn from the app's theory section, titled *Mysteries and Paradoxes*. Each clip was approximately the same length as those in the meditation intervention. The voice recordings focused on a variety of topics, including Harris's philosophy on consciousness

and first-person experience, the relationship between reason and empathy in living an examined life, and the potential usefulness of psychedelics and other consciousness-altering substances. This control was chosen as other MM studies have used audio recordings from a non-fiction audio book as a control (see Hanley, Dambrun, & Garland, 2020; Hanley, Dorjee, & Garland, 2020). However, the present study utilized audio clips from the *Waking Up* app to maintain consistency in voice, tone, and speech pattern (Borchardt & Zoccola, 2018). This approach aligns with previous research, which has controlled for potential voice preference effects by using the same voice across recordings (Day et al., 2023). Permission to use the *Waking Up* app audio content for research purposes was obtained from an app administrator.

2.4 Measures

2.4.1 Nature Connectedness

The connectedness to nature scale (CNS; Mayer & Frantz, 2004; see Appendix A) was presented to participants pre- and post-experiment to assess their levels of trait NC. The 14-item CNS includes statements (e.g., “I often feel a sense of oneness with the natural world around me” and “I think of the natural world as a community to which I belong”) that reflect the degree to which one feels connected to and affiliated with the natural world. Statements are rated on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*), with higher scores indicating greater NC. The CNS has demonstrated good internal consistency ($\alpha = .90$, Adventure-Heart & Proeve, 2017; $\alpha = .82$, Mayer & Frantz, 2004) and test-retest reliability ($r = .78, p < .001$). In the current study, internal consistency for the CNS was acceptable at pre-test ($\alpha = .76$) and good at post-test ($\alpha = .81$).

The content of the CNS includes affective and experiential dimensions of human-nature connection, both of which influential ecologists have proposed as central aspects of NC that are important in effectively addressing environmental issues (see Mayer & Frantz, 2004). The CNS demonstrates sufficient construct validity as it positively correlates with other validated scales of human-nature connection ($r = .53-.81, p < .001$; see Tam, 2013, Table 2) and does not significantly correlate with aptitude ($r = -.23; .14, p > .05$) and social desirability ($r = .17, p > .05$; Mayer & Frantz, 2004). Evidence also shows that the CNS correlates with various outcomes, such as ecological behaviour and pro-environmental support, to a similar degree as other validated measures of NC (see Tam, 2013, Table 5).

2.4.2 Decentering

The Metacognitive Processes of Decentering Scale, state version (MPoD-s; Hanley, Bernstein, et al., 2020; see Appendix B) was administered to participants after each session. The 3-item MPoD-s is a brief state version of the 15-item MPoD trait scale (MPoD-t; Hanley, Bernstein, et al., 2020), with each item capturing a dimension that, in sum, constitute the process of decentering represented by the MPoD-t. The three dimensions of the MPoD-s are: disidentification from internal experience (“I experienced my sense of self as separate from my changing thoughts, emotions, and sensations”), reduced reactivity to internal experience (“I was able to step back and be aware of distressing thoughts, emotions, and sensations without being taken over by them.”), and meta-awareness (“I was able to watch my thoughts and emotions drift by like leaves on a stream”). However, the statement representing meta-awareness was slightly reworded as “I was able to watch thoughts, emotions, and sensations come and go” to avoid a

potential priming effect on NC (see Hanley et al., 2023). Each item uniquely assesses one of these processes on an 11-point Likert scale (0 = *not at all* to 10 = *very much*), with higher scores indicating greater transient levels of decentering.

The MPoD was developed based on Bernstein et al.'s (2015) meta-cognitive processes model of decentering and is a collection of items obtained from existing validated measures of decentering (see Hanley, Bernstein, et al., 2020, Table 2). The MPoD-t has been shown to have strong significant correlations with other measures of decentering and similar constructs (e.g., well-being, mindfulness, positive affect; (see Hanley, Bernstein, et al., 2020, Table 6), as well as known-group criterion validity as significant differences in MPoD-t scores have been found between practitioners and non-practitioners of mindfulness (see Hanley, Bernstein, et al., 2020, Table 7). The MPoD-s also demonstrated criterion validity as those who practiced mindfulness experienced greater levels of decentering after a medical procedure than those who took part in psychoeducation after enduring the same surgical operation (see Hanley, Bernstein, et al., 2020). The MPoD-s has been shown to have good internal consistency ($\alpha = .83$; Hanley et al., 2023). In the current study, internal consistency for the MPoD-s was acceptable to excellent across sessions ($\alpha = .77-.89$).

2.4.3 Self-Transcendence

The state version of the Nondual Awareness Dimensional Assessment (NADA-S; Hanley et al., 2018; see Appendix C) was provided to participants post-session. The NADA-S is a scaled-down state version of the NADA trait assessment (NADA-T; Hanley et al., 2018), both of which capture levels of self-transcendence. The NADA-S is comprised of three items, each rated on a 10-point Likert scale (1 = *not at all* to 10 = *very*

much). The first item assesses relational self-transcendence (“I experienced all things seeming to unify into a single whole”) and the second measures annihilation self-transcendence (“I experienced all sense of self and identity dissolve away”). The third item captures the feeling of bliss (“I felt surrounded and filled with a blissful warmth or energy”), a STPE that often accompanies self-transcendence (see Hanley, Dorjee, & Garland, 2020).

The content of the NADA is grounded in Yaden et al.’s (2017) proposed theoretical framework of self-transcendence and was constructed by combining items from various validated measures that capture, to some degree, elements of self-transcendence that together represent the three-dimensional construct of self-transcendence (see Hanley et al., 2018, Table 1). The NADA-T has been shown to strongly correlate with other theoretically aligned concepts, such as interdependent identity and dispositional mindfulness, and has been found to occur at significantly greater levels in mindfulness practitioners than non-practitioners. Similarly, the NADA-S has also demonstrated known-groups validity as those exposed to mindfulness meditation practice exhibited significantly greater states of self-transcendence than those engaged in an attentional control task, $F(1, 557) = 43.78, p < .001, \eta^2_p = .07$ (Hanley et al., 2018). The NADA-S has been shown to have good internal reliability ($\alpha = .83$; Hanley et al., 2023). In the current study, internal consistency for the NADA-S across sessions was acceptable to excellent ($\alpha = .77-.91$).

2.5 Procedure

Each participant enrolled in the study on SONA, then received an email with a link that directed them to Qualtrics to begin their first session. After providing consent,

participants were presented with a pre-session compliance statement, asking them to complete all sessions, including the baseline, in a quiet environment with minimal distraction and noise, and to answer the questions carefully and honestly. The first baseline session began with participants being asked to answer a battery of demographic questions (see Appendices D, E, and F), including the CNS (see Appendix A), followed by a 5 min resting baseline period in which they were asked to remain seated as comfortably as possible, and with little distraction (see Hanley, Dorjee, & Garland, 2020). Then, they completed the MPoD-s and NADA-S. After completing the baseline session, participants were assigned to either the mindfulness training group or the active listening control group (podcast recording) using an alternating assignment method: the first participant was placed in the mindfulness group, the second in the control group, the third in the mindfulness group, and so forth. This approach allowed participants to participate immediately upon enrollment, ensuring an adequate sample size and the study's completion within the academic semester. In the following five experimental sessions, participants engaged in 9–11 minutes of either mindfulness training or listening to the podcast clips, depending on group assignment, followed by a pre-survey compliance statement, the MPoD-s, and the NADA-S. The final sixth session also included administering the CNS, end of session.

To access each subsequent session, participants received an email with the Qualtrics' link following the completion of the prior session. Participants completed each session within an approximately 48-hour window. If a session was not completed within this period, a gentle reminder to complete that session was emailed. This helped ensure that most sessions were completed within two weeks while providing some flexibility for

participants. Prior to beginning each session, participants were presented with a pre-session compliance statement, asking them to listen to and follow the instructions of the audio (i.e., either meditation or active listening) in its entirety and respond to the following questions, carefully and honestly, directly after so that their response accurately reflected their experience. This instruction was to help ensure greater engagement in each session within an appropriate length of time.

2.6 Statistical Analyses

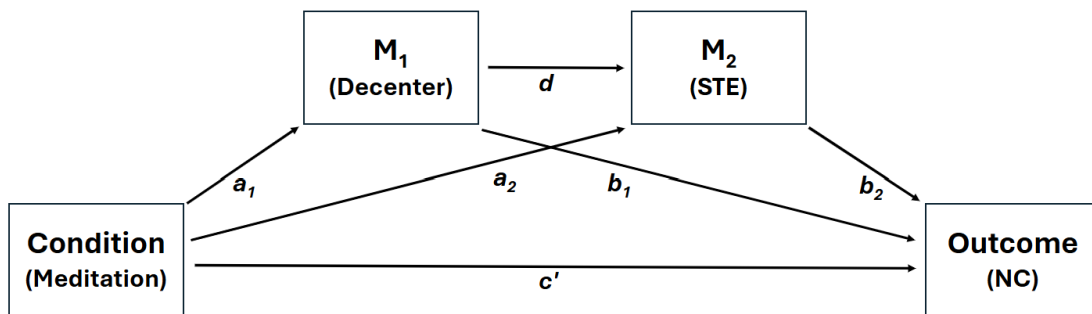
Descriptive statistics were computed for all variables, including relevant demographic factors such as age, gender, meditation experience, religiosity, and trait mindfulness, as well as baseline decentering, self-transcendence, and NC. Missing data were managed by retaining less critical missing values, while participant datasets with more significant missing information, such as missing data from the primary variables of interest (i.e., decentering, self-transcendence, NC) were excluded from the analysis. Univariate outliers were identified through visual inspection and z-score analysis and managed through winsorizing. A visual examination and Mahalanobis distance were performed on multivariate data to inspect for outliers. Distributions of univariate and multivariate data were examined for normality. Significant differences in baseline demographics between groups were examined. Only participants who completed all six sessions were included in the analysis.

To examine the overall effect of meditation on trait NC (H1), a two-way mixed ANOVA was conducted, assessing the main effects of time (pre- vs. post-experiment) and condition (meditation vs. active listening control), as well as their interaction.

To test H2, a serial mediation analysis was performed to examine the effect of meditation on baseline adjusted NC (post-experiment) through baseline adjusted decentering (mediator 1; M1) at third session (time 3; T3) and baseline adjusted self-transcendence (mediator 2; M2) at fifth session (time 5; T5) (see figure 1). Decentering was assessed at T3 as it typically emerges early in mindfulness practice (Bernstein et al., 2015; Hanley, Dorjee, & Garland, 2020), while self-transcendence, a deeper experiential outcome, was measured later at T5. This spacing reflects the theoretical ordering of the constructs (see Dorjee, 2016, Figure 2) and allows for temporal separation. Nature connectedness was assessed post-experiment to capture the cumulative effects of the full training period (i.e., all 5 experimental sessions). To examine indirect effects, a 95% bias-corrected confidence interval (CI) with 5000 resamples was employed.

Figure 1

Serial Mediation Model Explaining the Effects of Mindfulness Meditation on Nature Connectedness



Note. Serial mediation model testing the effects of mindfulness practice on baseline adjusted trait levels of nature connectedness at session six through decentering (M₁) at session three and baseline adjusted self-transcendent state (M₂) at session five, as well as all other paths.

Two separate two-way mixed ANOVAs were conducted to assess the effects of meditation on decentering and self-transcendence over time. Each analysis evaluated the main effects of time (across all six sessions: timepoints 1 through 6; T1–T6) and condition (meditation vs. active listening control), as well as the interaction between time and condition. The purpose of this analysis was to 1) explore whether these shifts in experience across sessions will be similar to what has been found in previous research, and 2) serve as manipulation checks by examining the degree of change in decentering and self-transcendence in response to the intervention, given that these states are well-established outcomes of mindfulness practice (Hanley et al. 2018; Hanley et al., 2023; Hanley, Bernstein, Nakamura et al., 2020; Hanley, Dorjee, & Garland, 2020).

Two additional exploratory analyses were performed: a moderation analysis to determine whether trait mindfulness influenced the relationship between condition and baseline-adjusted NC, and a multiple regression analysis to identify whether age, gender, meditation experience, religiosity, trait mindfulness, baseline decentering, and baseline self-transcendence predicted baseline NC levels.

In all analyses, except for the multiple regression examining predictors, age, gender, meditation experience (see Appendix D) Feldman et al., 2010), religiosity (see Appendix G), and trait mindfulness (see Appendix F) were included as control variables to account for their potential influence on outcomes.

All data analyses were performed using IBM SPSS version 29.0. Model six of Hayes' (version 4.0) PROCESS macro for SPSS (Hayes, 2022) was used with SPSS to examine the serial mediation and exploratory moderation analysis.

3.0 Results

Unpaired t-tests revealed that all descriptive variable scores did not differ significantly ($p > .05$), except for decentering ($p < .001$), between the experimental and control groups. See Table 1 for baseline measure descriptives and unpaired t-test results for between-group differences. See Table 2 for bivariate correlations.

Table 1

Baseline Variable Descriptives and Unpaired t-test Results

Baseline variables	<i>M</i>			<i>SD</i>			<i>t</i>	<i>df</i>	<i>p</i>
	MM	Con	Total	MM	Con	Total			
Age	21.11	20.85	20.96	5.09	4.95	5.00	0.31	167	.512
Nature	46.77	47.55	47.17	7.21	6.42	6.80	-	167	.142
Decentering	16.29	17.39	16.83	7.07	5.25	6.21	-	155.50	.002
Self-	12.07	12.98	12.49	5.95	5.40	5.69	-	167	.318
Trait mindfulness	73.43	74.64	74.08	11.00	9.71	10.35	-	167	.552
Religiosity	29.46	29.21	29.29	10.84	11.37	11.06	0.09	167	.462
Meditation	1.83	1.80	1.81	0.62	0.67	0.65	0.26	167	.439
Gender	-	-	-	-	-	-	0.22	167	.969

Note. $N = 169$ (mindfulness meditation group, $n = 85$; control group, $n = 84$). MM = mindfulness meditation group; Con = control group; Total = total sample.

Table 2*Bivariate Correlations for Baseline Measure Outcome Variables and Covariates*

Variables	1	2	3	4	5	6
1. Nature connectedness	1	.15	.26**	.15	.07	.13
2. Decentering		1	.55**	.21**	-.01	.01
3. Self-transcendence			1	.10	.17*	.04
4. Trait mindfulness				1	.01	-.01
5. Religiosity					1	.11
6. Meditation experience						1

Note. $N = 169$. * $p < .05$. ** $p < .01$.

3.1 Outliers

Univariate outliers were examined in SPSS via descriptives statistics. Kurtosis and skewness for all variables of primary interest (i.e., NC, decentering, and self-transcendence at all timepoints) were within the ± 1 and ± 3 range, respectively. Univariate normality was also visually examined, which indicated an extreme outlier for NC pre-experiment. This value was adjusted to the lower limit ($M - (3 \times SD)$) from 18 to 27. The post-experiment NC value associated with this score was also adjusted from 26 to 39 to reflect the same degree of NC change ($\uparrow 69\%$).

Multivariate outliers were assessed using Mahalanobis distance, with a critical χ^2 value of 32.91 ($df = 12, p < .001$). There were four cases that exceeded this threshold, which were flagged for further inspection. Each outlier was removed one at a time, until all four were removed. However, sensitivity testing revealed that the removal of these outliers had relatively little impact on the over results or conclusions of the analysis and therefore remained in the analysis. Multivariate normality was assessed by examining

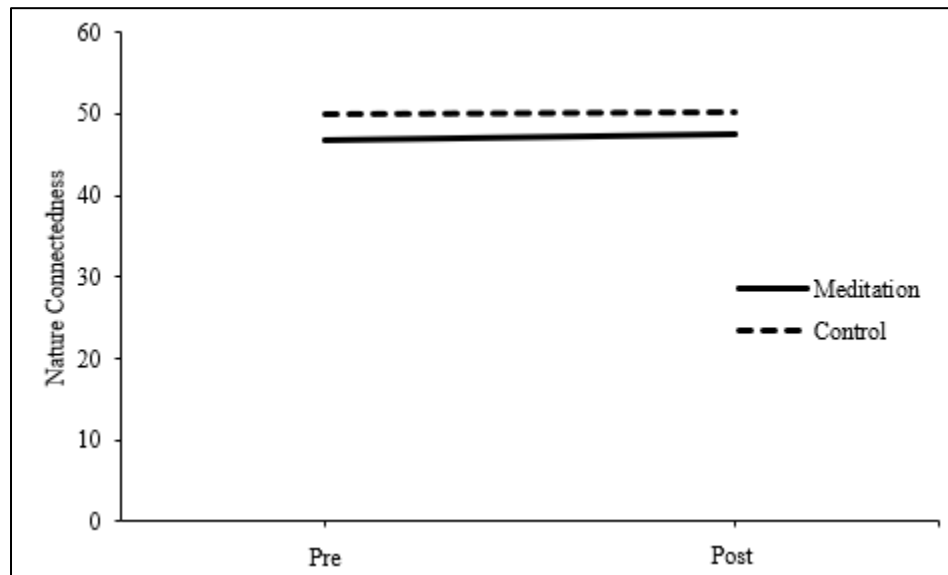
residual values for each DV at each timepoint across conditions. Skewness and kurtosis were within an acceptable range. The Shapiro-Wilk test indicated normality for most timepoints, with a few exceptions showing significant ($p < .05$) deviations. Histograms and Q-Q plots largely suggested normality, with uncertainty of a few timepoints. Box's M test indicated that the observed covariance matrices of the DV's are equal across groups, $M = 104.90$, $F(78, 87017.25) = 1.24$, $p = .07$.

3.2 H1: NC Will Increase in Response to MM

A two-way mixed ANOVA was conducted to examine the overall effect of meditation on trait NC which examined the main effect of time (pre- vs. post-experiment) and condition (meditation vs. active listening control), as well as the interaction between time and condition, while controlling for age, gender, trait mindfulness, meditation experience, and religiosity. The results revealed no significant main effects of time, $F(1, 161) = 1.00$, $p = .32$, $\eta^2_p = .006$, and condition, $F(1, 161) = 0.20$, $p = .65$, $\eta^2_p = .001$ (meditation group, $M = 47.55$, $SD = 6.42$; control group, $M = 50.18$, $SD = 6.90$), nor a significant interaction between time and condition, $F(1, 161) = 0.48$, $p = .49$, $\eta^2_p = .003$. These findings do not support H1. See Figure 2 for illustration of pre- and post-experiment mean scores for both the meditation and control groups.

Figure 2

Pre- and Post-Experiment Mean Scores for Nature Connectedness



Note. Mean scores for nature connectedness for both the meditation and control groups pre- and post-experiment.

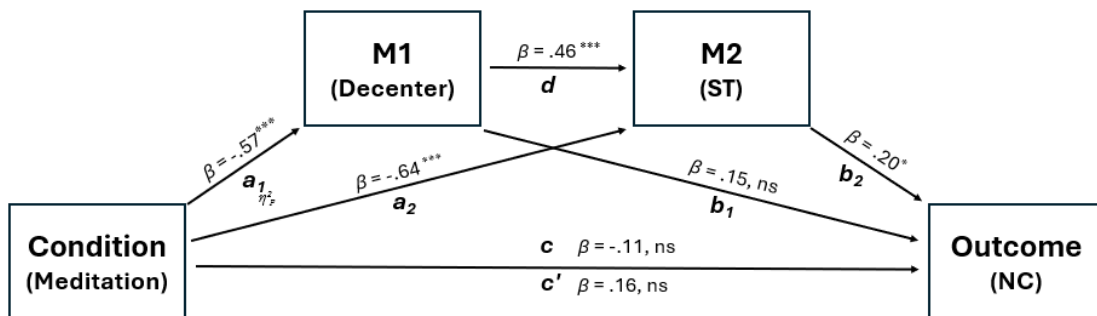
3.3 H2: Increases in NC in Response to MM Will Occur Through Decentering and Self-Transcendence

Both mediators (decentering and self-transcendence) and the outcome variable (NC) were baseline adjusted before entering them into the serial mediation model. Age, gender, trait mindfulness, meditation experience, and religiosity were also entered into the model as covariates. The serial mediation analysis indicated no significant direct effect ($b = 0.93$, $SE = 0.99$, $t(161) = 0.95$, $p = .35$, 95% CI [-1.02, 2.88]) of intervention on NC but showed indirect effects (using 5000 bootstrapped samples) via self-transcendence ($b = -0.75$, $SE = 0.42$, 95% CI [-1.71, -0.07]) and sequentially through decentering and self-transcendence ($b = -0.31$, $SE = 0.18$, 95% CI [-0.73, -0.03]). There was no indirect effect of group on NC through decentering ($b = -0.50$, $SE = 0.40$, 95% CI

[-1.44, 0.15]). These findings indicate that meditation has an indirect effect on NC through self-transcendence alone, and sequentially through decentering and self-transcendence. Decentering did not mediate the effect of condition on NC independently but facilitated self-transcendence, which in turn was linked to increases in NC. These results partially support H2. See Figure 3 for serial mediation model with standardized path coefficients and Table 3 for total, direct, and indirect effects.

Figure 3

Serial Mediation Pathway with Standardized Coefficients



Note. $N = 169$. $^*p < .05$. $^{**}p < .01$. ns = non-significant. Condition = meditation group vs active listening group; M1 = mediator 2 (decentering); M2 = mediator 2 (ST; self-transcendence); Outcome = nature connectedness. All standardized coefficients reflect baseline adjusted scores for both mediators and the outcome variable.

Table 3*Total, Direct, and Indirect effects of the Serial Mediation Model*

Mediation pathways	Unstandardized values					
	β	B	SE	t	95%CI	
					LL	UL
Total effect: IV \rightarrow DV	-.11	-0.63	0.91	-0.69	-2.42	1.16
Direct effect: IV \rightarrow DV	.16	0.93	0.99	0.95	-1.02	2.88
Unstandardized Indirect effects	B		Boot SE		Boot 95%CI	
					Boot LL	Boot UL
IV \rightarrow M1 \rightarrow DV	-0.50		0.40		-1.44	0.15
IV \rightarrow M2 \rightarrow DV	-0.75		0.42		-1.70	-0.07
IV \rightarrow M1 \rightarrow M2 \rightarrow DV	-0.31		0.18		-0.73	-0.03
Partially standardized Indirect effects	$p\beta$		Boot SE		Boot95%CI	
					Boot LL	Boot UL
IV \rightarrow M1 \rightarrow DV	-.09		0.07		-0.24	0.03
IV \rightarrow M2 \rightarrow DV	-.13		0.07		-0.28	-0.01
IV \rightarrow M1 \rightarrow M2 \rightarrow DV	-.05		0.03		-0.13	-0.01

Note. $N = 169$. IV = independent variable (mediation vs active listening); DV = dependent variable (nature connectedness); M1 = mediator 1 (decentering); M2 = mediator 2 (self-transcendence); Boot = 5000 bootstrapped samples. All coefficients reflect baseline adjusted scores for both mediators and the dependent variable. SE , t , and CI for total and direct paths reflect unstandardized (B) effects.

3.4 Exploratory Analyses

3.4.1 *The effects of meditation on decentering and ST*

Two separate two-way mixed ANOVAs were employed to examine the overall effect of meditation on decentering and self-transcendence across time. Each analysis assessed the main effect of time across all six sessions (T1–T6), and condition (meditation vs. active listening control) on each dependent variable, as well the interaction between time and condition on each outcome while controlling for age, gender, trait mindfulness, meditation experience, and religiosity.

For the main effect of time, Mauchly's Test of Sphericity was violated for both decentering $\chi^2(14) = 122.15, p < .001$, and ST, $\chi^2(14) = 129.03, p < .001$, therefore the Greenhouse-Geisser correction was applied. For decentering, the results revealed that the main effect of time was not significant, $F(3.80, 611.18) = 0.60, p = .70, \eta^2_p = .004$, however the main effect of condition, $F(1, 161) = 13.90, p < .001, \eta^2_p = .079$, and the interaction between time and condition, $F(3.80, 611.18) = 14.10, p < .001, \eta^2_p = .081$, were significant (see Figure 4a).

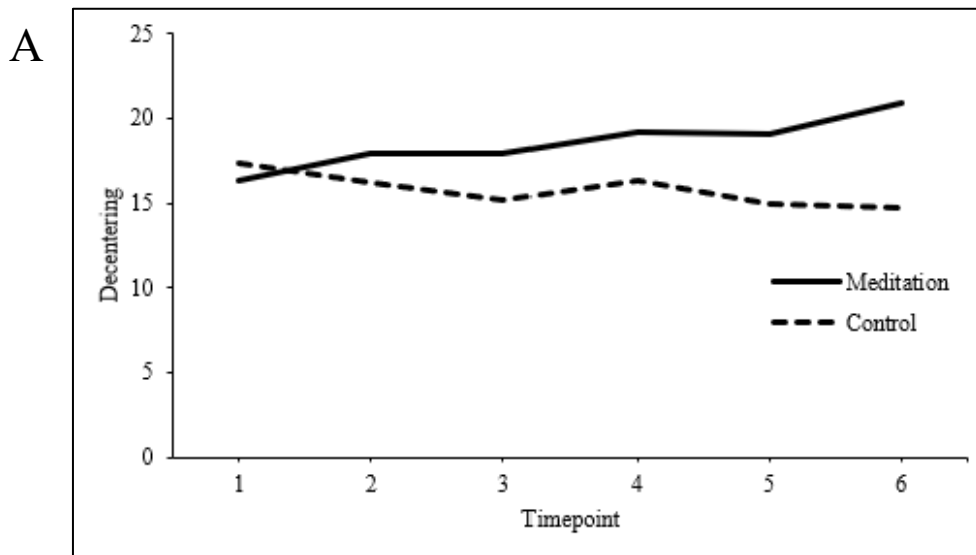
With regard to self-transcendence, the main effect of time was also not significant, $F(3.68, 593.00) = 0.62, p = .69, \eta^2_p = .004$, but the main effect of condition, $F(1, 161) = 13.01, p < .001, \eta^2_p = .075$, and the interaction between time and condition, $F(3.68, 593.00) = 18.17, p < .001, \eta^2_p = .101$, were significant (see Figure 4b).

The significant interaction between time and condition for both decentering and self-transcendence indicates that while the overall effect of time was not significant, the mindfulness intervention led to greater changes over time compared to the control group. This suggests that, although time alone did not produce significant changes, the condition

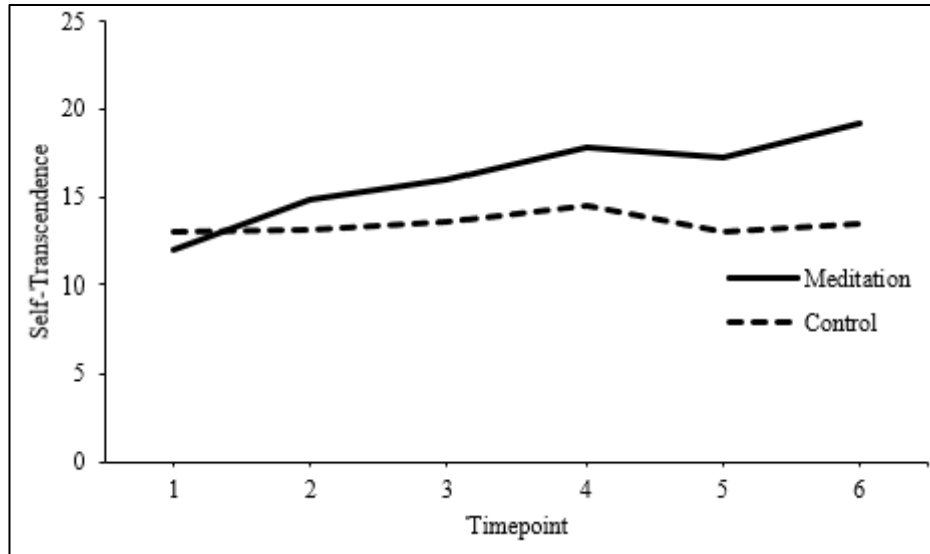
(meditation vs. control) influenced the trajectory of both decentering and self-transcendence, with the meditation group showing significantly greater increases across sessions.

Figure 4

Changes in Decentering (A) and Self-Transcendence (B) Across Time



Note. Decentering mean scores across all six timepoints for both the meditation and control groups.

B

Note. Self-transcendence mean scores across all six timepoints for both the meditation and control groups.

3.4.2 The influence of trait mindfulness on the effects of meditation on NC

A moderation analysis was conducted to examine whether trait mindfulness moderated the effect of condition on (baseline adjusted) NC, while controlling for age, gender, prior meditation experience and religiosity. The overall model was not significant, $F(7, 160) = 1.16$, $MSE = 34.21$, $p = .33$, $R^2 = .048$. Neither the main effect of condition, $b = -9.02$, $SE = 6.71$, $t(160) = -1.35$, $p = .18$, 95% CI [-22.27, 4.22], nor the main effect of trait mindfulness, $b = -0.14$, $SE = 0.14$, $t(160) = -1.04$, $p = .30$, 95% CI [-0.41, 0.13], were significant. Critically, the interaction effect between condition and trait mindfulness was not significant, $b = 0.11$, $SE = 0.09$, $t(160) = 1.26$, $p = .21$, 95% CI [-0.06, 0.29]. These results indicate that trait mindfulness did not moderate the effect of condition on NC.

3.4.3 Predictors of Nature Connectedness

A multiple regression was conducted to examine whether age, gender, meditation experience, religiosity, trait mindfulness, baseline decentering, and baseline levels of self-transcendence predict baseline measured NC. The overall model was significant, $F(7,160) = 3.07, p < .001$, explaining 12% of the variance in NC, $R^2 = .12$, Adjusted $R^2 = .08$. When examining individual predictors, self-transcendence was the only variable that significantly contributed to the overall model ($B = 0.32, SE = 0.11, t(160) = 2.96, p = .004$; see Table 4). This analysis indicated that at baseline – prior to any experimental manipulation – self-transcendence positively predicted NC.

Table 4

Multiple Regression: Test Statistics for Predictors of NC

Variables	β	B	SE	t	p
Age	.15	0.20	0.10	1.91	.059
Gender	-.03	-0.31	0.74	-0.42	.677
Meditation experience	.12	1.23	0.79	1.55	.122
Religiosity	.02	0.01	0.05	0.27	.786
Trait mindfulness	.10	0.07	-0.05	1.28	.201
Decentering	-.01	-0.01	0.10	-0.09	.929
Self-transcendence	.27	0.32	0.11	2.96	.004

Note. $N = 169$.

4.0 Discussion

This study examined whether brief mindfulness sessions increase trait nature connectedness (NC) over time, and whether this change occurs through states of decentering and self-transcendence. Results revealed that, while the intervention increased corollaries of mindfulness including decentering and self-transcendence, as expected, it did not lead to an increase in NC. Nonetheless, serial mediation analysis revealed that changes in NC were fully mediated by changes in decentering and self-transcendence.

4.1 H1: Nature Connectedness Will Increase in Response to Mindfulness Training

As noted above, there was no significant difference between the experimental and control groups with respect to the effect of mindfulness training on NC over the course of the study. These results do not agree with some research that did find an effect of mindfulness on NC (Adventure-Heart & Proeve, 2017; Chloe et al., 2020b; Ray et al., 2020; J. Wang, 2017; X. Wang, 2016). There are a few possible reasons for the difference between the findings of the present study and past research. One possible explanation is differences in methodology. For instance, research conducted by J. Wang et al. (2017) and X. Wang et al. (2016) employed a cognitive task-based mindfulness intervention (CTBMI) that is rooted in Langer's (1989) conceptualization of mindfulness, i.e., a state of active engagement and openness to novelty, where individuals remain context-sensitive and avoid habitual thinking. In other words, the task facilitated active engagement, flexibility, openness, and creative thinking (Pirson et al., 2012), whereas the intervention in our study consisted of the intentional act of non-doing – i.e., the cultivation of present moment awareness to subjective experience without interference

(Anālayo, 2003; Bhikkhu, 1996). Interestingly, a study by Garrison et al. (2015) examined differences in neural activity in response to mindfulness meditation, similar to what was employed in the present study, versus a cognitive task, similar to the intervention given in the J. Wang et al. and X. Wang et al. studies. They found that meditation led to greater reductions in default mode network activity (DMN)— a neural network involved in self-referential processing. Which, interestingly, could be linked to NC as less pathological self-related thinking has been linked to increased connection to nature. However, adaptive self-referential processing has been positively associated with NC (see Lengieza & Swim, 2021 for review). These findings demonstrate a need for further research on the link between specific self-related processes, the DMN, and NC.

Furthermore, the X. Wang and J. Wang studies face several limitations. For example, the CTBMIs included subtasks that involved creating novel categories with given words (e.g., “sunshine”, “prairie”, and “ocean”) that depict aspects of nature. Yet the intervention in the current study made no reference to the natural environment. Therefore, it could be that exposure to nature, rather than the mindfulness task itself, led to greater NC. This is an important factor to consider, as many studies have shown that exposure to nature stimuli of various sorts, from actual time spent in nature to nature-related sounds and images, enhances NC (see Sheffield et al. 2022).

Another limiting factor is that X. Wang et al. employed two different measures pre- (CNS) and post-experiment (Inclusion of Nature in Self scale; INS; Schultz, 2002). This is a key aspect to consider because the CNS is an affective measure of NC, whereas the INS gauges one’s cognitive representation of connection. By assessing these related but distinct aspects of NC (Tam, 2013), in this way, it is not possible to draw clear

conclusions about the impact of the intervention on NC. Similarly, J. Wang et al. measured NC only post-intervention, which is a similar limitation but more problematic as it does not control for prior levels of nature connectedness (Kuppens et al., 2010), making it even more difficult to attribute any observed differences to the intervention rather than pre-existing variability (see Baldwin, 2018).

The final thing to consider is that the above studies, and the INS employed within them, do not explicitly indicate whether they are assessing state or trait outcomes of NC. This is an essential factor to take into account as each study's intervention consisted of a single 15–20 m mindfulness session, which would likely reflect state NC and not trait NC; as such brief interventions are considered not sufficient in eliciting trait factors (see Almenröder et al., 2024 for review). In the current study, however, the scale used was specifically designed to assess trait levels of NC (i.e., the CNS; Mayer & Frantz, 2004).

While the above studies (J. Wang et al., 2017; X. Wang et al., 2016) used a distinctly different intervention (cognitive with nature), there are some that have found effects on NC using interventions that are similar to those used in the present study. For instance, Adventure-Heart and Proeve (2017) found that those who completed a brief session of mindfulness training or love and kindness meditation had significantly greater levels of NC (via the state adapted CNS) than those exposed to a relaxation control. However similar, the researchers measured state levels of NC in response to a single mindfulness session versus trait levels of NC in response to five sessions of practice over time in the present study. And like J. Wang (2017), Adventure-Heart and Proeve conducted a post-test only design, which leads to the same validity issues described above.

Few studies have examined the effects of mindfulness training on NC, in which most have not isolated the effects of meditation itself. Instead, they have compared meditation with and without nature exposure (e.g., Ray et al., 2020), making it difficult to determine whether any observed increases in NC stem from the meditation practice or the natural environment. This distinction is important, as previous research has shown that simply being in nature can enhance NC, independent of meditation (Sheffield et al., 2022), and that mindfulness enhances nature's effect on NC (Nisbet et al., 2019; Passmore & Holder, 2016; Richardson et al., 2022).

For example, Ray et al. (2020) found increases in NC in response to a similar intervention, and that nature enhanced the interventions effect on NC, using a longitudinal design. The study consisted of a four-week online meditation program that included three to five 15 m sessions per week but measured *trait* NC both pre- and post-experiment. However, the experiment did not include a non-meditation control in addition to the intervention group that consisted of mindfulness meditation with nature sounds. Rather, the control group included the same meditation practice, but with spa sounds. Not having a non-meditation control, or meditation without any background music, means that it is not possible to determine whether meditation itself increases NC. Furthermore, spa music often incorporates some aspect of natural elements in addition to soft, soothing, and ambient music. This may have accounted for the increase in NC, as previously mentioned, numerous studies have demonstrated that exposure to nature itself increases NC (Braun & Dierkes 2016; Sheffield et al., 2022; Wyles et al., 2017).

Similar to Ray et al. (2020), Choe et al. (2020a) compared those who took part in a 1 hr per week mindfulness-based stress reduction (MBSR) training in either a natural,

outdoor built, or indoor environment over a 6-week period. The results showed that only the nature condition experienced significantly greater levels of NC over time.

Nevertheless, there was no non-meditation control group, again making it impossible to determine whether it was meditation that contributed, or played a unique role, in the increase in NC.

In another study, the same researchers included a non-meditation control. The study examined differences in NC between those exposed to either a MBSR or relaxation condition within natural and non-natural environments, over the course of 3 weeks. The findings revealed significant increases in NC in only those exposed to nature, while either meditating or relaxing, whereas non-natural environments had no effect on NC. That is, meditation without nature (in built environments) did not increase NC. These findings suggest that nature exposure, rather than meditation itself, was the driving factor in increasing NC (Choe et al., 2020b).

Of all the above mentioned studies, the one that revealed similar results (i.e., no effect of meditation in built environment on NC) like the present study was Choe et al. (2020b), which was methodologically similar. For instance, the CNS employed in our study and the nature relatedness scale (NR; Nisbet et al., 2009) implemented by Choe et al. (2020b) are two distinct, yet highly correlated ($r = .76$; Tam, 2013) trait measures of NC. And despite variations in the session length and frequency, the overall length of both experiments was comparable. Also, the mindfulness content within the interventions employed in the current study (Waking Up app) and Choe et al.'s (2020b) experiment (MBSR; Kabat-Zinn, 1982) share core features. Specifically, both emphasize mindfulness as the central technique for cultivating awareness of present moment experience by

observing thoughts, the breath, and bodily sensations without judgement or overidentification, i.e., through decentering. Furthermore, Chloe et al. (2020b) included non-meditation and meditation without nature groups, which assists in separating the effects attributable to mindfulness practice, as in the current study. Considering the similar methodological features between Chloe et al. (2020b) and the current study, and the fact that both studies found mindfulness to have no effect on NC, it is reasonable to conclude that mindfulness practice itself does not influence NC.

To summarize, while the findings from most of the studies discussed above are inconsistent with ours, their differences in methodological choices offer insight behind this discrepancy. Key differences, in some but not all the above-mentioned studies, include substantially different interventions and scale used to measure NC, posttest only design, a single session, and lack of non-meditation control.

Understanding ways to enhance NC is important, given its well-documented links to both positive mental health (Baceviciene & Jankauskiene, 2022; Bakir-Demir et al., 2019; Capaldi et al., 2014; Pritchard et al., 2019; Samus et al., 2022) and pro-environmental behaviors (Otto & Pensini, 2017; Mackay & Schmitt, 2019). A recent meta-analysis (Barragan-Jason et al., 2021) concluded that mindfulness interventions on their own enhance NC. However, the results of the present study, along with the methodological issues in prior research discussed above, cast doubt on that conclusion. Many of these studies lacked rigorous controls to isolate the effects of mindfulness itself, and their findings are complicated by factors such as nature exposure, the type of mindfulness intervention used, and differences in how NC was measured. Importantly, it

remains to be seen whether mindfulness interventions alone reliably enhance NC—a question that future research must address.

What is well established, however, is that nature exposure itself enhances NC (Brambilla et al., 2024; Braun & Dierkes 2016; Norwood et al., 2019; Sheffield et al., 2022; Wigley et al., 2025). Furthermore, while our findings suggest that mindfulness practice alone may not directly increase NC, prior research does indicate that mindfulness enhances nature’s effect on NC (Nisbet et al., 2019; Passmore & Holder, 2016; Richardson et al., 2022). This is crucial, as it suggests that mindfulness may still play a valuable role in strengthening the connection individuals feel with nature, just not in isolation from nature exposure itself.

While the intervention did not impact NC, it did have a significant effect on decentering and self-transcendence compared to the control across sessions. In fact, not only did the mindfulness group have consistently higher levels of decentering and self-transcendence at each time point, but it also generated time-dependent change. That is, the mindfulness group experienced significantly progressive increases in decentering and self-transcendence across sessions, whereas the control group showed little to no change in these states over time.

These results are consistent with previous theoretical frameworks, and findings from studies that are rooted in theory, which suggest that decentering and self-transcendence are direct mechanisms of action that emerge from mindfulness practice (Bernstein et al., 2015; Dorjee, 2016; Hanley et al., 2018; Hanley et al., 2023; Hanley, Dorjee, & Garland, 2020). Perhaps of even greater importance is that this body of evidence validates the intervention used in this study, demonstrating that the intervention

had the intended effects upon these corollaries of mindfulness. This provides further support to the notion that mindfulness itself has no significant effect on NC.

4.2 H2: Decentering and Self-Transcendence Will Partially Mediate the Effect of Mindfulness on Nature Connectedness

The pathway from mindfulness practice to NC through decentering and self-transcendence was investigated through serial mediation analysis. Our findings partially support our second hypothesis, in that both decentering and self-transcendence (path 1), and self-transcendence alone (path 2) fully mediated the effect of mindfulness practice on NC. This indicates that mindfulness practice indirectly increased NC through two distinct pathways: 1) by first fostering a distanced and non-reactive perspective on thoughts, emotions, and bodily sensations (decentering at mid-point of training), which then reduced self-salience while enhancing general connection and bliss (self-transcendence at end of training), ultimately leading to relatively stable feelings of connection to nature (post-experiment); and 2) by directly promoting self-transcendence, which in turn increased NC.

Prior to the present study, existing literature, collectively, suggested a potential path among these variables. For instance, Bernstein et al.'s (2015) "metacognitive processes model" suggests that decentering is a potential proximal outcome of mindfulness due to the state of meta-awareness invoked from practice, which then allows for the ability to be less reactive to and increasingly disidentified with thoughts, feelings, and physical sensations. Dorjee's (2016) model of "modes of existential awareness" (MEA) extends this path to self-transcendence, proposing that self-transcendence is a direct consequence of decentering. This is because decentering affords the ability to shift

from the “self” being the purview of attention, to a less limited field of awareness that allows for the loosening of self-boundaries and greater connection that are often accompanied by self-transcendent positive emotions (STPEs; Bernstein et al., 2015; 2019; Shoham et al., 2017; Yaden et al., 2017). Furthermore, experimental studies, including the current one, and cross-sectional research provide support for these models. For example, Hanley, Dorjee, and Garland (2020) found that mindfulness practice directly increased self-transcendence and indirectly through states of decentering, while Sanyer et al. (2023) found that self-transcendence partially and fully mediated the link between decentering and NC in two separate samples.

The findings from this analysis provide additional evidence in favour of the MEA hierarchy put forward by Dorjee (2016), while also providing preliminary support for an extended causal pathway that includes NC as a sequential outcome of self-transcendence. The extension of NC in this pathway can be explained by several factors, connected to both dimensions of self-transcendence and the emotions that often arise with it.

First, mindfulness practice allows one to adopt a distant, third-person perspective of the self, marked by reduced emotional reactivity and judgment (i.e., a decentered view), in which the self becomes less self-salient (Bernstein et al., 2015). Opposite to this decentered view are things like self-objectification (Scott, 2010), self-awareness (Frantz et al., 2005), and anxious, self-preoccupation with concerns about self-worth or the fear of failure (Richardson & Sheffield, 2015), which have all been linked to lower levels of NC. This is likely because greater self-focus leads one to emphasizing their uniqueness and seeking to distinguish themselves from others and the environment (Le & Levenson,

2005), resulting in greater feelings of disconnection. This highlights the crucial process of decentering in mitigating this excessive, pathological identification with the self.

The extent of reduced self-salience experienced is reflected in annihilation self-transcendence. By attenuating the sense of self, individuals may experience a deeper connection to their surroundings or something beyond themselves (Dambrun, 2016). For example, some researchers propose that NC involves a state of interconnectedness, where the self, others, and nature merge through the dissolution of physical boundaries and a shared sense of being (Dutcher et al., 2007). This phenomenon of diminished self-salience extends beyond the practice of meditation, with pharmacological research highlighting the link between NC and intense experiences of ego-dissolution—marked by a significant reduction in self-salience—following psilocybin use (Nour et al., 2017).

The most apparent sub-feature linked to NC within this path is relational self-transcendence. This aspect refers to a sense of connectedness with something beyond the self, typically involving other people and one's surrounding context, reflecting a sense of spiritual or transpersonal sense of connectedness (Yaden et al., 2017). Furthermore, several researchers suggest that connectedness arises in various forms, such as connectedness to the self (Klussman et al., 2022), others (Aron et al., 1992), and as in the current study, nature (Mayer & Frantz, 2004); which indicates that connectedness is a multidimensional construct (Townsend & McWhirter, 2005). In fact, Watts et al. (2022) demonstrated that self, other, and world connectedness collectively reflect a general sense of connectedness, as demonstrated through the development of the Watts Connectedness Scale. It could be that the transpersonal connection that was captured in the current study,

through relational self-transcendence, not only promotes connection to nature, but is an antecedent to many other forms of connection as well.

In addition to both facets of self-transcendence, numerous studies have shown that STPEs that often accompany transcendental experiences, such as awe, compassion, all-embracing love, gratitude, and bliss predict both connection to nature (Chen et al., 2022; Jacobs & McConnell, 2022; Sanyer et al., 2023; C. Wang et al., 2022), and to others (Algoe & Haidt, 2009; Aron et al., 1992; Fredrickson, 2009). While these emotions are not a fundamental feature of self-transcendence, some, like bliss, are believed to arise from experiential insights enabled by nondual awareness, which is reflected in both annihilational and relational forms of self-transcendence (Dambrun & Ricard, 2011). And it is meditative practice, like that of the current study, that has been extensively linked to such deep personal insights (see Tulver et al., 2023 for review).

While the present and past research provides an understanding of the path from mindfulness to NC through states of decentering and self-transcendence, the current study also found that mindfulness indirectly increased NC through just self-transcendence. Interestingly, in their theory of MEA, Dorjee (2016) suggests that certain forms of contemplative practice may skip certain MEA, in this case, decentering. However, to our knowledge, there seems to be no research that explains why decentering is not a necessary psychological intermediary between mindfulness practice and self-transcendence. As informed by the present findings, it could be that our intervention led to direct induction of self-transcendence, without the prior experience of decentering, in some participants. For instance, research conducted by De Oliveira et al. (2024) found that meta-awareness (a component of mindfulness) was responsible for the effect of

practice on STPEs, which have been linked to NC (Chen et al., 2022; Jacobs & McConnell, 2022; C. Wang et al., 2022). However, the same researchers found that the disidentification component of decentering mediated the effect between meditation practice and self-transcendence, including both annihilation and relational self-transcendence.

Another possible explanation for this second mediated path is the temporal process of analysis in the current study. As previously outlined, baseline adjusted scores for decentering at T3, self-transcendence at T5, and NC at T5 were entered into the serial mediation model. Since decentering reflected earlier scores in the study, it is possible that its effects were transient or context-dependent, whereas self-transcendence (measured directly prior to measured NC) may have reflected a stronger, more immediate psychological state that led to NC. This may indicate that decentering plays a role earlier in the process, and that in the fifth session, self-transcendence had taken over as the dominant mechanism that fully explained the effect of practice on NC. In other words, it appears that decentering helps set the stage for self-transcendence initially but is not required for sustaining or amplifying self-transcendence as practice continues.

Lastly, and similar to what is mentioned above, decentering and self-transcendence are conceptualized as either a state or trait (Bernstein et al., 2015; 2019; Yaden et al., 2017), which questions whether the temporal quality of each construct might influence how individuals respond to an intervention like mindfulness, and how this in turn affects nature connectedness (NC). To clarify, a state refers to temporary, fluctuating experiences (like decentering as a momentary shift in awareness), whereas a trait refers to more stable, enduring qualities (like decentering as a stable skill or

disposition). For example, decentering may function more as a metacognitive skill (Duncan et al., 2021) than a transient experience, suggesting it is more stable and gradually strengthened over time with repeated mindfulness practice. In contrast, self-transcendence may reflect a more immediate experiential shift in consciousness (Hanley et al., 2018), which reduces self-salience and increases feelings of interconnectedness, making it more immediate and responsive to mindfulness practice.

Therefore, it could be that mindfulness had a stronger impact on self-transcendence, because transcendence is more temporal in nature than decentering, which then directly influenced NC, a more proximal and relevant psychological process to NC. This could also explain why decentering alone did not significantly influence NC in the present study.

The lack of association between decentering and NC in the current study differs from what was found in the cross-sectional research conducted by Sanyer et al. (2023), who found both a direct and indirect relationship between decentering and NC through self-transcendence across two separate samples. However, Sanyer et al. measured *trait* decentering and self-transcendence at a single time point, while our study assessed these constructs as *states* that fluctuated across time. Since decentering may function more as a stable trait rather than a fluctuating state (as discussed above), it is possible that trait decentering is more strongly linked to trait NC. In contrast, state decentering may be more context-dependent and transient, which may explain why it didn't show the same relationship with NC in the current study. This distinction between trait and state might clarify why Sanyer et al. found significant links between decentering and NC, while the present study did not.

Sanyer et al. suggest that individuals who can decenter, i.e., observe their internal experiences from a detached perspective, may find it easier to reconnect with nature due to their stable sense of self-awareness. However, in our study, state decentering may have been too fleeting to create a lasting connection to nature. In other words, state decentering may serve as a temporary mechanism that sets the stage for self-transcendence or other enduring shifts, while trait decentering reflects the cumulative impact of those moments, leading to a more stable and sustained perspective that aligns with NC.

In summary, mindfulness practice fosters NC, with self-transcendence playing a key role. Decentering, as a transient state, seems to initiate this process, while self-transcendence, a more enduring shift, is a more direct pathway to NC. Our findings, in line with Sanyer et al. (2023), suggest that trait decentering is more consistently linked to trait NC, while state decentering, being more fleeting, may serve as an earlier precursor that facilitates self-transcendence, ultimately leading to a stronger and more stable connection to nature.

4.3 Additional Exploratory Analyses

Considering that several studies have demonstrated the link between mindfulness and NC (Barbaro & Pickett, 2016; Hanley, Bettmann, Kendrick et al., 2020; Jansen et al., 2024; Schutte & Malouff, 2018), the current study explored whether baseline levels of trait mindfulness influenced the effect of meditation on NC. The moderation analysis revealed that mindfulness did not moderate the effect of the intervention upon NC. In line with this finding, research conducted by Kiken et al. (2015) found that baseline levels of trait mindfulness did not predict state level trajectories of mindfulness over the course of an 8-week MBSR program. However, trait mindfulness has been found to influence

various other incomes. For instance, a large meta-analysis of randomized controlled trials by Sieder et al. (2024) found that baseline trait mindfulness significantly moderated the effect of mindfulness-based interventions on outcomes of both mental health and trait mindfulness. That said, the effect of this influence was relatively small. Taken together, this suggests the possibility that mindfulness practice itself may be a more substantial facilitator of change than pre-existing levels of mindfulness, at least in the context of cultivating NC.

The current study conducted another exploratory analysis to examine which factors predict baseline NC, drawing on previous research (see Lengieza & Swim, 2021) that identified several predictors of NC, including individual differences, situational contexts with and without nature (e.g., meditation), and internal mental states (e.g., decentering and self-transcendence). This analysis was conducted independently of the main longitudinal design. Our results found that baseline self-transcendence was the only significant predictor, whereas age approached significance ($p = .06$). Overall, these findings are, for the most part, in line with existing evidence (see Lengieza & Swim, 2021 for review).

The significant link between self-transcendence and NC suggests that individuals with a stronger pre-existing tendency toward self-transcendent experiences may already perceive themselves as part of the natural world, independent of mindfulness practice (Sanyer et al., 2023). Furthermore, the near-significant effect of age observed in the current study suggests a potential developmental trend. Lengieza and Swim (2021) propose that age may have a curvilinear effect on NC, where children initially outgrow their connection to nature, but later, starting in adulthood, begin to re-strengthen their

bond with nature. In line with this, evidence provided by Afacan (2024) found a positive association between NC and gerotranscendence. Gerotranscendence is the developmental shift toward greater connectedness and existential awareness as we age and is closely related to self-transcendence. Afacan's findings suggest that as individuals age and experience this shift, their connection to nature may naturally deepen, reinforcing the developmental trajectory implied by both the self-transcendence-NC link and the age-related resurgence in NC.

4.4 Implications for theory, practice, and policy

The findings of this study offer meaningful contributions to theory, practice, and policy, providing new insights that may guide future research and inform real-world applications. From a theoretical perspective, these results expand our understanding of the path from mindfulness practice to NC, highlighting NC as an outcome of practice through states of decentering and self-transcendence, and its relevance to existing models, such as the MPoD (Bernstein et al., 2015; 2019) and MEA (Dorjee, 2016), and theoretical frameworks (Yaden et al., 2017). This suggests the need for a refined and extended framework that accounts for NC.

The practical implications of this research are significant, as they can be implemented to create hands-on strategies for psychologists in various fields, including clinical practitioners and environmental conservationists, that could enhance both individual and environmental health outcomes. For example, findings from several studies suggest that mindfulness practice is an effective approach that improves various health outcomes (Fincham et al., 2023; Guillaume et al., 2024; Khoury et al., 2013) and has been the core of many well-established and validated psychotherapeutic approaches

to treating specific clinical populations (Gilbert, 2009; Hayes et al., 1999; Linehan, 1987). Importantly, the current study provides an understanding of the path from mindfulness, which can be applied therapeutically, to connectedness. Understanding this path is particularly beneficial for mindfulness-based clinical interventions, as it allows practitioners to more precisely target mechanisms of change, tailoring mindfulness interventions to not only reduce distress (Ghawadra et al., 2019) but also foster a sense of connection (Adventure-Heart & Proeve, 2017) and meaning (Hanner, 2024). This more comprehensive approach could enhance therapeutic outcomes by addressing both intrapersonal and interpersonal well-being, as decentering, self-transcendence, and NC have all been linked to positive mental health (Alves et al., 2022; Chan et al., 2021; Ellermann & Reed, 2001; Gandy et al., 2021; Hoge et al., 2014).

In addition to individual benefits, implementing a more holistic mindfulness-based approach could more precisely promote environmental behaviour (PEB; Ray et al., 2020; Thiermann & Sheate, 2022). This is increasingly important as climate change has contributed to a dramatic rise in global natural disasters and temperatures (Arnell et al., 2019; Hayhoe et al., 2017; National Centers for Environmental Information, 2023; Thomas & López, 2015), which have led to devastating impacts on some species (Cahill et al., 2013; J. W. Moore & Schindler, 2022; Prakash, 2021), human health, and the economy (Ortiz-Bobea et al., 2021). Given the urgent need for action to mitigate the climate crisis, fostering pro-environmental behaviour (PEB) is paramount, and understanding the psychological mechanisms that encourage such behaviour is essential.

Mindfulness-based approaches, by cultivating a present-focused, compassionate awareness, have the potential to promote not only emotional resilience in the face of

environmental degradation but also a shift in perspective that supports greater interconnectedness with the natural world (Wamsler, 2018). Unfortunately, research also suggests that greater NC can sometimes be associated with worse psychological symptoms, such as anxiety and despair, when exposed to environmental crises and natural disasters (Léger-Goodes et al., 2022; Thomson & Roach, 2023). Therefore, it is crucial to incorporate mindfulness-based approaches to offset these negative effects. Having a practice in place that fosters decentering and self-transcendence may not only lead to greater NC and PEB but also help mitigate the psychological distress that can arise from such heightened sensitivity to the natural world, offering a promising avenue for addressing the ecological challenges of our time.

At the level of policy, these findings highlight the importance of integrating mindfulness-based programs into public health and pro-environmental strategies, with a particular focus on fostering self-transcendence and, to a lesser extent, decentering, as essential mechanisms for increasing NC. Governments and institutions could support the development and dissemination of mindfulness-based practices through funding, education, and advocacy, recognizing the potential to enhance both individual mental health (see Bristow, 2019) and collective PEB. Such initiatives could involve implementing mindfulness practices within school curriculums, workplace wellness programs, and community mental health services, fostering a culture of mindfulness, connection, and ecological responsibility. Unfortunately, mindfulness interventions are notably underrepresented in global and public health literature and practice, indicating a need for such programs (Oman, 2023). By prioritizing policies that promote the cultivation of self-transcendence, alongside decentering, such approaches may not only

promote psychological resilience and reduce symptoms like anxiety and despair for those already increasingly connected to nature (Léger-Goodes et al., 2022; Thomson & Roach, 2023), but also encourage a deeper, connection for those who are not highly connected (Adventure-Heart & Proeve, 2017), while promoting PEB (Ray et al., 2020).

4.5 Strengths and limitations

A key strength of the current study is its experimental design with an adequate control condition, which allowed us to isolate the effects of mindfulness on NC by manipulating the intervention (mindfulness vs. active listening control). This approach is particularly valuable, as other studies have not included a sufficient control condition (e.g., Ray et al., 2020; Choe et al., 2020a), which inhibit the ability to draw conclusions about the unique contribution of mindfulness meditation on NC, offering greater insight into its effects.

Another strength of the current study is its ability to measure dynamic states of decentering and self-transcendence following each mindfulness session. While prior research (Hanley, Dorjee, & Garland, 2020) has explored these states in response to mindfulness, this study builds on that work by examining how fluctuations in decentering and self-transcendence over time contribute to trait-level NC post-experiment. This approach is important because prior research has shown mixed results regarding whether mindfulness practice itself increases NC (Adventure-Heart & Proeve, 2017; Choe et al., 2020b). Our study suggests that it may not be mindfulness itself, but rather the processes of decentering and self-transcendence, that are needed to facilitate an increase in NC. This provides a more detailed and nuanced understanding of how mindfulness practice leads to greater NC.

Furthermore, while two previous studies in this area relied solely on post-test measures of NC (Adventure-Heart & Proeve, 2017; J. Wang et al., 2017), and one used a different NC measure pre- and post-experiment (X. Wang et al., 2017), our study measured NC both before and after the experiment using the same measure throughout. This approach is important because it allows for a more accurate assessment of changes in NC directly resulting from the intervention, offering a more precise and valid assessment of how mindfulness training influences NC over time.

A final strength of the current study is its longitudinal design, which allowed us to observe the effects of mindfulness meditation on trait-level NC over an extended period. This approach is particularly important because it provides a more comprehensive understanding of how mindfulness practice can influence NC, beyond short-term or immediate changes, through the sequential processes of decentering and self-transcendence.

Although there are many strengths, the current study also has some weaknesses. For instance, the study was conducted entirely online, which reduced control over the participants' environment. In an online setting, participants may have been exposed to various distractions, such as notifications or the presence of other individuals, and technical difficulties that could have interfered with their ability to effectively meditate (Lam et al., 2023). This lack of control over the physical environment may have diminished the effectiveness of the experimental manipulation. However, we asked each participant to complete each session in a quiet environment with minimal distractions, and the online format allowed for greater accessibility and convenience, which may have helped to recruit a larger sample (see Sassenberg & Ditrich, 2019).

Additionally, our sample consisted solely of university students, which may not fully reflect the broader population in terms of age, cultural background, or life experience. University students are often younger, more educated, and may have more homogeneous life experiences, which could limit the generalizability of the findings to other age groups or demographic backgrounds (Henry, 2008). This sample could bias the results, as it may not capture how mindfulness practice, and its effects on states like decentering and self-transcendence, apply to the wider population.

Another potential weakness is that states of decentering and self-transcendence were only measured after each session, rather than before, which limited the ability to capture within-session changes in these states. Pre- and post-measures are crucial for assessing how the intervention directly impacts these states during the session (Dimitrov & Rumrill, 2003) as opposed to solely observing changes between sessions or across groups. However, pre-session measures were intentionally excluded to mitigate potential response bias that could arise from participants anticipating changes or outcomes based on pre-session data (Furnham & Henderson, 1983). While baseline state measures were taken at the start of the experiment, the addition of pre-session measures would have offered a clearer picture of how these states evolved during each session.

Lastly, we did not administer a follow-up measure of NC to assess whether the effects of mindfulness practice on NC were sustained over time. While some research has shown long-lasting effects of mindfulness on NC (Ray et al., 2020), the absence of a follow-up in the current study limits our ability to fully evaluate whether these changes, driven by decentering and self-transcendence, persist over time or diminish. This is crucial in understanding whether mindfulness practice (through decentering and self-

transcendence) leads to lasting changes in nature connectedness or if the effects are temporary.

4.6 Suggestions for future research

To our knowledge, only one study has examined state NC in response to a single, brief mindfulness session; however, NC was examined post-session only (Adventure-Heart & Proeve, 2017). Thus, future research should assess state NC after multiple mindfulness sessions. Doing so would provide an understanding how state NC fluctuates in response to repeated training over time, how these momentary shifts relate to states of decentering and self-transcendence, and how all these states impact trait levels of NC. Additionally, most research has focused on either affective NC (Adventure-Heart & Proeve, 2017; Ray et al., 2020), or connection to nature via a multidimensional NC scale that did not distinguish the contribution of its cognitive dimension (Choe et al., 2020a; 2020b; Nisbet et al., 2019), in response to mindfulness meditation. Given the psychological nature of the self (Westen, 1992), and its link to the cognitive processes relevant to the current study (mindfulness, decentering, and self-transcendence; Shireen et al., 2022; Bernstein et al., 2015; Hanley et al., 2018), it would be valuable to explore cognitive NC in response to mindfulness training.

Subsequent research should also investigate how mindfulness training influences both state and trait levels of decentering and self-transcendence, as well as their link to NC. Thus far, experimental studies have focused on the immediate, state-level effects of mindfulness training on decentering and self-transcendence (Hanley et al., 2018; Hanley et al., 2023; Hanley, Bernstein, Nakamura et al., 2020; Hanley, Dorjee, & Garland, 2020), while cross-sectional research has explored the relationships between trait

decentering, self-transcendence, and NC (Sanyer et al., 2023). However, it remains uncertain as to whether sustained mindfulness practice cultivates trait-level decentering and self-transcendence over time and whether these potential long-term shifts contribute to NC. In addition to these long-term shifts in decentering and self-transcendence post-experiment, this area of research would also benefit if subsequent studies assessed these traits, as well as dispositional NC, at follow-up to explore the potential sustained benefits of mindfulness practice long after training.

Another valuable initiative for future research would be to examine specific facets of decentering (meta-awareness, non-reactivity, and disidentification) and self-transcendence (annihilation, relational, and bliss). Doing so would offer more detailed and refined insight into how these sub-processes work individually and together to foster NC, such as which aspects contribute more substantially and uniquely than other aspects of the same construct.

While one study has compared differences in state NC in response to either a single brief mindfulness meditation or loving-kindness training session (Adventure-Heart & Proeve, 2017), research has yet to examine this longitudinally, in relation to decentering and self-transcendence, and with respect to trait NC. Investigating these factors would be valuable, as it could clarify whether mindfulness meditation, which emphasizes present moment awareness with openness and curiosity (Tanay & Bernstein, 2013), has distinct long-term effects on NC, compared to compassion-based practices, such as loving-kindness meditation, which foster empathy and emotional connection (Zeng et al., 2015). By comparing these approaches over time, researchers could determine which practice is more effective in strengthening NC and how both

decentering and self-transcendence contribute to this process. Additionally, because empathy (Di Fabio & Kenny, 2018) and compassion (Lumber et al., 2017) have been linked to NC, examining how these qualities develop through compassion-based practice could clarify their role in the potential fostering of NC. Understanding these dynamics could help refine meditation-based interventions aimed at enhancing a lasting and meaningful connection with nature.

Future studies should also explore the effects of mindfulness on NC across more diverse populations than the sample (university students) that was used in the current study. Examining individuals from varying age groups, cultural backgrounds, and life experiences would help determine whether the findings from the current study are generalizable across different demographic groups. Expanding the scope of research in this way would provide an understanding of how mindfulness practice influences NC in different contexts, offering valuable insights into the broader application and effectiveness of mindfulness meditation.

Another important avenue for future research is examining how the pathway identified in the present study (i.e., linking mindfulness practice, decentering, self-transcendence, and NC) may extend to PEB. Given the urgent climate crisis (Hayhoe et al., 2017; National Centers for Environmental Information, 2023; Thomas & [López](#), 2015) and the detrimental effects of human activity on the environment (Mahmoud & Gan, 2018; Prakash & Verma, 2022; Yue & Gao, 2018), understanding psychological mechanisms that foster PEB is critical. Research has shown that factors such as biospheric values (Karp, 1996; Latif et al., 2013; Ling & Xu, 2020; Nordlund & Garvill, 2002; Schultz & Zelezny, 1998), environmental attitudes (Best & Mayerl, 2013; Casaló

& Escario, 2018; Jakučionytė-Skodienė et al., 2020; Kesenheimer & Greitemeyer, 2021), and pro-social tendencies (Arya & Kumar, 2023) contribute to PEB, yet further investigation is needed into how mindfulness-based interventions may encourage these behaviors. Since NC is a well-documented predictor of PEB (Anderson & Krettenauer, 2021; Duong & Pensini, 2023; Liu et al., 2022), exploring whether mindfulness-driven increases in NC translates into greater ecological concern and action would provide valuable real-world insights. Future studies should assess whether cultivating self-transcendent experiences and decentering through mindfulness strengthens not only NC but also the motivation to engage in sustainable behaviors, ultimately contributing to efforts aimed at addressing the climate crisis.

5.0 Conclusion

This study was the first to examine the effects of mindfulness practice on nature connectedness (NC) through the mediating roles of decentering and self-transcendence. The findings revealed that mindfulness meditation did not directly influence NC; rather, its effects emerged through two distinct pathways—one sequentially through decentering and ST, and the other through self-transcendence alone. These results provide new insights into the psychological mechanisms underlying the effects mindfulness training on NC, highlighting the importance of self-transcendent experiences in fostering a deeper connection with nature. Additionally, the study underscores the complexity of this process, suggesting that mindfulness practice alone may not be sufficient in promoting NC without the facilitation of broader shifts in self-perception and awareness.

Future research should continue to explore the nuances of this pathway, including the specific facets of decentering and self-transcendence that contribute to NC, the long-term effects of mindfulness practice, and how these processes may extend to pro-environmental behavior. Additionally, investigating how different mindfulness-based interventions, such as compassion-focused practices, influence NC through these and other mechanisms could provide valuable insights into improving meditation-based approaches for enhancing NC. It is through greater understanding of these pathways that researchers can better inform interventions aimed at strengthening individuals' connection to nature, which may have meaningful implications for both psychological well-being and environmental sustainability.

Bibliography

- Abatista, A. G., & Cova, F. (2023). Are self-transcendent emotions one big family? An empirical taxonomy of positive self-transcendent emotion labels. *Affective Science*, 4(4), 731–743. <https://doi.org/10.1007/s42761-023-00194-1>
- Adair, K. C., Fredrickson, B. L., Castro-Schilo, L., Kim, S., & Sidberry, S. (2017). Present with you: Does cultivated mindfulness predict greater social connection through gains in decentering and reductions in negative emotions? *Mindfulness*, 9(3), 737–749. <https://doi.org/10.1007/s12671-017-0811-1>
- Adventure-Heart, D. J., & Proeve, M. (2017). Mindfulness and loving-kindness meditation. *Psychological Reports*, 120(1), 102–117. <https://doi.org/10.1177/0033294116685867>
- Afacan, Y. (2024). Exploring the facilitators of the gerotranscendence theory: Correlations among sustainable behaviors, biophilic design, and nature connectedness. *Health Environments Research & Design Journal*, 17(4), 150–171. <https://doi.org/10.1177/19375867241271433>
- Algoe, S. B., & Haidt, J. (2009). Witnessing excellence in action: The ‘other-praising’ emotions of elevation, gratitude, and admiration. *The Journal of Positive Psychology*, 4(2), 105–127. <https://doi.org/10.1080/17439760802650519>
- Alves, S., Betrabet Gulwadi, G., & Nilsson, P. (2022). An exploration of how biophilic attributes on campuses might support student connectedness to nature, others, and self. *Frontiers in Psychology*, 12, 1–14. <https://doi.org/10.3389/fpsyg.2021.793175>
- Anālayo, B. (2003). *Satipaṭṭhāna: The direct path to realization*. Windhorse Publications.

- Anderson, D. J., & Krettenauer, T. (2021). Connectedness to nature and pro-environmental behaviour from early adolescence to adulthood: A comparison of urban and Rural Canada. *Sustainability*, *13*(7), 1–17. <https://doi.org/10.3390/su13073655>
- Arnell, N. W., Lowe, J. A., Challinor, A. J., & Osborn, T. J. (2019). Global and regional impacts of climate change at different levels of global temperature increase. *Climatic Change*, *155*(3), 377–391. <https://doi.org/10.1007/s10584-019-02464-z>
- Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, *63*(4), 596–612. <https://doi.org/10.1037/0022-3514.63.4.596>
- Arya, B., & Kumar, H. (2023). Value behaviour norm theory approach to predict private sphere pro-environmental behaviour among university students. *Environmental and Climate Technologies*, *27*(1), 164–176. <https://doi.org/10.2478/rtuect-2023-0013>
- Ateş, H. (2020). Merging theory of planned behavior and value identity personal norm model to explain pro-environmental behaviors. *Sustainable Production and Consumption*, *24*, 169–180. <https://doi.org/10.1016/j.spc.2020.07.006>
- Baceviciene, M., & Jankauskiene, R. (2022). The mediating effect of nature restorativeness, stress level, and nature connectedness in the association between nature exposure and quality of life. *International Journal of Environmental Research and Public Health*, *19*(4), 1–15. <https://doi.org/10.3390/ijerph19042098>
- Baer, R. A. (2016). Assessment of mindfulness and closely related constructs: Introduction to the special issue. *Psychological Assessment*, *28*(7), 787–790. <https://doi.org/10.1037/pas0000309>

- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27–45. <https://doi.org/10.1177/1073191105283504>
- Baker, J. O. (2009). The variety of religious experiences. *Review of Religious Research, 51*(1), 39–54.
- Bakir-Demir, T., Berument, S. K., & Sahin-Acar, B. (2019). The relationship between greenery and self-regulation of children: The mediation role of nature connectedness. *Journal of Environmental Psychology, 65*, 1–7. <https://doi.org/10.1016/j.jenvp.2019.101327>
- Baldwin, L. (2018). Research designs and their limitations. In *Research concepts for the practitioner of educational leadership* (pp. 37-48). Brill. https://doi.org/10.1163/9789004365155_008
- Barbaro, N., & Pickett, S. M. (2016a). Mindfully green: Examining the effect of connectedness to nature on the relationship between mindfulness and engagement in pro-environmental behavior. *Personality and Individual Differences, 93*, 137–142. <https://doi.org/10.1016/j.paid.2015.05.026>
- Barrable, A., & Booth, D. (2022). Disconnected: What can we learn from individuals with very low nature connection? *International Journal of Environmental Research and Public Health, 19*(13), 1–9. <https://doi.org/10.3390/ijerph19138021>
- Barragan-Jason, G., de Mazancourt, C., Parmesan, C., Singer, M. C., & Loreau, M. (2021). Human–nature connectedness as a pathway to sustainability: A global meta-analysis. *Conservation Letters, 15*(1), 1–7. <https://doi.org/10.1111/conl.12852>

- Barrett, F. S., & Griffiths, R. R. (2017). Classic hallucinogens and mystical experiences: Phenomenology and neural correlates. In: A. L. Halberstadt, F. X. Vollenweider, D. E. Nichols (Eds.), *Behavioral neurobiology of psychedelic drugs: Vol. 36. Current topics in behavioral neurosciences* (pp. 393–430). Springer.
https://doi.org/10.1007/7854_2017_474
- Bernstein, A., Hadash, Y., & Fresco, D. M. (2019). Metacognitive processes model of decentering: Emerging methods and insights. *Current Opinion in Psychology*, 28, 245–251. <https://doi.org/10.1016/j.copsy.2019.01.019>
- Bernstein, A., Hadash, Y., Lichtash, Y., Tanay, G., Shepherd, K., & Fresco, D. M. (2015). Decentering and related constructs. *Perspectives on Psychological Science*, 10(5), 599–617. <https://doi.org/10.1177/1745691615594577>
- Best, H., & Mayerl, J. (2013). Values, beliefs, attitudes: An empirical study on the structure of environmental concern and recycling participation. *Social Science Quarterly*, 94(3), 691–714. <https://doi.org/10.1111/ssqu.12010>
- Bethelmy, L. C., & Corraliza, J. A. (2019). Transcendence and sublime experience in nature: Awe and inspiring energy. *Frontiers in Psychology*, 10, 1–12.
<https://doi.org/10.3389/fpsyg.2019.00509>
- Bhikkhu, T. (1996). *The wings to awakening* (7th ed.). Dhamma Dana Publications.
- Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, 11(3), 230–241. <https://doi.org/10.1093/clipsy.bph077>

- Bohlmeijer, E., ten Klooster, P. M., Fledderus, M., Veehof, M., & Baer, R. (2011). Psychometric Properties of the five facet mindfulness questionnaire in depressed adults and development of a short form. *Assessment, 18*(3), 308–320. <https://doi.org/10.1177/1073191111408231>
- Borchardt, A. R., & Zoccola, P. M. (2018). Recovery from stress: An experimental examination of focused attention meditation in novices. *Journal of Behavioral Medicine, 41*(6), 836–849. <https://doi.org/10.1007/s10865-018-9932-9>
- Brambilla, E., Petersen, E., Stendal, K., Sundling, V., MacIntyre, T. E., & Calogiuri, G. (2024). Effects of immersive virtual nature on nature connectedness: A systematic review and meta-analysis. *DIGITAL HEALTH, 10*, 1–25. <https://doi.org/10.1177/20552076241234639>
- Braun, T., & Dierkes, P. (2016). Connecting students to nature – how intensity of nature experience and student age influence the success of outdoor education programs. *Environmental Education Research, 23*(7), 937–949. <https://doi.org/10.1080/13504622.2016.1214866>
- Bristow, J. (2019). Mindfulness in politics and public policy. *Current Opinion in Psychology, 28*, 87–91. <https://doi.org/10.1016/j.copsyc.2018.11.003>
- Burzler, M. A., & Tran, U. S. (2022). Dispositional mindfulness and the process of mindfulness cultivation: A qualitative synthesis and critical assessment of the extant literature on the five facet mindfulness questionnaire (FFMQ). *Collabra: Psychology, 8*(1), 1–27. <https://doi.org/10.1525/collabra.56176>

- Cahill, A. E., Aiello-Lammens, M. E., Fisher-Reid, M. C., Hua, X., Karanewsky, C. J., Yeong Ryu, H., Sbeglia, G. C., Spagnolo, F., Waldron, J. B., Warsi, O., & Wiens, J. J. (2013). How does climate change cause extinction? *Proceedings of the Royal Society B: Biological Sciences*, *280*, 1–9. <https://doi.org/10.1098/rspb.2012.1890>
- Capaldi, C. A., Dopko, R. L., & Zelenski, J. M. (2014). The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in Psychology*, *5*, 1–15. <https://doi.org/10.3389/fpsyg.2014.00976>
- Carmody, J., Baer, R., Lykins, L., & Olendzki, N. (2009). An empirical study of the mechanisms of mindfulness in a mindfulness-based stress reduction program. *Journal of Clinical Psychology*, *65*(6), 613–626. <https://doi.org/10.1002/jclp.20579>
- Casaló, L. V., & Escario, J.-J. (2018). Heterogeneity in the association between environmental attitudes and pro-environmental behavior: A multilevel regression approach. *Journal of Cleaner Production*, *175*, 155–163. <https://doi.org/10.1016/j.jclepro.2017.11.237>
- Castelo, N., White, K., & Goode, M. R. (2021). Nature promotes self-transcendence and prosocial behavior. *Journal of Environmental Psychology*, *76*, 1–5. <https://doi.org/10.1016/j.jenvp.2021.101639>
- Chan, S. H., Qiu, L., Esposito, G., Mai, K. P., Tam, K.-P., & Cui, J. (2021). Nature in virtual reality improves mood and reduces stress: Evidence from young adults and senior citizens. *Virtual Reality*, *27*, 3285–3300. <https://doi.org/10.1007/s10055-021-00604-4>

- Chen, L., Liu, J., Fu, L., Guo, C., & Chen, Y. (2022). The impact of gratitude on connection with nature: The mediating role of positive emotions of self-transcendence. *Frontiers in Psychology, 13*, 1–12.
<https://doi.org/10.3389/fpsyg.2022.908138>
- Chin, J. M., & Schooler, J. W. (2009). Meta-awareness. In William P. Banks, (Ed). *Encyclopedia of Consciousness, vol. 2*, pp. 33–41. Oxford.
<https://doi.org/10.1016/b978-012373873-8.00051-7>
- Choe, E. Y., Jorgensen, A., & Sheffield, D. (2020a). Does a natural environment enhance the effectiveness of mindfulness-based stress reduction (MBSR)? Examining the mental health and wellbeing, and nature connectedness benefits. *Landscape and Urban Planning, 202*, 1–12. <https://doi.org/10.1016/j.landurbplan.2020.103886>
- Choe, E. Y., Jorgensen, A., & Sheffield, D. (2020b). Simulated natural environments bolster the effectiveness of a mindfulness programme: A comparison with a relaxation-based intervention. *Journal of Environmental Psychology, 67*, 1–13.
<https://doi.org/10.1016/j.jenvp.2019.101382>
- Clayton, S., & Myers, G. (2009). *Conservation psychology: Understanding and promoting human care for nature*. Wiley-Blackwell.
- Cummins, C., & Lyke, J. (2013). Peak experiences of psilocybin users and non-users. *Journal of Psychoactive Drugs, 45*(2), 189–194.
<https://doi.org/10.1080/02791072.2013.785855>

- Curll, S. L., Stanley, S. K., Brown, P. M., & O'Brien, L. V. (2024). Part of or apart from nature? Characteristics, environmental attitudes, and priorities of the nature (dis)connected. *Ambio*, 54(3), 552–565. <https://doi.org/10.1007/s13280-024-02096-3>
- D'Antoni, F., Feruglio, S., Matiz, A., Cantone, D., & Crescentini, C. (2021). Mindfulness meditation leads to increased dispositional mindfulness and interoceptive awareness linked to a reduced dissociative tendency. *Journal of Trauma & Dissociation*, 23(1), 8–23. <https://doi.org/10.1080/15299732.2021.1934935>
- Dambrun, M. (2016). When the dissolution of perceived body boundaries elicits happiness: The effect of selflessness induced by a body scan meditation. *Consciousness and Cognition*, 46, 89–98. <https://doi.org/10.1016/j.concog.2016.09.013>
- Dambrun, M., & Ricard, M. (2011). Self-centeredness and selflessness: A theory of self-based psychological functioning and its consequences for happiness. *Review of General Psychology*, 15(2), 138–157. <https://doi.org/10.1037/a0023059>
- Day, M. A., Matthews, N., Davies, J. N., Walker, C., Bray, N., Kim, J., & Jensen, M. P. (2023). Outcome expectancies, effects, and mechanisms of brief training in mindfulness meditation vs. loving-kindness meditation vs a control condition for pain management: A randomized pilot study. *Journal of Pain & Palliative Care Pharmacotherapy*, 38(3), 206–216. <https://doi.org/10.1080/15360288.2022.2141944>

- De Oliveira, P., Juneau, C., Stinus, C., Corman, M., Michelli, N., Pellerin, N., Shankland, R., & Dambrun, M. (2024). Cultivating self-transcendence through meditation practice: A test of the role of Meta-awareness, (dis)identification and non-reactivity. *Psychological Reports*. <https://doi.org/10.1177/00332941241246469>
- Di Fabio, A., & Kenny, M. E. (2018). Connectedness to nature, personality traits and empathy from a sustainability perspective. *Current Psychology*, *40*(3), 1095–1106. <https://doi.org/10.1007/s12144-018-0031-4>
- Dimitrov, D. M., & Rumrill, Jr., P. D. (2003). Pretest-posttest designs and measurement of change. *WORK: A Journal of Prevention, Assessment & Rehabilitation*, *20*(2), 159–165. <https://doi.org/10.3233/wor-2003-00285>
- Dorjee, D. (2016). Defining contemplative science: The metacognitive self-regulatory capacity of the mind, context of meditation practice and modes of existential awareness. *Frontiers in Psychology*, *7*, 1–15. <https://doi.org/10.3389/fpsyg.2016.01788>
- Dornhoff, M., Sothmann, J.-N., Fiebelkorn, F., & Menzel, S. (2019). Nature relatedness and environmental concern of young people in Ecuador and Germany. *Frontiers in Psychology*, *10*, 1–13. <https://doi.org/10.3389/fpsyg.2019.00453>
- Duncan, N. S., Zimmer-Gembeck, M. J., Gardner, A. A., & Modecki, K. (2021). The measurement and benefit of decentering for coping self-efficacy, flexibility, and ways of coping with Interpersonal Stress. *Personality and Individual Differences*, *179*, 110932. <https://doi.org/10.1016/j.paid.2021.110932>

- Dunne, J. D., Thompson, E., & Schooler, J. (2019). Mindful meta-awareness: Sustained and non-propositional. *Current Opinion in Psychology*, 28, 307–311.
<https://doi.org/10.1016/j.copsyc.2019.07.003>
- 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>
- Duong, M., & Pensini, P. (2023). The role of connectedness in sustainable behaviour: A parallel mediation model examining the prosocial foundations of pro-environmental behaviour. *Personality and Individual Differences*, 209, 1–6.
<https://doi.org/10.1016/j.paid.2023.112216>
- Ellermann C. R., & Reed P. G. (2001). Self-Transcendence and depression in middle-age adults. *Western Journal of Nursing Research*, 23(7), 698–713.
<https://doi.org/10.1177/01939450122045492>
- Fincham, G. W., Mavor, K., & Dritschel, B. (2023). Effects of mindfulness meditation duration and type on well-being: An online dose-ranging randomized controlled trial. *Mindfulness*, 14(5), 1171–1182. <https://doi.org/10.1007/s12671-023-02119-2>
- Fessler, M., Winnebeck, E., Schroeter, T., Gummersbach, M., Huntenburg, J. M., Gaertner, M., & Barnhofer, T. (2016). An investigation of the effects of brief mindfulness training on self-reported interoceptive awareness, the ability to decenter, and their role in the reduction of depressive symptoms. *Mindfulness*, 7(5), 1170–1181.
<https://doi.org/10.1007/s12671-016-0559-z>

- Frantz, C., Mayer, F. S., Norton, C., & Rock, M. (2005). There is no “I” in nature: The influence of self-awareness on connectedness to nature. *Journal of Environmental Psychology, 25*(4), 427–436. <https://doi.org/10.1016/j.jenvp.2005.10.002>
- Fredrickson, B. (2009). *Positivity*. Three Rivers Press.
- Furnham, A., & Henderson, M. (1983). Response bias in self-report measures of general health. *Personality and Individual Differences, 4*(5), 519–525. [https://doi.org/10.1016/0191-8869\(83\)90083-1](https://doi.org/10.1016/0191-8869(83)90083-1)
- Gandy, S., Forstmann, M., Carhart-Harris, R. L., Timmermann, C., Luke, D., & Watts, R. (2020). The potential synergistic effects between psychedelic administration and nature contact for the improvement of mental health. *Health Psychology Open, 7*(2), 1–21. <https://doi.org/10.1177/2055102920978123>
- Garcia-Romeu, A. (2010). Self-transcendence as a measurable transpersonal construct. *Journal of Transpersonal Psychology, 42*(1), 26–47.
- Garland, E. L., & Fredrickson, B. L. (2019). Positive psychological states in the arc from mindfulness to self-transcendence: Extensions of the mindfulness-to-meaning theory and applications to addiction and chronic pain treatment. *Current Opinion in Psychology, 28*, 184–191. <https://doi.org/10.1016/j.copsyc.2019.01.004>
- Garrison, K. A., Zeffiro, T. A., Scheinost, D., Constable, R. T., & Brewer, J. A. (2015). Meditation leads to reduced default mode network activity beyond an active task. *Cognitive, Affective, & Behavioral Neuroscience, 15*(3), 712–720. <https://doi.org/10.3758/s13415-015-0358-3>

- Gatersleben, B., Jackson, T., Meadows, J., Soto, E., & Yan, Y. L. (2018). Leisure, materialism, well-being and the environment. *European Review of Applied Psychology*, 68(3), 131–139. <https://doi.org/10.1016/j.erap.2018.06.002>
- Gecht, J., Kessel, R., Forkmann, T., Gauggel, S., Druke, B., Scherer, A., & Mainz, V. (2014). A mediation model of mindfulness and decentering: Sequential psychological constructs or one and the same? *BMC Psychology*, 2(18), 1–13. <https://doi.org/10.1186/2050-7283-2-18>
- Ghawadra, S. F., Abdullah, K. L., Choo, W. Y., & Phang, C. K. (2019). Mindfulness-based stress reduction for psychological distress among nurses: A systematic review. *Journal of Clinical Nursing*, 28(21–22), 3747–3758. <https://doi.org/10.1111/jocn.14987>
- Gilbert, P. (2009). *Compassion focused therapy*.
- Guan, F., Chen, J., Chen, O., Liu, L., & Zha, Y. (2019). Awe and prosocial tendency. *Current Psychology*, 38(4), 1033–1041. <https://doi.org/10.1007/s12144-019-00244-7>
- Guillaume, N., Bélisle, M.-P., Jean, M., & Dupuis, G. (2024). Training in tranquil abiding meditation as a treatment for core symptoms and a cognitive remediation program of executive functions in young adults with ADHD: A pilot study. *Psychology of Consciousness: Theory, Research, and Practice*, 11(2), 252–276. <https://doi.org/10.1037/cns0000294>
- Haigh, E. A., Moore, M. T., Kashdan, T. B., & Fresco, D. M. (2010). Examination of the factor structure and concurrent validity of the Langer Mindfulness/Mindlessness Scale. *Assessment*, 18(1), 11–26. <https://doi.org/10.1177/1073191110386342>

- Hanley, A. W., Bernstein, A., Nakamura, Y., Hadash, Y., Rojas, J., Tennant, K. E., Jensen, R. L., & Garland, E. L. (2020). The metacognitive processes of decentering scale: Development and initial validation of trait and state versions. *Psychological Assessment, 32*(10), 956–971. <https://doi.org/10.1037/pas0000931>
- Hanley, A. W., Bettmann, J. E., Kendrick, C. E., Deringer, A., & Norton, C. L. (2020). Dispositional mindfulness is associated with greater nature connectedness and self-reported ecological behavior. *Ecopsychology, 12*(1), 54–63. <https://doi.org/10.1089/eco.2019.0017>
- Hanley, A. W., Dambrun, M., & Garland, E. L. (2020). Effects of mindfulness meditation on self-transcendent states: Perceived body boundaries and spatial frames of reference. *Mindfulness, 11*(5), 1194–1203. <https://doi.org/10.1007/s12671-020-01330-9>
- Hanley, A. W., Derringer, S. A., & Hanley, R. T. (2017). Dispositional mindfulness may be associated with deeper connections with nature. *Ecopsychology, 9*(4), 225–231. <https://doi.org/10.1089/eco.2017.0018>
- Hanley, A. W., Dorjee, D., & Garland, E. L. (2020). Mindfulness training encourages self-transcendent states via decentering. *Psychology of Consciousness: Theory, Research, and Practice, 10*(4), 1–10. <https://doi.org/10.1037/cns0000262>
- Hanley, A. W., Mai, T., & Garland, E. L. (2023). Self-transcendent states during a modified mindfulness-based stress reduction program predict improvements in mood. *Psychology of Consciousness: Theory, Research, and Practice, 10*(3), 213–224. <https://doi.org/10.1037/cns0000347>

- Hanley, A. W., Nakamura, Y., & Garland, E. L. (2018). The Nondual Awareness Dimensional Assessment (NADA): New tools to assess nondual traits and states of consciousness occurring within and beyond the context of meditation. *Psychological Assessment, 30*(12), 1625–1639. <https://doi.org/10.1037/pas0000615>
- Hanner, O. (2024). Mindfulness meditation and the meaning of life. *Mindfulness, 15*(9), 2372–2385. <https://doi.org/10.1007/s12671-024-02404-8>
- Harris, S. (2025). *Waking Up* (Version 3.7.0) [Web app]. Waking Up LLC. <https://wakingup.com>
- Hayes, A. F. (2022). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (3 ed.). The Guilford Press.
- Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (1999). *Acceptance and Commitment Therapy. An experiential approach to behavior change*. Guilford.
- Hayes-Skelton, S. A., & Graham, J. (2012). Decentering as a common link among mindfulness, cognitive reappraisal, and social anxiety. *Behavioural and Cognitive Psychotherapy, 41*(3), 317–328. <https://doi.org/10.1017/s1352465812000902>
- Hayes-Skelton, S. A., & Lee, C. S. (2019). Decentering in mindfulness and cognitive restructuring for social anxiety: An experimental study of a potential common mechanism. *Behavior Modification, 44*(6), 817–840. <https://doi.org/10.1177/0145445519850744>

- Hayhoe, K. J., Edmonds, R. E. Kopp, A. N., LeGrande, B. M., Sanderson, M. F., Wehner, P., & Wuebbles, D. J. (2017). Climate models, scenarios, and projections. In D. J. Wuebbles, D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, & T. K. Maycock (Eds.), *Climate Science Special Report: Fourth National Climate Assessment: Vol. 1. U. S. Global Change Research Program* (pp. 133–160). <https://doi.org/10.7930/J0WH2N54>
- Henry, P. J. (2008). Student sampling as a theoretical problem. *Psychological Inquiry*, *19*(2), 114–126. <https://doi.org/10.1080/10478400802049951>
- Hoge, E. A., Bui, E., Goetter, E., Robinaugh, D. J., Ojserkis, R. A., Fresco, D. M., & Simon, N. M. (2014). Change in decentering mediates improvement in anxiety in mindfulness-based stress reduction for generalized anxiety disorder. *Cognitive Therapy and Research*, *39*(2), 228–235. <https://doi.org/10.1007/s10608-014-9646-4>
- Howell, A. J., Dopko, R. L., Passmore, H.-A., & Buro, K. (2011). Nature connectedness: Associations with well-being and mindfulness. *Personality and Individual Differences*, *51*(2), 166–171. <https://doi.org/10.1016/j.paid.2011.03.037>
- Huber, S., & Huber, O. W. (2012). The centrality of religiosity scale (CRS). *Religions*, *3*(3), 710–724. <https://doi.org/10.3390/rel3030710>
- Jacobs, T. P., & McConnell, A. R. (2022). Self-transcendent emotion dispositions: Greater connections with nature and more sustainable behavior. *Journal of Environmental Psychology*, *81*, 1–11. <https://doi.org/10.1016/j.jenvp.2022.101797>

- Jakučionytė-Skodienė, M., Dagiliūtė, R., & Liobikienė, G. (2020). Do general pro-environmental behaviour, attitude, and knowledge contribute to energy savings and climate change mitigation in the residential sector? *Energy*, *193*, 1–9.
<https://doi.org/10.1016/j.energy.2019.116784>
- Jankowski, T., & Holas, P. (2014). Metacognitive model of mindfulness. *Consciousness and Cognition*, *28*, 64–80. <https://doi.org/10.1016/j.concog.2014.06.005>
- Jansen, P., Rahe, M., & Wolff, F. (2024). How does mindfulness relate to sustainable attitude and behavior? The role of possible mediators. *Current Psychology*, *43*(22), 1–13. <https://doi.org/10.1007/s12144-024-05741-y>
- Jiang, T., & Sedikides, C. (2022). Awe motivates authentic-self pursuit via self-transcendence: Implications for prosociality. *Journal of Personality and Social Psychology*, *123*(3), 576–596. <https://doi.org/10.1037/pspi0000381>
- Josefsson, T., Lindwall, M., & Broberg, A. G. (2012). The effects of a short-term mindfulness based intervention on self-reported mindfulness, decentering, executive attention, psychological health, and coping style: Examining unique mindfulness effects and mediators. *Mindfulness*, *5*(1), 18–35.
<https://doi.org/10.1007/s12671-012-0142-1>
- Joye, Y., & Verpooten, J. (2013). An exploration of the functions of religious monumental architecture from a Darwinian perspective. *Review of General Psychology*, *17*(1), 53–68. <https://doi.org/10.1037/a0029920>
- Kähönen, J. (2023). Psychedelic unselfing: Self-transcendence and change of values in psychedelic experiences. *Frontiers in Psychology*, *14*, 1–20.
<https://doi.org/10.3389/fpsyg.2023.1104627>

- Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical Considerations and preliminary results. *General Hospital Psychiatry, 4*(1), 33–47. [https://doi.org/10.1016/0163-8343\(82\)90026-3](https://doi.org/10.1016/0163-8343(82)90026-3)
- Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain and illness*. Delacorte.
- Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*(2), 144–156. <https://doi.org/10.1093/clipsy.bpg016>
- Kabat-Zinn, J. (2005). *Coming to our senses. Healing ourselves and the world through mindfulness*. Hyperion.
- 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>
- Kang, B., Kim, T., Kim, M. J., Lee, K. H., Choi, S., Lee, D. H., Kim, H. R., Jun, B., Park, S. Y., Lee, S. J., & Park, S.-B. (2015). Relief of chronic posterior neck pain depending on the type of forest therapy: Comparison of the therapeutic effect of forest bathing alone versus forest bathing with exercise. *Annals of Rehabilitation Medicine, 39*(6), 957–963. <https://doi.org/10.5535/arm.2015.39.6.957>
- Karp, D. G. (1996). Values and their effect on pro-environmental behavior. *Environment and Behavior, 28*(1), 111–133. <https://doi.org/10.1177/0013916596281006>

- Keenan, R., Lumber, R., Richardson, M., & Sheffield, D. (2021). Three good things in nature: A nature-based positive psychological intervention to improve mood and well-being for depression and anxiety. *Journal of Public Mental Health, 20*(4), 243–250. <https://doi.org/10.1108/jpmh-02-2021-0029>
- Kellert, S. R. (1993). The biological basis for human values of nature. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 42–69). Island Press.
- Kellert S. R., & Wilson E. O. (1993). *The Biophilia Hypothesis*. Island Press.
- Kesenheimer, J. S., & Greitemeyer, T. (2021). Going green (and not being just more pro-social): Do attitude and personality specifically influence pro-environmental behavior? *Sustainability, 13*(6), 1–12. <https://doi.org/10.3390/su13063560>
- Khoury, B., Lecomte, T., Fortin, G., Masse, M., Therien, P., Bouchard, V., Chapleau, M.-A., Paquin, K., & Hofmann, S. G. (2013). Mindfulness-based therapy: A comprehensive meta-analysis. *Clinical Psychology Review, 33*(6), 763–771. <https://doi.org/10.1016/j.cpr.2013.05.005>
- Kiken, L. G., Garland, E. L., Bluth, K., Palsson, O. S., & Gaylord, S. A. (2015). From a state to a trait: Trajectories of state mindfulness in meditation during intervention predict changes in trait mindfulness. *Personality and Individual Differences, 81*, 41–46. <https://doi.org/10.1016/j.paid.2014.12.044>
- Klussman, K., Nichols, A. L., Curtin, N., Langer, J., & Orehek, E. (2022). Self-connection and well-being: Development and validation of a self-connection scale. *European Journal of Social Psychology, 52*(1), 18–45. <https://doi.org/10.1002/ejsp.2812>

- Kumar, A., & Verma A. K. (2017). Biodiversity loss and its ecological impact in India. *International Journal on Biological Sciences*, 8(2), 156-160.
- Kuppens, P., Oravecz, Z., & Tuerlinckx, F. (2010). Feelings change: Accounting for individual differences in the temporal dynamics of affect. *Journal of Personality and Social Psychology*, 99(6), 1042–1060. <https://doi.org/10.1037/a0020962>
- Lam, S. U., Kirvin-Quamme, A., & Goldberg, S. B. (2022). Overall and differential attrition in mindfulness-based interventions: A meta-analysis. *Mindfulness*, 13(11), 2676–2690. <https://doi.org/10.1007/s12671-022-01970-z>
- Lam, S. U., Xie, Q., & Goldberg, S. B. (2023). Situating meditation apps within the ecosystem of meditation practice: Population-based survey study. *JMIR Mental Health*, 10, 1–15. <https://doi.org/10.2196/43565>
- Langer, E. J. (1989). Minding matters: The consequences of mindlessness–mindfulness. *Advances in Experimental Social Psychology*, 22(1), 137–173. [https://doi.org/10.1016/s0065-2601\(08\)60307-x](https://doi.org/10.1016/s0065-2601(08)60307-x)
- Langer, E. J. (2000). Mindful learning. *Current Directions in Psychological Science*, 9(6), 220–223. <https://doi.org/10.1111/1467-8721.00099>
- Langer, E. J., & Piper, A. I. (1987). The prevention of mindlessness. *Journal of Personality and Social Psychology*, 53(2), 280–287. <https://doi.org/10.1037/0022-3514.53.2.280>
- Latif, S. A., Omar, M. S., Bidin, Y. H., & Awang, Z. (2013). Role of environmental knowledge in creating pro-environmental residents. *Procedia - Social and Behavioral Sciences*, 105, 866–874. <https://doi.org/10.1016/j.sbspro.2013.11.088>

- Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., Shapiro, S., Carmody, J., Abbey, S., & Devins, G. (2006). The toronto mindfulness scale: Development and validation. *Journal of Clinical Psychology, 62*(12), 1445–1467. <https://doi.org/10.1002/jclp.20326>
- Le, T. N., & Levenson, M. R. (2005). Wisdom as self-transcendence: What's love (& individualism) got to do with it? *Journal of Research in Personality, 39*(4), 443–457. <https://doi.org/10.1016/j.jrp.2004.05.003>
- Léger-Goodes, T., Malboeuf-Hurtubise, C., Mastine, T., Généreux, M., Paradis, P.-O., & Camden, C. (2022). Eco-anxiety in children: A scoping review of the mental health impacts of the awareness of climate change. *Frontiers in Psychology, 13*, 1–13. <https://doi.org/10.3389/fpsyg.2022.872544>
- Lengieza, M. L., & Swim, J. K. (2021). The paths to connectedness: A review of the antecedents of connectedness to nature. *Frontiers in Psychology, 12*, 1–20. <https://doi.org/10.3389/fpsyg.2021.763231>
- Leong, L. Y., Fischer, R., & McClure, J. (2014). Are nature lovers more innovative? The relationship between connectedness with nature and cognitive styles. *Journal of Environmental Psychology, 40*, 57–63. <https://doi.org/10.1016/j.jenvp.2014.03.007>
- Levenson, M. R., Jennings, P. A., Aldwin, C. M., & Shiraishi, R. W. (2005). Self-transcendence: Conceptualization and measurement. *The International Journal of Aging and Human Development, 60*(2), 127–143. <https://doi.org/10.2190/xrxm-fyra-7u0x-grc0>

- Liefländer, A. K., Fröhlich, G., Bogner, F. X., & Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research, 19*(3), 370–384.
<https://doi.org/10.1080/13504622.2012.697545>
- Linehan, M. M. (1987). Dialectical Behavior Therapy for Borderline Personality Disorder: Theory and Method. *Bulletin of the Menninger Clinic, 51*(3), 261–277.
- Ling, M., & Xu, L. (2020). Relationships between personal values, micro-contextual factors and residents' pro-environmental behaviors: An explorative study. *Resources, Conservation and Recycling, 156*, 1–10.
<https://doi.org/10.1016/j.resconrec.2020.104697>
- Liu, Y., Cleary, A., Fielding, K. S., Murray, Z., & Roiko, A. (2022). Nature connection, pro-environmental behaviours and wellbeing: Understanding the mediating role of nature contact. *Landscape and Urban Planning, 228*, 1–10.
<https://doi.org/10.1016/j.landurbplan.2022.104550>
- Lumber, R., Richardson, M., & Sheffield, D. (2017). Beyond knowing nature: Contact, emotion, compassion, meaning, and beauty are pathways to nature connection. *PLOS ONE, 12*(5), 1–24. <https://doi.org/10.1371/journal.pone.0177186>
- Macaulay, R., Johnson, K., Lee, K., & Williams, K. (2022). Comparing the effect of mindful and other engagement interventions in nature on attention restoration, nature connection, and mood. *Journal of Environmental Psychology, 81*, 1–11.
<https://doi.org/10.1016/j.jenvp.2022.101813>

- Mackay, C. M. L., & Schmitt, M. T. (2019). Do people who feel connected to nature do more to protect it? A meta-analysis. *Journal of Environmental Psychology*, *65*, 1–9. <https://doi.org/10.1016/j.jenvp.2019.101323>
- Mahmoud, S. H., & Gan, T. Y. (2018). Impact of anthropogenic climate change and human activities on environment and ecosystem services in arid regions. *Science of The Total Environment*, *633*, 1329–1344. <https://doi.org/10.1016/j.scitotenv.2018.03.290>
- Martin, C., & Czellar, S. (2017). Where do biospheric values come from? A connectedness to nature perspective. *Journal of Environmental Psychology*, *52*, 56–68. <https://doi.org/10.1016/j.jenvp.2017.04.009>
- Maslow, A. H. (1970). *Religions, values, and peak-experience*. Penguin Compass.
- Masud, M. M., Akhtar, R., Afroz, R., Al-Amin, A. Q., & Kari, F. B. (2013). Pro-environmental behavior and public understanding of climate change. *Mitigation and Adaptation Strategies for Global Change*, *20*(4), 591–600. <https://doi.org/10.1007/s11027-013-9509-4>
- 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. <https://doi.org/10.1016/j.jenvp.2004.10.001>
- Mayer, F. S., Frantz, C. M., Bruehlman-Senecal, E., & Dolliver, K. (2009). Why is nature beneficial? *Environment and Behavior*, *41*(5), 607–643. <https://doi.org/10.1177/0013916508319745>

- McConnell, A. R., & Jacobs, T. P. (2020). Self-nature representations: On the unique consequences of nature-self size on pro-environmental action. *Journal of Environmental Psychology, 71*, 1–13. <https://doi.org/10.1016/j.jenvp.2020.101471>
- McDonald, M. G., Wearing, S., & Ponting, J. (2009). The nature of peak experience in wilderness. *The Humanistic Psychologist, 37*(4), 370–385. <https://doi.org/10.1080/08873260701828912>
- McMahan, E. A., Estes, D., Murfin, J. S., & Bryan, C. M. (2018). Nature connectedness moderates the effect of nature exposure on explicit and implicit measures of emotion. *Journal of Positive Psychology and Wellbeing, 2*(2), 128–148.
- Mifsud, R., & Sammut, G. (2023). Worldviews and the role of social values that underlie them. *PLOS ONE, 18*(7), 1–16. <https://doi.org/10.1371/journal.pone.0288451>
- Moneta, G. B., & Csikszentmihalyi, M. (1996). The effect of perceived challenges and skills on the quality of subjective experience. *Journal of Personality, 64*(2), 275–310. <https://doi.org/10.1111/j.1467-6494.1996.tb00512.x>
- Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Consciousness and Cognition, 18*(1), 176–186. <https://doi.org/10.1016/j.concog.2008.12.008>
- Moore, J. W., & Schindler, D. E. (2022). Getting ahead of climate change for ecological adaptation and resilience. *Science, 376*(6600), 1421–1426. <https://doi.org/10.1126/science.abo3608>
- Moral-Bofill, L., López de la Llave, A., & Pérez-Llantada, M. C. (2023). Predictors of flow state in performing musicians: An analysis with the logistic regression method. *Frontiers in Psychology, 14*, 1–12. <https://doi.org/10.3389/fpsyg.2023.1271829>

- Moreton, S. G., Arena, A., Hornsey, M. J., Crimston, C. R., & Tiliopoulos, N. (2019). Elevating nature: Moral elevation increases feelings of connectedness to nature. *Journal of Environmental Psychology, 65*, 1–11. <https://doi.org/10.1016/j.jenvp.2019.101332>
- Muneghina, O., Van Gordon, W., Barrows, P., & Richardson, M. (2021). A novel mindful nature connectedness intervention improves paranoia but not anxiety in a nonclinical population. *Ecopsychology, 13*(4), 248–256. <https://doi.org/10.1089/eco.2020.0068>
- National Centers for Environmental Information. (2023). *Climate at a Glance: Global Time Series*. <https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series>
- Newton, K., & Moreton, S. G. (2023). Self-transcendent positive emotions as a potential mechanism underpinning the effects of meaningful psychedelic experiences on connectedness to nature. *Ecopsychology, 15*(2), 142–159. <https://doi.org/10.1089/eco.2022.0044>
- Nguyen, T. N., Lobo, A., & Greenland, S. (2016). Pro-environmental purchase behaviour: The role of consumers' biospheric values. *Journal of Retailing and Consumer Services, 33*, 98–108. <https://doi.org/10.1016/j.jretconser.2016.08.010>
- Nisbet, E. K., Shaw, D. W., & Lachance, D. G. (2020). Connectedness with nearby nature and well-being. *Frontiers in Sustainable Cities, 2*, 1–13. <https://doi.org/10.3389/frsc.2020.00018>
- Nisbet, E. K., & Zelenski, J. M. (2011). Underestimating nearby nature. *Psychological Science, 22*(9), 1101–1106. <https://doi.org/10.1177/0956797611418527>

- Nisbet, E. K., Zelenski, J. M., & Grandpierre, Z. (2019). Mindfulness in nature enhances connectedness and mood. *Ecopsychology*, *11*(2), 81–91.
<https://doi.org/10.1089/eco.2018.0061>
- Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale. *Environment and Behavior*, *41*(5), 715–740.
<https://doi.org/10.1177/0013916508318748>
- Nordlund, A. M., & Garvill, J. (2002). Value structures behind proenvironmental behavior. *Environment and Behavior*, *34*(6), 740–756.
<https://doi.org/10.1177/001391602237244>
- Norwood, M. F., Lakhani, A., Fullagar, S., Maujean, A., Downes, M., Byrne, J., Stewart, A., Barber, B., & Kendall, E. (2019). A narrative and systematic review of the behavioural, cognitive and emotional effects of passive nature exposure on young people: Evidence for prescribing change. *Landscape and Urban Planning*, *189*, 71–79. <https://doi.org/10.1016/j.landurbplan.2019.04.007>
- Nour, M. M., Evans, L., & Carhart-Harris, R. L. (2017). Psychedelics, personality and political perspectives. *Journal of Psychoactive Drugs*, *49*(3), 182–191.
<https://doi.org/10.1080/02791072.2017.1312643>
- Oman, D. (2023). Mindfulness for global public health: Critical analysis and agenda. *Mindfulness*. 1–40. <https://doi.org/10.1007/s12671-023-02089-5>
- Ortiz-Bobea, A., Ault, T. R., Carrillo, C. M., Chambers, R. G., & Lobell, D. B. (2021). Anthropogenic climate change has slowed global agricultural productivity growth. *Nature Climate Change*, *11*(4), 306–312. <https://doi.org/10.1038/s41558-021-01000-1>

- Otto, S., & Pensini, P. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environmental Change*, *47*, 88–94.
<https://doi.org/10.1016/j.gloenvcha.2017.09.009>
- Passmore, H.-A., & Holder, M. D. (2016). Noticing nature: Individual and social benefits of a two-week intervention. *The Journal of Positive Psychology*, *12*(6), 537–546.
<https://doi.org/10.1080/17439760.2016.1221126>
- Pearson, M. R., Brown, D. B., Bravo, A. J., & Witkiewitz, K. (2014). Staying in the moment and finding purpose: The associations of trait mindfulness, decentering, and purpose in life with depressive symptoms, anxiety symptoms, and alcohol-related problems. *Mindfulness*, *6*(3), 645–653. <https://doi.org/10.1007/s12671-014-0300-8>
- Piccininni, C., Michaelson, V., Janssen, I., & Pickett, W. (2018). Outdoor play and nature connectedness as potential correlates of internalized mental health symptoms among Canadian adolescents. *Preventive Medicine*, *112*, 168–175.
<https://doi.org/10.1016/j.ypmed.2018.04.020>
- Pirson, M., Langer, E. J., Bodner, T., & Zilcha, S. (2012). The development and validation of the Langer mindfulness scale - enabling a socio-cognitive perspective of mindfulness in organizational contexts. *SSRN Electronic Journal*, 1–54.
<https://doi.org/10.2139/ssrn.2158921>
- Poon, K.-T., Teng, F., Chow, J. T., & Chen, Z. (2015). Desiring to connect to nature: The effect of ostracism on ecological behavior. *Journal of Environmental Psychology*, *42*, 116–122. <https://doi.org/10.1016/j.jenvp.2015.03.003>

- Prakash, S. (2021). Impact of climate change on aquatic ecosystem and its biodiversity: An overview. *International Journal Biological Innovations*, 3(2), 1–6.
<https://doi.org/10.46505/ijbi.2021.3210>
- Prakash, S., & Verma, A. K. (2022). Anthropogenic activities and biodiversity threats. *International Journal of Biological Innovations*, 4(1), 94–103.
<https://doi.org/10.46505/ijbi.2022.4110>
- Pritchard, A., Richardson, M., Sheffield, D., & McEwan, K. (2019). The relationship between nature connectedness and eudaimonic well-being: A meta-analysis. *Journal of Happiness Studies*, 21(3), 1145–1167. <https://doi.org/10.1007/s10902-019-00118-6>
- Ray, T. N., Franz, S. A., Jarrett, N. L., & Pickett, S. M. (2020). Nature enhanced meditation: Effects on mindfulness, connectedness to nature, and pro-environmental behavior. *Environment and Behavior*, 53(8), 864–890.
<https://doi.org/10.1177/0013916520952452>
- Richardson, M., Hamlin, I., Butler, C. W., Thomas, R., & Hunt, A. (2022). Actively noticing nature (not just time in nature) helps promote nature connectedness. *Ecopsychology*, 14(1), 8–16. <https://doi.org/10.1089/eco.2021.0023>
- Richardson, M., & Sheffield, D. (2015). Reflective self-attention: A more stable predictor of connection to nature than mindful attention. *Ecopsychology*, 7(3), 166–175.
<https://doi.org/10.1089/eco.2015.0010>

- Rong, L., Zhao, M., & Xu, M. (2023). How do self-transcendent values and institutional forces influence consumer intentions to purchase new energy vehicles under subsidy withdrawal? Evidence from China. *Environment, Development and Sustainability*, 1 – 28. <https://doi.org/10.1007/s10668-023-04224-7>
- Samus, A., Freeman, C., van Heezik, Y., Krumme, K., & Dickinson, K. J. M. (2022). How do urban green spaces increase well-being? The role of perceived wildness and nature connectedness. *Journal of Environmental Psychology*, 82, 1–10. <https://doi.org/10.1016/j.jenvp.2022.101850>
- Sanyer, M. M., Bettmann, J. E., Anstadt, G., Ganesh, K., & Hanley, A. W. (2023). Decenter to reenter nature: Relationships between decentering, self-transcendence, and nature connectedness. *Psychology of Consciousness: Theory, Research, and Practice*, 10(3), 205–212. <https://doi.org/10.1037/cns0000307>
- Sassenberg, K., & Ditrich, L. (2019). Research in social psychology changed between 2011 and 2016: Larger sample sizes, more self-report measures, and more online studies. *Advances in Methods and Practices in Psychological Science*, 2(2), 107–114. <https://doi.org/10.1177/2515245919838781>
- Schmidt, S. (2011). Mindfulness in east and west – Is it the same?. In H. Walach, S. Schmidt, W. Jonas (Eds.), *Neuroscience, consciousness and spirituality: Vol. 1. Studies in Neuroscience, consciousness, and spirituality* (pp. 23–38). Springer. https://doi.org/10.1007/978-94-007-2079-4_2
- Schoemann, A. M., Boulton, A. J., & Short, S. D. (2017). Determining power and sample size for simple and complex mediation models. *Social Psychological and Personality Science*, 8(4), 379–386. <https://doi.org/10.1177/1948550617715068>

- Schultz, P. W. (2002). Inclusion with nature: The psychology of human-nature relations. In P. Schmuck & P. W. Schultz (Eds.), *Psychology of sustainable development* (pp. 61–78). Kluwer Academic.
- Schultz, P. W., & Tabanico, J. (2007). Self, identity, and the natural environment: Exploring implicit connections with nature. *Journal of Applied Social Psychology*, 37(6), 1219–1247. <https://doi.org/10.1111/j.1559-1816.2007.00210.x>
- Schultz, P. W., & Zelezny, L. C. (1998). Values and proenvironmental behavior: A five-country survey. *Journal of Cross-Cultural Psychology*, 29(4), 540–558. <https://doi.org/10.1177/0022022198294003>
- Schutte, N. S., & Malouff, J. M. (2018). Mindfulness and connectedness to nature: A meta-analytic investigation. *Personality and Individual Differences*, 127, 10–14. <https://doi.org/10.1016/j.paid.2018.01.034>
- Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In L. Berkowitz & M. P. Zanna (Eds.), *Advances in experimental social psychology*. (Vol. 25, pp. 1-65). Academic Press.
- Scott, B. A. (2010). Babes and the woods: Women’s objectification and the feminine beauty ideal as ecological hazards. *Ecopsychology*, 2(3), 147–158. <https://doi.org/10.1089/eco.2010.0030>
- Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2013). *Mindfulness-based cognitive therapy for depression* (2nd ed.). Guilford Press.
- Sheffield, D., Butler, C. W., & Richardson, M. (2022). Improving nature connectedness in adults: A meta-analysis, review and agenda. *Sustainability*, 14(19), 1–23. <https://doi.org/10.3390/su141912494>

- Shireen, H., Khanyari, S., Vance, A., Johannesson, H., Preissner, C., Dor-Ziderman, Y., Khoury, B., & Knäuper, B. (2022). Paying attention to the self: A systematic review of the study of the self in mindfulness research. *Mindfulness, 13*(6), 1373–1386. <https://doi.org/10.1007/s12671-022-01844-4>
- Shoham, A., Goldstein, P., Oren, R., Spivak, D., & Bernstein, A. (2017). Decentering in the process of cultivating mindfulness: An experience-sampling study in time and context. *Journal of Consulting and Clinical Psychology, 85*(2), 123–134. <https://doi.org/10.1037/ccp0000154>
- Sieder, K., Thiedmann, P., Voracek, M., & Tran, U. S. (2024). Baseline trait mindfulness moderates the efficacy of mindfulness interventions and active controls: A meta-analysis of 177 Randomised controlled trials. *Applied Psychology: Health and Well-Being, 16*(4), 2499–2519. <https://doi.org/10.1111/aphw.12550>
- Smallwood, J., & Schooler, J. W. (2015). The science of mind wandering: Empirically navigating the stream of consciousness. *Annual Review of Psychology, 66*(1), 487–518. <https://doi.org/10.1146/annurev-psych-010814-015331>
- Snell, T. L., & Simmonds, J. G. (2015). Mystical experiences in nature: Comparing outcomes for psychological well-being and environmental behaviour. *Archive for the Psychology of Religion, 37*(2), 169-184. <https://doi.org/10.1163/15736121-12341303>
- Sothmann, J-N., & Menzel, S. (2017). A scale for differentiating affective and cognitive nature connection dimensions, externally validated in terms of self-transcendence and environmental concern. *International Journal of Environmental & Science Education, 12*(8), 1847–1869.

- Stellar, J. E., Gordon, A. M., Piff, P. K., Cordaro, D., Anderson, C. L., Bai, Y., Maruskin, L. A., & Keltner, D. (2017). Self-transcendent emotions and their social functions: Compassion, gratitude, and awe bind us to others through prosociality. *Emotion Review*, 9(3), 200–207. <https://doi.org/10.1177/1754073916684557>
- Swami, V., Barron, D., Todd, J., Horne, G., & Furnham, A. (2020). Nature exposure and positive body image: (Re-)examining the mediating roles of connectedness to nature and trait mindfulness. *Body Image*, 34, 201–208. <https://doi.org/10.1016/j.bodyim.2020.06.004>
- Tam, K.-P. (2013). Concepts and measures related to connection to nature: Similarities and differences. *Journal of Environmental Psychology*, 34, 64–78. <https://doi.org/10.1016/j.jenvp.2013.01.004>
- Tanay, G., & Bernstein, A. (2013). State Mindfulness Scale (SMS): Development and initial validation. *Psychological Assessment*, 25(4), 1286–1299. <https://doi.org/10.1037/a0034044>
- Tanay, G., Lotan, G., & Bernstein, A. (2012). Salutary proximal processes and distal mood and anxiety vulnerability outcomes of mindfulness training: A pilot preventive intervention. *Behavior Therapy*, 43(3), 492–505. <https://doi.org/10.1016/j.beth.2011.06.003>
- Thiermann, U. B., & Sheate, W. R. (2022). How does mindfulness affect pro-environmental behaviors? A qualitative analysis of the mechanisms of change in a sample of active practitioners. *Mindfulness*, 13(12), 2997–3016. <https://doi.org/10.1007/s12671-022-02004-4>

- Thomas, V., & [López](#), R. (2015). Global increase in climate-related disasters. *Asian Development Bank Economics Working Paper Series* (466), SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.2709331>
- Thomson, E. E., & Roach, S. P. (2023). The relationships among nature connectedness, climate anxiety, climate action, climate knowledge, and mental health. *Frontiers in Psychology, 14*, 1–11. <https://doi.org/10.3389/fpsyg.2023.1241400>
- Tiscareno-Osorno, X., Demetriou, Y., Marques, A., Peralta, M., Jorge, R., MacIntyre, T. E., MacIntyre, D., Smith, S., Sheffield, D., Jones, M. V., Beckmann, J., & Schönbach, D. M. (2023). Systematic review of explicit instruments measuring nature connectedness: What do we know and what is next? *Environment and Behavior, 55*(8–10), 551–608. <https://doi.org/10.1177/00139165231212321>
- Tiwari, P. (2022). Influence of millennials' eco-literacy and biospheric values on green purchases: The mediating effect of attitude. *Public Organization Review, 23*(3), 1195–1212. <https://doi.org/10.1007/s11115-022-00645-6>
- Tornstam, L. (1994). Gero-transcendence: A theoretical and empirical exploration. In L. E. Thomas & S. A. Eisenhandler (Eds.), *Aging and the religious dimension*, (pp. 203–225). Auburn House.
- Townsend, K. C., & McWhirter, B. T. (2005). Connectedness: A review of the literature with implications for counseling, assessment, and research. *Journal of Counseling & Development, 83*(2), 191–201. <https://doi.org/10.1002/j.1556-6678.2005.tb00596.x>

- Tulver, K., Kaup, K. K., Laukkonen, R., & Aru, J. (2023). Restructuring insight: An integrative review of insight in problem-solving, meditation, psychotherapy, delusions and psychedelics. *Consciousness and Cognition, 110*, 103494. <https://doi.org/10.1016/j.concog.2023.103494>
- Unsworth, S., Palicki, S.-K., & Lustig, J. (2016). The impact of mindful meditation in nature on self-nature interconnectedness. *Mindfulness, 7*(5), 1052–1060. <https://doi.org/10.1007/s12671-016-0542-8>
- Van Cappellen, P. (2017). Rethinking self-transcendent positive emotions and religion: Insights from psychological and biblical research. *Psychology of Religion and Spirituality, 9*(3), 254–263. <https://doi.org/10.1037/re10000101>
- Wamsler, C. (2018). Mind the gap: The role of mindfulness in adapting to increasing risk and climate change. *Sustainability Science, 13*(4), 1121–1135. <https://doi.org/10.1007/s11625-017-0524-3>
- Wang, C., Geng, L., & Rodríguez Casallas, J. D. (2022). Mindfulness to climate change inaction: The role of awe, “dragons of inaction” psychological barriers and nature connectedness. *Journal of Environmental Psychology, 84*, 1–10. <https://doi.org/10.1016/j.jenvp.2022.101912>
- Wang, J., Geng, L., Schultz, P. W., & Zhou, K. (2017). Mindfulness increases the belief in climate change: The mediating role of connectedness with nature. *Environment and Behavior, 51*(1), 3–23. <https://doi.org/10.1177/0013916517738036>
- Wang, J., & Huo, Y. (2022). Effect of materialism on pro-environmental behavior among youth in China: The role of nature connectedness. *Frontiers in Psychology, 13*, 1–10. <https://doi.org/10.3389/fpsyg.2022.794816>

- Wang, X., Geng, L., Zhou, K., Ye, L., Ma, Y., & Zhang, S. (2016). Mindful learning can promote connectedness to nature: Implicit and explicit evidence. *Consciousness and Cognition, 44*, 1–7. <https://doi.org/10.1016/j.concog.2016.06.006>
- Watts, R., Kettner, H., Geerts, D., Gandy, S., Kartner, L., Mertens, L., Timmermann, C., Nour, M. M., Kaelen, M., Nutt, D., Carhart-Harris, R., & Roseman, L. (2022). The Watts Connectedness Scale: A new scale for measuring a sense of connectedness to self, others, and world. *Psychopharmacology, 239*(11), 3461–3483. <https://doi.org/10.1007/s00213-022-06187-5>
- Wayment, H., & Bauer, J. (2017). The quiet Ego: Concept, measurement, and wellbeing. In M. D. Robinson & M. Eid (Eds.), *The happy mind: Cognitive contributions to well-being*, (pp. 77–94). Springer. <https://doi.org/10.1007/978-3-319-58763-95>
- Weinstein, N., Przybylski, A. K., & Ryan, R. M. (2009). Can nature make us more caring? Effects of immersion in nature on intrinsic aspirations and generosity. *Personality and Social Psychology Bulletin, 35*(10), 1315–1329. <https://doi.org/10.1177/0146167209341649>
- Westen, D. (1992). The cognitive self and the psychoanalytic self: Can we put our selves together? *Psychological Inquiry, 3*(1), 1–13. https://doi.org/10.1207/s15327965pli0301_1
- Whitburn, J., Linklater, W. L., & Milfont, T. L. (2018). Exposure to urban nature and tree planting are related to pro-environmental behavior via connection to nature, the use of nature for psychological restoration, and environmental attitudes. *Environment and Behavior, 51*(7), 787–810. <https://doi.org/10.1177/0013916517751009>

- Wigley, I. C. M., Nazzari, S., Pastore, M., Provenzi, L., & Barelo, S. (2025). The contribution of environmental sensitivity and connectedness to nature to mental health: Does nature view count? *Journal of Environmental Psychology, 102*, 1–9. <https://doi.org/10.1016/j.jenvp.2025.102541>
- Wilson, E. O. (1984). *Biophilia*. Harvard University Press.
- Wulff, D. M. (2000). Mystical experience. In E. Cardena, S. J. Lynn, & S. Krippner (Eds.), *Varieties of anomalous experience: Examining the scientific evidence* (pp. 397–440). American Psychological Association. <https://doi.org/10.1037/10371-012>
- Wyles, K. J., White, M. P., Hattam, C., Pahl, S., King, H., & Austen, M. (2017). Are some natural environments more psychologically beneficial than others? The importance of type and quality on connectedness to nature and psychological restoration. *Environment and Behavior, 51*(2), 111–143. <https://doi.org/10.1177/0013916517738312>
- Yaden, D. B., Haidt, J., Hood, R. W., Vago, D. R., & Newberg, A. B. (2017). The varieties of self-transcendent experience. *Review of General Psychology, 21*(2), 143–160. <https://doi.org/10.1037/gpr0000102>
- Yang, Y., Hu, J., Jing, F., & Nguyen, B. (2018). From awe to ecological behavior: The mediating role of connectedness to nature. *Sustainability, 10*(7), 1–14. <https://doi.org/10.3390/su10072477>

- Yeo, N. L., White, M. P., Alcock, I., Garside, R., Dean, S. G., Smalley, A. J., & Gatersleben, B. (2020). What is the best way of delivering virtual nature for improving mood? An experimental comparison of high definition TV, 360° video, and computer generated virtual reality. *Journal of Environmental Psychology*, 72, 1–13. <https://doi.org/10.1016/j.jenvp.2020.101500>
- Yue, X.-L., & Gao, Q.-X. (2018). Contributions of natural systems and human activity to greenhouse gas emissions. *Advances in Climate Change Research*, 9(4), 243–252. <https://doi.org/10.1016/j.accre.2018.12.003>
- Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulness meditation improves cognition: Evidence of brief mental training. *Consciousness and Cognition*, 19(2), 597–605. <https://doi.org/10.1016/j.concog.2010.03.014>
- Zelenski, J. M., & Desrochers, J. E. (2021). Can positive and self-transcendent emotions promote pro-environmental behavior? *Current Opinion in Psychology*, 42, 31–35. <https://doi.org/10.1016/j.copsy.2021.02.009>
- Zeng, X., Chiu, C. P., Wang, R., Oei, T. P., & Leung, F. Y. (2015). The effect of loving-kindness meditation on positive emotions: A meta-analytic review. *Frontiers in Psychology*, 6, 1 – 14. <https://doi.org/10.3389/fpsyg.2015.01693>
- Zhang, G., Wu, G., & Yang, J. (2023). The restorative effects of short-term exposure to nature in immersive virtual environments (IVEs) as evidenced by participants' brain activities. *Journal of Environmental Management*, 326, 1–11. <https://doi.org/10.1016/j.jenvman.2022.116830>

Appendix A

The Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004)

Please answer the following questions to the best of your ability (there is no right or wrong answer) by selecting the option that best pertains to how you generally feel.

Each response includes five options, with option 1 indicating that you *Disagree strongly* with the statement (i.e., that is not how you generally feel) and option 5 indicating that you *Agree strongly* with the statement (i.e., how you generally feel).

1. I often feel a sense of oneness with the natural world around me.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

2. I think of the natural world as a community to which I belong.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

3. I recognize and appreciate the intelligence of other living organisms.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

4. I often feel disconnected from nature.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

6. I often feel a kinship with animals and plants.

[1] Disagree strongly

[2] Disagree a little

[3] Neither agree nor disagree

[4] Agree a little

[5] Agree strongly

7. I feel as though I belong to the Earth as equally as it belongs to me.

[1] Disagree strongly

[2] Disagree a little

[3] Neither agree nor disagree

[4] Agree a little

[5] Agree strongly

8. I have a deep understanding of how my actions affect the natural world.

[1] Disagree strongly

[2] Disagree a little

[3] Neither agree nor disagree

[4] Agree a little

[5] Agree strongly

9. I often feel part of the web of life.

[1] Disagree strongly

[2] Disagree a little

[3] Neither agree nor disagree

[4] Agree a little

[5] Agree strongly

10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.

[1] Disagree strongly

[2] Disagree a little

[3] Neither agree nor disagree

[4] Agree a little

[5] Agree strongly

11. Like a tree can be part of a forest, I feel embedded within the broader natural world.

[1] Disagree strongly

[2] Disagree a little

[3] Neither agree nor disagree

[4] Agree a little

[5] Agree strongly

12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

14. My personal welfare is independent of the welfare of the natural world.

- [1] Disagree strongly
- [2] Disagree a little
- [3] Neither agree nor disagree
- [4] Agree a little
- [5] Agree strongly

Appendix B

The Metacognitive Processes of Decentering Scale (MPoD-s; Hanley, Bernstein, et al., 2020)

To the best of your ability, please rate the following statements in relation to your experience while listening to the audio clip. You can rate each statement on a scale of 0–10, with 0 indicating *not at all* and 10 representing *very much*, by clicking on the appropriate scale number.

I was able to step back and be aware of distressing thoughts, emotions, and sensations without being taken over by them.

<i>Not at</i>											<i>Very</i>
<i>all</i>											<i>much</i>
0	1	2	3	4	5	6	7	8	9	10	

I experienced my sense of self as separate from my changing thoughts, emotions, and sensations.

<i>Not at</i>											<i>Very</i>
<i>all</i>											<i>much</i>
0	1	2	3	4	5	6	7	8	9	10	

I was able to watch thoughts, emotions, and sensations come and go.

<i>Not at</i>											<i>Very</i>
<i>all</i>											<i>much</i>
0	1	2	3	4	5	6	7	8	9	10	

Appendix C

The Nondual Awareness Dimensional Assessment (NADA-S; Hanley et al., 2018)

Please rate the following statements as accurately possible in relation to your experience while listening to the audio clip. You can rate each statement on a scale of 1–10, with 1 indicating *not at all* and 10 representing *very much*, by selecting the appropriate scale number.

1. I experienced all sense of self and identity dissolve away.

<i>Not at</i>											<i>Very</i>
<i>all</i>											<i>much</i>
0	1	2	3	4	5	6	7	8	9	10	

2. I experienced all things seeming to unify into a single whole.

<i>Not at</i>											<i>Very</i>
<i>all</i>											<i>much</i>
0	1	2	3	4	5	6	7	8	9	10	

3. I felt surrounded and filled with a blissful warmth or energy.

<i>Not at</i>											<i>Very</i>
<i>all</i>											<i>much</i>
0	1	2	3	4	5	6	7	8	9	10	

Appendix D

Demographic questionnaire

We ask that you answer the following questions to the best of your ability. Some questions require you to openly answer. Other questions require you to select the best option that pertains to you.

1. What is your age? _____

2. To which gender identity do you most identify?

Female

Male

Transgender Female

Transgender Male

Gender Variant/Nonconforming

Feel free to indicate if not listed _____

Prefer not to answer

3. Do you have experience with any form of meditation practice?

Yes

No

If yes, please indicate which of the following you have experience with

Mindfulness meditation

Love and kindness meditation

Progressive relaxation

Spiritual meditation

Feel free to indicate if not listed _____

How often have you practiced?

Often (5–7 times per week)

Less often (2–4 times per week)

Sometimes (2–4 times per month)

Rarely (2–4 times per year)

Never (no experience)

Feel free to indicate if not listed _____

Appendix E

The Centrality of Religiosity Scale-10 (CRS-10; Huber & Huber, 2012)

Please answer the following questions to the best of your ability (there is no right or wrong answer) by selecting the option that best pertains to you. Each response includes five options, with option 1 indicating that the statement either *never* reflects your experience or that you *not at all* attribute any importance to the statement, and option 5 indicating that the statement either *very often* reflects your experience or that you *very much so* attribute importance to the statement.

1. How often do you think about religious issues?

[1] Never

[2] Rarely

[3] Occasionally

[4] Often

[5] Very often

2. To what extent do you believe that God, deities, or something divine exists?

[1] Never

[2] Rarely

[3] Occasionally

[4] Often

[5] Very often

3. How often do you take part in religious services?

[1] Never

[2] Rarely

[3] Occasionally

[4] Often

[5] Very often

4. How often do you pray (or, if more applicable, meditate in relation to religion/spirituality)?

[1] Never

[2] Rarely

[3] Occasionally

[4] Often

[5] Very often

5. How often do you experience situations in which you have the feeling that God, deities or something divine intervenes (or allows for an intervention) in your life?

[1] Never

[2] Rarely

[3] Occasionally

[4] Often

[5] Very often

6. How interested are you in learning more about religious topics?

[1] Not at all

[2] Not very much

[3] Moderately

[4] Quite a bit

[5] Very much so

7. To what extent do you believe in an afterlife—for example immortality of the soul, resurrection of the dead or reincarnation?

[1] Not at all

[2] Not very much

[3] Moderately

[4] Quite a bit

[5] Very much so

8. How important is to take part in religious services?

[1] Not at all

[2] Not very much

[3] Moderately

[4] Quite a bit

[5] Very much so

9. How important is personal prayer (or, if more applicable, meditation in relation to religion/spirituality) for you?

- [1] Not at all
- [2] Not very much
- [3] Moderately
- [4] Quite a bit
- [5] Very much so

10. How often do you experience situations in which you have the feeling that God, deities, or something divine want(s) to communicate or to reveal something to you – or lets something be communicated or revealed to you?

- [1] Never
- [2] Rarely
- [3] Occasionally
- [4] Often
- [5] Very often

Appendix F

The Five Facet Mindfulness Questionnaire-Short Form (FFMQ-SF; Bohlmeijer et al., 2011)

Please answer the following questions to the best of your ability (there is no right or wrong answer) by selecting the option that most pertains to you. Each response includes five options, with the first option indicating that the statement is either *never or very rarely true* for you, and the last option indicating that the statement is either *very often or always true* for you.

1. I pay attention to physical experiences, such as the wind in my hair or sun on my face.

- [1] Never or very rarely true
- [2] Rarely true
- [3] Sometimes true
- [4] Often true
- [5] Very often or always true

2. Generally, I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.

- [1] Never or very rarely true
- [2] Rarely true
- [3] Sometimes true
- [4] Often true
- [5] Very often or always true

3. I notice the smells and aromas of things.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

4. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

5. I'm good at finding words to describe my feelings.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

6. I can easily put my beliefs, opinions, and expectations into words.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

7. It's hard for me to find the words to describe what I'm thinking.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

8. When I feel something in my body, it's hard for me to find the right words to describe it.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

9. Even when I'm feeling terribly upset, I can find a way to put it into words.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

10. I find it difficult to stay focused on what's happening in the present moment.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

11. It seems I am "running on automatic" without much awareness of what I'm doing.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

12. I rush through activities without being really attentive to them.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

13. I do jobs or tasks automatically without being aware of what I'm doing.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

14. I find myself doing things without paying attention.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

15. I tell myself I shouldn't be feeling the way I'm feeling.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

16. I make judgments about whether my thoughts are good or bad.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

17. I tell myself that I shouldn't be thinking the way I'm thinking.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

18. I think some of my emotions are bad or inappropriate and I shouldn't feel them.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

19. I disapprove of myself when I have illogical ideas.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

20. I watch my feelings without getting carried away by them.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

21. When I have distressing thoughts or images, I don't let myself be carried away by them.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

22. When I have distressing thoughts or images, I feel calm soon after.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

23. Usually when I have distressing thoughts or images I can just notice them without reacting.

[1] Never or very rarely true

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

24. When I have distressing thoughts or images, I just notice them and let them go.

[1] Never or very rarely true.

[2] Rarely true

[3] Sometimes true

[4] Often true

[5] Very often or always true

Curriculum Vitae

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Conference Presentations: Paper Presentation; “A longitudinal association between diurnal preference and depression,” Student Psychology Studies Symposium (SPSS).

Paper Presentation; “Experimental assessment of the factors influencing the restorative potential of bird sounds in humans,” Canadian Psychology Association Convention 2025.