Author/s:
Macaulay, R;Johnson, K;Lee, K;Williams, K

Title:
Examining the facets of mindful engagement and mind wandering in nature

Date:
2024-03

Citation:
Macaulay, R., Johnson, K., Lee, K. & Williams, K. (2024). Examining the facets of mindful engagement and mind wandering in nature. Journal of Environmental Psychology, 94, https://doi.org/10.1016/j.jenvp.2024.102253.

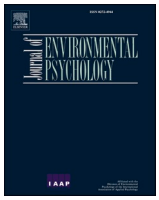
Persistent Link:
https://hdl.handle.net/11343/340487

Journal of Environmental Psychology 94 (2024) 102253

Contents lists available at ScienceDirect

Journal of Environmental Psychology

journal homepage: www.elsevier.com/locate/jep



Examining the facets of mindful engagement and mind wandering in nature

Rose Macaulay [a,*], Katherine Johnson [b], Kate Lee [a], Kathryn Williams [a]

[a] School of Agriculture, Food and Ecosystem Sciences, University of Melbourne, Baldwin Spencer Building, Parkville, 3010, Victoria, Australia
[b] Melbourne School of Psychological Sciences, University of Melbourne, Redmond Barry Building, Parkville, 3010, Victoria, Australia

ARTICLE INFO

Handling Editor: L. McCunn

Keywords:
Nature experience
Mindfulness
Mind wandering
Restoration
Nature connection

ABSTRACT

Mindfulness and mind wandering may both enhance the psychological outcomes of nature experiences. Both states are multi-faceted, with mindfulness involving specific components such as decentering, body awareness, and nonjudgment, and mind wandering involving intentional and spontaneous mind wandering. These facets may differentially predict psychological outcomes of nature experiences, however these associations have not been tested. In this study we examined facets of mindfulness and mind wandering in nature and tested their associations with outcomes of psychological restoration and nature connection. We also tested the effects of situational factors on these engagement facets in nature. We conducted an experiment in which participants were instructed on how to engage with nature during a 20min experience in nearby nature and completed online surveys before and after the outdoor experience. Participants were allocated into one of four groups, each given different engagement instructions. We used measures of state mindfulness that assessed three facets – decentering, nonjudgment, and body awareness – and measures of mind wandering that assessed two facets – mindlessness, and deliberate mind wandering. Regression analyses revealed associations between these facets and outcomes of the nature experience; decentering and deliberate mind wandering were associated with positive outcomes, including stronger nature connection and positive affect, and nonjudgment was associated with higher negative affect. Further analyses revealed perceived restorativeness and other situational factors such as affective state influenced engagement during the nature experience. These results demonstrate the value of deconstructing mindfulness and mind wandering in nature to explore facets that have beneficial or adverse effects on psychological outcomes. We conclude with practical directions for nature-based engagement interventions that can target the beneficial components of these practices in different contexts.

1. Introduction

Both mindfulness and mind wandering have the potential to enhance psychological outcomes of nature experiences, including nature connection, mood, and attention restoration (Lymeus, Lindberg, & Hartig, 2018; Macaulay, Johnson, Lee, & Williams, 2022c; Nisbet, Zelenski, & Grandpierre, 2019; Williams et al., 2018). In this paper we consider mindfulness and mind wandering to be engagement forms that can emerge in and alter the experience of nature. Mindfulness is a form of awareness that involves attending to the present moment with qualities of acceptance, nonjudgment, and without elaboration (Bishop et al., 2006; Kabat-Zinn, 2003). Mind wandering typically involves a form of introspection that is self-generated and unrelated to one's current task or external situation (Seli, Risko, & Smilek, 2016; Smallwood & Schooler, 2006).

Past studies have demonstrated the value in deconstructing the facets of mindfulness (e.g., Coffey, Hartman, & Fredrickson, 2010) and mind wandering (Seli, Risko, & Smilek, 2016) when examining their associations with psychological outcomes. For mindfulness, researchers have found that some facets of trait mindfulness (non-reactivity, observing) are associated with higher nature connection, while other facets (nonjudging and acting) are not (Barbaro & Pickett, 2016; Hanley, Derringer, & Hanley, 2017; Sadowski, Böke, Mettler, Heath, & Khoury, 2020). However, these findings come from cross-sectional survey studies, and the same outcomes have not been explored in the context of nature experiences or mindfulness interventions. For mind wandering, researchers have distinguished between intentional and unintentional aspects of mind wandering (Seli, Carriere, & Smilek, 2015), although this distinction has not been considered in the context of nature. Thus, little is known about which facets of mindfulness and mind wandering strengthen the outcomes of nature experiences. Studies that examine these engagement forms in nature experiences must consider their

* Corresponding author.
E-mail address: rose.macaulay@unimelb.edu.au (R. Macaulay).

https://doi.org/10.1016/j.jenvp.2024.102253
Received 6 February 2023; Received in revised form 12 December 2023; Accepted 6 February 2024
Available online 11 February 2024

multiple facets, to avoid broad – and potentially imprecise – applications of engagement in nature.

This paper aims to examine the facets of mindfulness and mind wandering in nature experiences that lead to better outcomes of psychological restoration and nature connection. We explore mindfulness and mind wandering in the context of *nearby nature* experiences: that is, experiences of nature in the local landscape (Rickard & White, 2021), which may be in backyards or neighbourhoods. Theoretically, this paper will provide insight into the pathways between engagement and restoration and nature connection. Practically, this will allow for more targeted nature-based engagement interventions that focus on the facets known to strengthen outcomes. The first step of these advancements is evaluating mindfulness and mind wandering facets in nature experiences and their influence on outcomes of connection with nature, mood, and attention restoration. Second, we explore the situational factors that influence the experience of mindfulness and mind wandering in nature, to test the conditions in which their key facets lead to psychological outcomes. In this paper we refer to specific terms related to engagement. We provide definitions in Table 1 for clarity.

1.1. Mindfulness and mind wandering in nearby nature experiences

To avoid conflating different forms and facets of mindfulness and mind wandering in nature, it is important to conceptualise and measure them as multi-faceted constructs. However, unidimensional operationalisations of mindfulness and mind wandering are often used in the literature, particularly when comparing the two constructs. A recent systematic review found that the Mindful Attention and Awareness Scale (MAAS) was most commonly used to contrast mindfulness and mind wandering (Turkelson & Mano, 2021), despite this scale only measuring the attentional component of mindfulness (Grossman & Van Dam, 2011). Further, mind wandering was often operationalised as attentional lapses on sustained attention tasks. Such measures leave multidimensionality unaccounted for and may result in misunderstanding the impacts and mechanisms of these engagement forms (Seli et al., 2015). We must avoid adopting this limited approach in research on engagement in nature experiences. Multi-faceted and dimensional conceptualisations and measures of mindfulness and mind wandering (e.g., Baer et al., 2008; Seli et al., 2015) offer a solution for examining them in nature experiences. In the following we review how mindfulness and mind wandering - and their underpinning facets - are applied in people's experiences of nearby nature.

Mindfulness in nature experiences has been examined in a variety of ways. Depending on the practice, mindfulness may involve a focused awareness of external sensory input, or internal thoughts and emotions, or a broad monitoring of one's entire unfolding experience (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008; Lutz, Jha, Dunne, & Saron, 2015; Vago & Zeidan, 2016). The empirical literature examining mindfulness in nature reflects this diversity of practices, including studies on outdoor mindfulness courses using exercises such as focused attention and body scans (Choe, Jorgensen, & Sheffield, 2020), and open monitoring by observing the experience with curiosity and openness (Lymeus et al., 2018). Other studies examine whether outcomes of nature exposure are enhanced with the addition of mindfulness and apply a form of mindfulness that focuses on the sensations of walking in nature (Shin et al., 2013) or on a broader range of nature-based sensory experiences in outdoor environments (Nisbet et al., 2019). These experimental studies have shown that mindfulness in nature can improve connection with nature (Nisbet et al., 2019), anxiety, and happiness (Shin et al., 2013).

Table 1
Definitions and examples of terms related to engagement.

Term	Definition	Examples
Engagement form	A specified mental state or type of awareness that characterises a momentary or ongoing cognitive experience	Mindful engagement; mind wandering; focused attention
Engagement facet	The distinct components or elements that comprise an engagement form	Present moment-awareness; nonjudgment
Engagement practice	The technique or behaviour employed to cultivate an engagement form	Paying attention with curiosity and openness; intentionally letting thoughts drift in and out

There are theoretical explanations for how the facets of mindfulness may strengthen psychological outcomes of nature experiences, though empirical evidence for these is limited. Several mechanisms are identified: a heightened awareness of the sensory experience (Barbaro & Pickett, 2016; Nisbet et al., 2019); detachment from the subjective experience (decentering) that leads to greater immersion in and connection with nature (Hanley et al., 2017); and acceptance and non-judgment towards the experience of nature (Wang et al., 2016). This literature has previously been summarised into three key mechanisms that may underpin the benefits of mindfulness in nature: perceptual sensitivity, decentering, and non-reactivity (Macaulay, Lee, Johnson, & Williams, 2022a).

First, perceptual sensitivity is a quality of mindful awareness that develops through deeper sensory engagement experienced through mindfulness practice (Tanay & Bernstein, 2013). Researchers have proposed that mindfulness in nature creates a deeper experience through closer sensory engagement with nature and present-moment awareness (Barbaro & Pickett, 2016; Howell, Dopko, Passmore, & Buro, 2011), and that mindful engagement itself enhances awareness of the environment (Nisbet et al., 2019). There is some mixed evidence relating to the associations between nature experience and awareness and perceptual sensitivity: Stewart and Haaga (2018) found that nature exposure led to higher mindfulness as measured with the MAAS, which measures attention and distraction, but not on the State Mindfulness Scale (Tanay & Bernstein, 2013), which measures awareness of mental events and bodily sensations.

Decentering through mindful awareness involves detachment from the self and deidentifying from one's internal experience (Hölzel et al., 2011), which is suggested to promote greater engagement with the external environment (Hanley et al., 2017). Decentering in mindful nature experiences is proposed to support a sense of *being away* in nature through deeper present-moment experience, thus promoting restorative outcomes (Lymeus et al., 2018). Further, research has demonstrated associations between decentering and a sense of nature connection in cross-sectional survey studies (Hanley et al., 2017), and that mindful nature experiences lead to a heightened sense of decentering (Nisbet et al., 2019).

Non-reactivity in mindfulness involves allowing thoughts and emotions to arise without reacting or elaborating on them (Baer et al., 2008), and can be supported via open monitoring mindful practices where one observes internal and external phenomena as they arise, without reactivity or judgment (Lutz et al., 2015). In nature experiences, we consider non-reactivity and nonjudgment to be particularly relevant where there may be challenging aspects of experience that may evoke negative emotions or thoughts (Macaulay et al., 2022a). This quality of mindful awareness (including nonjudgment and acceptance) has been identified as a key pathway between a nature-based mindfulness intervention and outcomes such as calmness and happiness (Djernis, Lundsgaard, Rønn-Smidt, & Dahlgaard, 2023). Further, cross-sectional research has demonstrated non-reactivity to be a key mindfulness facet associated with nature connection (Sadowski et al., 2020). Together, the above studies provide some initial evidence for the links between mindfulness facets (perceptual sensitivity, decentering, and non-reactivity and non-judgment), nature exposure and nature connection; however, no studies have examined yet how these mindfulness facets function within nature experiences to directly affect outcomes of the experience.

There is some theoretical and empirical evidence for the benefit of

mind wandering in nature. While mind wandering can be defined as task-unrelated thought (Seli, Risko, & Smilek, 2016), the role of the environment and the present task or situation is relevant to whether individuals engage in mind wandering, and the outcomes of the mind wandering experience (Mooneyham & Schooler, 2013; Schooler et al., 2014). Studies have found that mind wandering can indeed be triggered by external stimuli, such as verbal cues or videos, and that the stimulus itself can influence the form that mind wandering takes (Faber & D'Mello, 2018; Pelagatti, Binda, & Vannucci, 2018). There is some evidence that being in nature may generate positive introspection during the experience (Cervinka, Schwab, & Haluza, 2020), and that mind wandering in nearby nature experiences can lead to calming and restorative benefits (Macaulay, Lee, Johnson, & Williams, 2022b). Theoretical accounts of mind wandering in nature suggest that it is the fascinating, undemanding qualities in nature that enable introspection and mind wandering, which may lead to better creative thinking (Atchley, Strayer, & Atchley, 2012). Further, Williams et al. (2018) propose that mind wandering in nature could support attention restoration via a shifting of awareness between an external fascinating environment and internal effortless thought processes.

The thought content and intentionality of mind wandering will likely affect the consequences of mind wandering in nature (Seli et al., 2015; Smallwood & Andrews-Hanna, 2013). Across several papers, Seli et al. (2015; 2016a, b; 2017) demonstrated that intentional and unintentional mind wandering are distinct forms. Unintentional, spontaneous mind wandering is associated with a lack of control and inattentiveness, while intentional, deliberate mind wandering is associated with goal-directed thought and relief from boredom (Carriere, Seli, & Smilek, 2013; Seli, Risko, & Smilek, 2016). Mind wandering that is productive, future-oriented and/or sufficiently interesting is associated with positive mood, while past-oriented or uninteresting thoughts can lead to negative mood (Franklin et al., 2013; Smallwood & Andrews-Hanna, 2013). Further, Smallwood and Andrews-Hanna (2013) suggested that the right conditions – such as undemanding and positive environments – will lead to adaptive mind wandering with positive outcomes.

In nature, intentional mind wandering may lead to positive psychological outcomes, where an individual is facing low cognitive demands, is supported by aesthetically pleasing natural qualities, and has the capacity to engage in goal-directed or otherwise engaging thought (Seli, Risko, & Smilek, 2016; Williams et al., 2018). We note that this process of intentional mind wandering in nature maps onto earlier accounts of restoration through *reflection*, which is supported by pleasing aesthetic experiences and a moderate level of (soft) fascination in nature (Kaplan, 1993). Unintentional, spontaneous mind wandering may occur in nature if an attempt to focus on a current task is hindered by attention being drawn away by some salient external or internal stimulus (Carriere et al., 2013). If internal (affective) concerns are strong, spontaneous mind wandering may lead to negative affective outcomes as a result of being ruminative and uncontrolled (Seli et al., 2015) – though we note that mind wandering and rumination are distinct mental states (Christoff, Irving, Fox, Spreng, & Andrews-Hanna, 2016). Taken together, we suggest that both deliberate and spontaneous mind wandering may occur in nature and impact outcomes in contrasting ways.

1.2. Diverse contexts influence engagement in nature experiences

How an individual perceives the environment is likely to impact the experience of mindfulness and mind wandering in nature, and their underlying facets. A restorative environment with fascinating qualities is proposed to support the practice of mindfulness as the environment softly holds attention and allows rest (Kaplan, 1995, 2001; Lymeus et al., 2018), and may promote mind wandering due to lower cognitive demands (Williams et al., 2018). However, not all nature experiences occur in environments that are perceived to be restorative. In more constrained environments, such as busy urban green spaces or uninteresting settings, both mindfulness and mind wandering may take quite different forms. Being mindful in less restorative environments may require a stronger capacity for nonjudgment towards one's experience (Macaulay et al., 2022a). Mind wandering in an environment that demands an individual's attention – for example, a stressful urban environment – may be unproductive and lead to error or risk, and can indicate a failure to regulate attention (Smallwood & Andrews-Hanna, 2013). On the other hand, mind wandering in environments that have few cognitive demands may be associated with benefits such as future planning and creativity (Schooler et al., 2014). To understand these nuances, it is necessary to examine the effects of perceived restorativeness of an environment on the facets of mindfulness and mind wandering.

Other situational factors such as individual levels of trait mindfulness, nature connection, and current mood, are also likely to influence whether one can be mindful or engage in deliberate or spontaneous mind wandering (Macaulay et al., 2022b). 'Experience sampling' methods have revealed that mood can influence both state mindfulness (Gotink et al., 2016) and mind wandering (Poerio, Totterdell, & Miles, 2013), though these studies do not examine different facets of mindfulness or mind wandering. In this study we also consider whether trait nature connection impacts state mindfulness and mind wandering in nature, building on existing literature that has established an association between trait connection with nature and trait mindfulness (Schutte & Malouff, 2018). As we have argued above, understanding how these factors influence mindfulness and mind wandering in nature experiences must include an examination of their effect on the underlying facets of these engagement forms.

Intervention instruction (for example, instructing someone to pay attention to nature; Lin, Tsai, Sullivan, Chang, & Chang, 2014) will also change how an individual engages and interacts within a nature experience. While existing literature examines the effect of engagement instructions on psychological outcomes of the nature experience, such as level of restoration (e.g., Pasanen, Johnson, Lee, & Korpela, 2018), wellbeing outcomes (Passmore & Holder, 2017) and nature connection (Lumber et al., 2017), here we consider the potential effect of intervention instructions on how individuals engage in nature. For example, being instructed to engage mindfully may heighten immersion in and contact with nature through decentering, or function to increase psychological distance and support restoration (Macaulay et al., 2022a). These ideas remain exploratory and require testing to understand how intervention instructions might influence engagement in nature and subsequent outcomes of the experience.

1.3. Current study and research questions

Our aim in this study was to examine the underpinning facets of mindfulness and mind wandering in nearby nature experiences, including what shapes them, and how they affect outcomes. In the current study we test the role of intervention instructions while accounting for engagement in nature, building on published findings that examined the direct effect of an intervention on outcomes (see Macaulay et al. (2022c) for full details of the intervention instructions). To start, we test whether the engagement intervention instructions influenced mindfulness and mind wandering facets differently. We test three facets of mindfulness – decentering, body awareness, and nonjudgment – and two facets of mind wandering – mindlessness and deliberate mind wandering (for further detail, see Section 3.2). Our first research question is thus.

1. Do intervention group instructions (i.e., instructions to engage mindfully, to direct attention to nature, or to mind wander) influence the facets of mindfulness and mind wandering in nature?

We then examined situational influences on mindfulness and mind wandering in nature, to understand the parameters of these forms of engagement. We asked.

2. How does perceived restorativeness of the environment, trait nature connection, trait mindfulness and affect influence the facets of mindfulness and mind wandering in nature?

Finally, we tested the effect of engagement during the experience on psychological outcomes of nature. We examined the effect of mindfulness and mind wandering facets on outcomes, and then tested how the intervention instructions were involved in this association. We asked.

3a. How do facets of mindfulness and mind wandering in nature influence psychological outcomes of nature connection, affect, and attention?
3b. Do engagement intervention instructions influence these outcomes when accounting for mindfulness and mind wandering during the experience?

These research questions are depicted in Fig. 1.

2. Method

2.1. Participants and procedure

Sample size was determined a priori with a power analysis using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007). Based on power = .80, α = 0.05, and $f^2 = 0.06$, we aimed to have a sample size = 175. With expected attrition rates we aimed to recruit 250 participants. Participants were recruited through online advertising and newsletters and were mostly staff and students at the University of Melbourne. Three hundred and thirty-one participants began the survey, but 116 did not finish the survey, resulting in a final sample of $n = 215$. The majority of participants were university students (68%), female (74%) and the mean age was 24.3 years ($SD = 9.4$).

The study ran between October 2020 to April 2021 (over Spring, Summer, and Autumn months). Participants were asked to spend 20-mins in an outdoor environment. Due to the study taking place during the COVID-19 pandemic, participants were instructed to visit an outdoor environment near their homes; this may have been their own backyards or a nearby green space. Before and after this experience, they completed online surveys and an attention task. The pre-test survey consisted of demographic questions, measures of trait nature connection, trait mindfulness, positive and negative affect, and the Sustained Attention to Response Task (SART). The post-test survey consisted of the SART, measures of positive and negative affect, state connection with nature, state mindfulness and state mind wandering, perceived restorativeness of the outdoor experience, and reported characteristics of the environment they visited.[1] After the pre-test survey, all participants visited an outdoor environment for 20-mins. Participants were randomly allocated into one of four intervention groups: a group instructed to engage mindfully during their outdoor experience ('mindful engagement'; $n = 49$); a group instructed to direct their attention in ways distinct from mindful qualities ('directed engagement'; $n = 55$); a group instructed to let their minds wander ('mind wandering'; $n = 57$); and an unguided group who received no engagement instructions ('unguided control'; $n = 54$). Full instructions are provided in Appendix A. Full details of the study methods and intervention structure are reported in (Macaulay et al., 2022c).

2.2. Measures

Sustained attention was measured using an online version of the Sustained Attention to Response Task (SART; Johnson et al., 2007; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). A random sequence of single digits was presented on the screen, and participants were instructed to press the spacebar quickly in response to all digits except '3'. The mean and standard deviation response times, and the number of commission errors (i.e., pressing spacebar when '3' is presented), were recorded and used in this study.

Trait and state connection with nature were measured with the Connectedness to Nature Scale short-form (CNS-7; Mayer & Frantz, 2004; Pasca, Aragonés, & Coello, 2017). Items are reworded slightly to reflect the trait- and state-forms of this scale, for example, "*I often feel disconnected from nature*" becomes "*At the present moment, I don't feel connected to nature*" in the state version. Internal consistency was good for both trait (α = 0.84) and state (α = 0.90) measures.

Trait mindfulness was measured with the 14-item Freiburg Mindfulness Inventory (FMI-14; Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006; α = 0.81).

Positive affect (PA) and negative affect (NA) were measured with the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). Responses were summed as separate scales (post-test PA α = 0.91; post-test NA α = 0.90).

Perceived restorativeness was measured with four items from the Perceived Restorativeness Scale (PRS; Hartig, Korpela, Evans, & Gärling, 1997; α = 0.82). Following previous studies that test restorativeness in small urban parks, we used four items that measure fascination with the environment/experience and a sense of being away from everyday demands (Lindal & Hartig, 2015; Nordh, Hartig, Hagerhall, & Fry, 2009).

2.2.1. Engagement during the nature experience: state mindfulness and state mind wandering

We selected scales and subscales to capture the multifaceted nature of both state mindfulness and state mind wandering (see Appendix D for a full list of items). The facets that we targeted are those that are conceptually relevant to restorative nature experiences, as identified in previous research (Macaulay et al., 2022a). Overall state mindfulness was measured with the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013; α = 0.87), which contains subscales of Mind and Body. The Body subscale was used in this study to represent awareness of physical sensations (α = 0.76), and both the Mind and Body subscales were used together as a total measure of state mindfulness. We also used the nonjudgmental acceptance subscale from the Multidimensional State Mindfulness Questionnaire (MSMQ; Blanke & Brose, 2017; α = 0.75); and the decentering subscale from the Toronto Mindfulness Scale (TMS; Lau et al., 2006; α = 0.83). State mind wandering was measured with the Mind Wandering- Deliberate (MW-D) subscale (α = 0.69) from Carriere et al. (2013) that measures deliberate, intentional mind wandering; and the 5-item state version of the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003; α = 0.75) that measures mindlessness or a lack of awareness. Participants rated items based on how well they reflected their outdoor experience, from 1 (Not at all) to 5 (Extremely).

2.3. Analysis

All analyses were conducted using SPSS version 27. Data were checked for missing values. There were no patterns in missing values (Little's Missing Completely at Random test, $\chi^2 = 210.50$, $df = 211$, $p = .50$), and there were a low (<10%) number of partial respondents across the study; therefore, pairwise deletion is viewed as an unbiased strategy

[1] We measured environmental characteristics with 11 items that reflect the restorative features in the environment (Appendix B). The items on this scale were identified through review of past research (including Lindal & Hartig, 2015; Mesimäki, Hauru, & Lehvävirta, 2019; Nordh & Østby, 2013) that specify features in urban green spaces that contribute to restoration. While we aimed to use these items as a way to test how environmental restorativeness influenced engagement in nature, we found that many items were heavily skewed (negatively or positively) and did not satisfy statistical assumptions required for the multiple regression analyses. We therefore decided to only use perceived restorativeness as an indicator of environmental restorativeness. In light of these challenges, we recommend further research that develops and validates a self-report measure for restorative characteristics of visited environments.

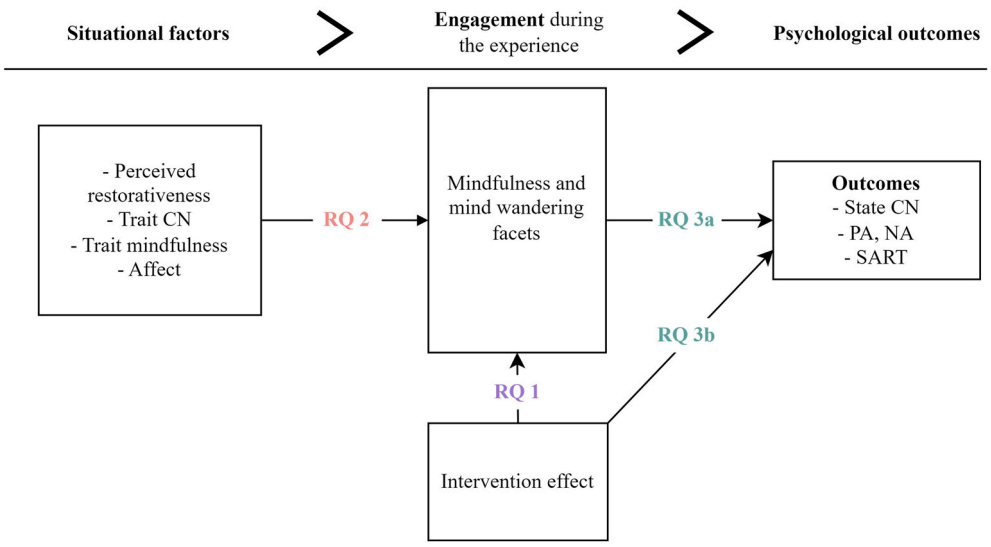


Fig. 1. Conceptual representation of research questions (RQ). CN = Connection with nature; PA = Positive affect; NA = Negative affect; SART = Sustained attention to response task.

for handling missing data (Newman, 2014). Assumptions of the following statistical tests were assessed and satisfied, including homoscedasticity of the regression models, normal distribution of residuals, and multicollinearity. Collinearity was assessed by inspecting the correlations between all predictor variables (including engagement facets, all <0.70) and VIF and tolerance statistics. Negative affect was transformed using an inverse function due to violating assumptions of homogeneity of variance. Researchers checked participant adherence to the study protocol by calculating the time spent between the pre-test and the post-test survey to ensure participants had spent the required time in the outdoor environment.

RQ1: A series of ANCOVAs were conducted to test intervention group differences on each of the facets of mindfulness and mind wandering. Trait mindfulness was entered as the covariate, to control for any variation in engagement during the experience that was due to one's level of existing trait mindfulness.

RQ2: To test how situational factors influenced engagement during the nature experience, perceived restorativeness, trait mindfulness, trait connection with nature, and positive and negative affect before the nature experience were entered into a series of regression analyses together to predict the mindfulness and mind wandering facets.

RQ3a and RQ3b: To test how mindfulness and mind wandering during the nature experience influenced psychological outcomes, we conducted separate multiple regression models where engagement facets, intervention groups, and pre-test scores predicted the following outcome variables: connection with nature, positive affect, negative affect, mean response time and standard deviation of response time, and commission errors on the SART. Engagement facets, pre-test scores and intervention groups were both included in the regression models so that any effect of intervention group on psychological outcomes would be tested while controlling for the other predictor variables (i.e., engagement facets and the pre-test scores on each outcome variable). We reasoned that if intervention groups did significantly influence outcomes in the overall model, then a follow-up analysis could test the interaction between group and engagement and identify whether the engagement facets were associated with outcomes differently depending on group allocation.

3. Results

3.1. Intervention instructions influence engagement facets

A series of ANCOVAs revealed some intervention group differences between the facets of mindfulness and mind wandering (RQ1; Table 2). As expected, the mindful engagement group had the highest level of state mindfulness (State Mindfulness Scale) overall, however, this difference was not statistically significant. The unguided control group had lower scores of *nonjudgment*, in comparison with the mindful engagement group ($p = .02$), the directed engagement group ($p < .001$), and the mind wandering group ($p = .02$). The unguided control group also had lower scores of *decentering* in comparison with the mindful engagement group ($p = .005$) and the mind wandering group ($p = .04$).

3.2. Situational factors influence engagement facets

The regression models testing the influence of situational factors on engagement during the experience (RQ2) significantly predicted all engagement facets (Table 3). Standardised regression coefficients and their confidence intervals are presented in Fig. 2. Perceived restorativeness was strongly and positively associated with all engagement facets, indicating that how restorative individuals perceived the environment to be was the strongest influence on how they engaged during their time there. While controlling for perceived restorativeness and other situational factors, we found that trait nature connection had no significant associations with engagement during the experience. Trait mindfulness was positively associated with decentering, but had no significant influence on state mind wandering in the experience. Positive affect was positively associated with body awareness during the experience, and negatively associated with nonjudgment. Inversed negative affect had a strong negative association with nonjudgment and was also negatively associated with decentering, deliberate mind wandering, and mindlessness. Accounting for the inversed transformation, this means that higher negative affect was associated with a higher level of nonjudgment, decentering and mind wandering.

3.3. Mindfulness and mind wandering facets predict key psychological outcomes

To test RQ3a and RQ3b the five engagement facets, baseline (pre-test) variables, and intervention group dummy variables were all

Table 2
ANCOVAs testing the difference between intervention groups on mindfulness and mind wandering.

Dependent variable *Covariate: trait level mindfulness*	Mindful engagement group	Directed engagement group	Mind wandering group	Unguided control group	Omnibus test
	EMM (SE)	EMM (SE)	EMM (SE)	EMM (SE)	
State mindfulness (total)	3.52 (0.09)	3.36 (0.08)	3.33 (0.08)	3.19 (0.09)	F (3, 206) = 2.37, p = .07, partial η^2 = .03
Nonjudgment	2.68[a] (0.13)	2.84[a] (0.12)	2.63[a] (0.12)	2.25[b] (0.12)	F (3, 206) = **4.31, p < .01,** partial η^2 = .06
Decentering	3.31[a] (0.09)	3.08 (0.09)	3.20[a] (0.09)	2.93[b] (0.09)	F (3, 206) = **2.98, p = .03,** partial η^2 = .04
Body awareness	3.50 (0.09)	3.39 (0.09)	3.24 (0.08)	3.34 (0.09)	F (3, 206) = 1.47, p = .22, partial η^2 = .02
Mindlessness	2.82 (0.11)	2.74 (0.11)	2.87 (0.10)	2.57 (0.11)	F (3, 206) = 1.45, p = .22, partial η^2 = .02
Deliberate MW	3.20 (0.13)	3.28 (0.12)	3.41 (0.12)	3.12 (0.12)	F (3, 206) = 1.11, p = .35, partial η^2 = .02

[a, b] Means in the same row containing different superscripts differ significantly. EMM = estimated marginal means. SE = standard error.

entered into multiple regression models to predict separate psychological outcomes (Table 4). Within these models, the facets of mindfulness and mind wandering were associated with outcomes to differing degrees (Fig. 3). Decentering and deliberate mind wandering were both positively associated with connection with nature, and decentering was positively associated with positive affect. Nonjudgment was negatively associated with inverse negative affect, and deliberate mind wandering was positively associated with inverse negative affect. When accounting for pre-test scores and intervention group allocation, none of the engagement facets were significantly associated with commission errors, mean RT, or SD RT on the SART.

In comparison to the unguided control group, none of the intervention groups were significantly associated with connection with nature, positive affect, negative affect, or mean RT on the SART. This result indicates that when accounting for both state mindfulness and state mind wandering facets during the nature experience, allocation to an experimental group did not have a significant influence on these outcomes. Of note, commission errors on the SART was significantly higher in the directed engagement group compared to those in the unguided control group, and SD RT was significantly higher in both the mindful engagement group and directed engagement group compared to the unguided control group. Because intervention group had a significant effect on the outcome variable in this regression model, we conducted a second regression model to test for interactions between this intervention group and engagement facets. The multiple regression model did not significantly predict commission errors (F (15, 164) = 1.49, p = .08), or SD RT (F (15, 164) = 1.34, p = .15) and none of the predictor variables or interaction terms had significant associations with the outcome variable. This result suggests that engagement facets influenced commission errors and SD RT similarly across all groups.

4. Discussion

This study provides novel insights into the effects of mindfulness and mind wandering in nearby nature experiences, by 1) examining the underlying facets of these engagement forms that may contribute to psychological outcomes, and 2) exploring the situational parameters of mindfulness and mind wandering facets in nature to test whether they differ functionally in different personal circumstances. A key finding was that some facets of mindfulness and mind wandering sharply contrast in how they relate to psychological outcomes. This highlights the value of distinguishing engagement facets to understand how engagement may optimise the outcomes of nature. For instance, although the decentering facet was associated with higher positive affect, nonjudgment was associated with higher negative affect. We also showed that mindfulness and mind wandering in nature were influenced by how restorative an individual perceived the environment to be. These interventions also depend on individual factors like trait mindfulness, nature connection, and their mood. We provide an integrated summary of these findings in Table 5, which enables practical recommendations for implementing nature-based engagement interventions.

4.1. Mindfulness and mind wandering facets contribute to psychological outcomes

In this study we advanced understanding of how both mindfulness and mind wandering may be best applied in nearby nature, by examining the specific facets of each that contribute to psychological outcomes of nature experiences (RQ1, RQ3a). The mindfulness facet, *decentering,* was associated with positive psychological outcomes. Decentering was associated with higher connection with nature and better mood after the nature experience, indicating an overall positive effect of deidentifying with thoughts and emotions during a nature experience. The association with state-level connection with nature is consistent with cross-sectional research that found that individuals who deidentify more with their thoughts and emotions have a stronger trait-level connection with nature (Hanley et al., 2017). Hanley and colleagues propose that decentering can allow one to experience a greater identification with the external experience, and natural world.

An unexpected finding was that the mindfulness facet, *nonjudgment*, had negative associations with psychological outcomes. Nonjudgment was associated with higher negative affect after the nature experience, indicating that this engagement facet led to lower mood. In line with mindfulness literature, we would expect that the tendency to accept and be nonjudgmental towards the mental experience would be associated with positive psychological outcomes (Mattes, 2019; Schroevers & Brandsma, 2010). However, others have speculated that nonjudgment may be particularly relevant to strongly negative mental states, or to situations that are challenging (Blanke & Brose, 2017), and less important for everyday mental states. In the current study's context of a work break in an outdoor location where individuals were not faced with a challenging or stressful situation, nonjudgment may not have been especially relevant or valid to test. Second, the concept of nonjudgment for those unfamiliar with mindfulness practice may further challenge the validity of the measure. The items used to measure nonjudgment (e.g., "I thought some of my thoughts/feelings were slightly off" (reverse scored)), may have instead reflected a degree of meta-awareness to thoughts and emotions. That is, if an individual strongly agreed with this item, they may have been highly aware of their thoughts; on the other hand, if an individual disagreed with this item, they may have been unaware or unable to report on their mental state during the nature experience. This example illustrates the need for caution when measuring mindfulness among individuals who have no experience with the concept/practice (Van Dam, Hobkirk, Danoff-Burg, & Earleywine, 2012).

Deliberate mind wandering led to lower negative affect, while

Table 3
Regression models: situational factors predicting engagement during the nature experience ($N = 207$).

	Body awareness			*Decentering*			*Nonjudgment*			*Mindlessness*			*Deliberate mind wandering*		
	B (CI)	*SE B*	β	*B (CI)*	*SE B*	β	*B (CI)*	*SE B*	β	*B (CI)*	*SE B*	β	*B (CI)*	*SE B*	β
Perceived restorativeness	0.05 (0.03, 0.07)	0.01	**.37*** **	0.06 (0.04, 0.08)	0.01	**.37*** **	0.04 (0.02, 0.07)	0.01	**.22*** **	0.03 (0.01, 0.06)	0.01	**.19** **	0.08 (0.05, 0.10)	0.01	**.41*** **
Trait nature connection	0.02 (0.00, 0.04)	0.01	.13	0.00 (−0.02, 0.02)	0.01	.02	0.00 (−0.02, 0.03)	0.01	.01	−0.01 (−0.03, 0.02)	0.01	−.04	0.01 (−0.02, 0.03)	0.01	.03
Trait mindfulness	0.01 (−0.01, 0.02)	0.01	.09	0.03 (0.02, 0.05)	0.01	**.27*** **	0.02 (0.00, 0.04)	0.01	.14	−0.001 (−0.02, 0.01)	0.01	−.04	0.01 (−0.01, 0.03)	0.01	.02
Pre-test positive affect	0.02 (0.01, 0.03)	0.01	**.16* **	0.01 (0.00, 0.03)	0.01	.12	−0.02 (−0.04, −0.001)	0.01	**−.16* **	0.01 (−0.01, 0.02)	0.01	.03	0.02 (−0.001, 0.03)	0.01	.12
Pre-test negative affect (inverse)	−3.18 (−6.83, 0.48)	1.85	−.11	−4.49 (−8.36, −0.61)	1.97	**−.14* **	−19.06 (−24.08, −14.02)	2.56	**−.47*** **	−14.21 (−18.88, −9.70)	2.37	**−.40*** **	−8.21 (−13.55, −3.40)	2.46	**−.21*** **
Overall model	$R^2 = .31$, $F(5, 202) = 17.56$, $p < .001$			$R^2 = .34$, $F(5, 202) = 20.92$, $p < .001$			$R^2 = .27$, $F(5, 202) = 14.51$, $p < .001$			$R^2 = .21$, $F(5, 202) = 10.31$, $p < .001$			$R^2 = .28$, $F(5, 202) = 15.44$, $p < .001$		

Note. Bold values indicate significant regression coefficients. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

mindlessness was not associated with any psychological outcomes. While mindlessness is commonly associated with negative psychological states such as negative affect (Kiken & Shook, 2014), deliberate mind wandering (Carriere et al., 2013) and mind wandering where the thought content is positive (Franklin et al., 2013) are associated with positive outcomes. We note that the benefits found for deliberate mind wandering in this study may not be generalized beyond nearby nature settings; mind wandering in wilder settings or during nature-based activities such as rock climbing could be associated with failures in attention and lead to negative psychological (and physical) consequences. Our findings demonstrate the value in distinguishing between forms of mind wandering in nearby nature, as the type of engagement may influence outcomes quite differently.

Deliberate mind wandering also led to higher connection with nature after the experience. We speculate two possible explanations for this effect, involving indirect and direct pathways. Regarding *indirect* pathways, we first propose that reduced negative affect may have mediated this effect, such that deliberate mind wandering led to reduced negative affect which in turn led to increased nature connection. This builds on proposals that a more restorative nature experience is also more connective (Nisbet & Zelenski, 2011; Wyles et al., 2019), and existing evidence for the inverse relationship between negative affect and state-level nature connection (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; Nisbet, Zelenski, & Murphy, 2011). Second, deliberate mind wandering may have led to stronger nature connection as a result of higher sensory engagement with nature during the experience, a nature connection pathway (Lumber et al., 2017). This effect may occur due to mutually reinforcing pathways between internally oriented mind wandering and externally oriented soft fascination (Williams et al., 2018). Our suggestion for *direct* pathways between deliberate mind wandering and nature connection speculates on the thought content underpinning the mind wandering experience: drawing on findings by Lengieza, Swim, and Hunt (2021) that identified links between self-reflection and self-transcendent outcomes, we propose that if mind wandering in nature involves reflecting on a sense of meaning in one's life, it could promote stronger nature connection as a form of self-transcendence. Future studies could test these suggestions by examining alternative mediating pathways and using methods that can identify thought content of mind wandering (e.g., experience sampling; Franklin et al., 2013).

4.2. Situational factors influence engagement in nature

Our second research question asked how situational factors influence engagement during the nature experience (RQ2). We included perceived restorativeness as a measure of how the participants evaluated and related to their environment. We found that, when controlling for other situational factors including trait mindfulness, nature connection, and affect, perceived restorativeness of the environment was consistently a strong predictor of all facets of engagement. The relative strength of perceived restorativeness as a predictor of engagement connects with literature that has found perceived restorativeness to mediate the relationship between nature exposure and wellbeing outcomes (Korpela, Borodulin, Neuvonen, Paronen, & Tyrväinen, 2014; Marselle, Irvine, Lorenzo-Arribas, & Warber, 2014), and findings that psychological outcomes of nature depend on individual evaluations of nature (Van den Berg, Jorgensen, & Wilson, 2014). We extend this work to suggest that individual interaction and evaluation of an environment (through perceived restorativeness) has a strong influence on the experience of how individuals engage in nature, more so than one's level of nature connection and their affective state.

The analysis also revealed some effects of an individual's disposition and affective state on how they engage during a nature experience. Those with higher trait mindfulness engaged more mindfully via decentering during the nature experience. This result is unsurprising given the established links between trait and state mindfulness (Bravo,

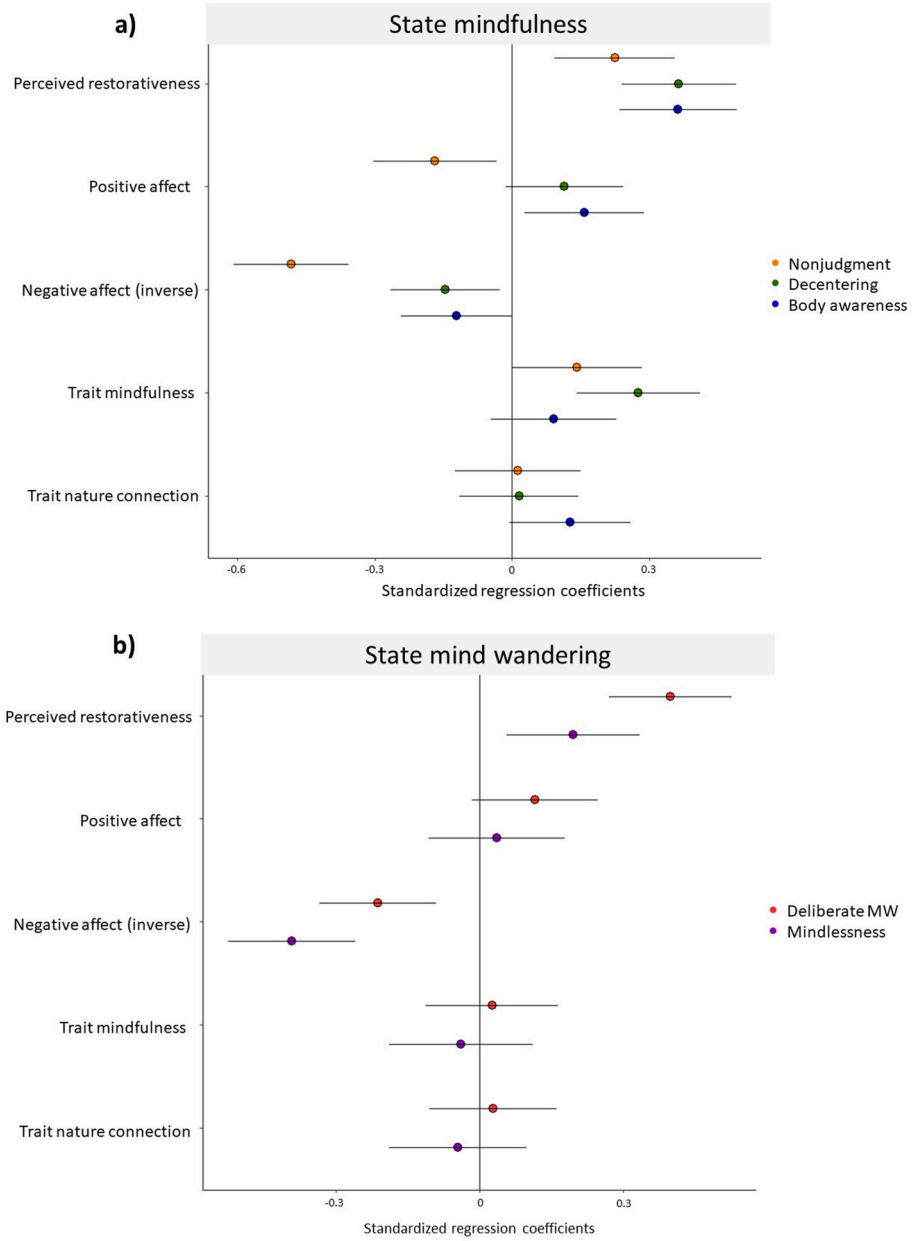


Fig. 2. Situational factors predict state mindfulness (a) and state mind wandering (b) in the nature experience in separate multiple regression models. Coloured circles are standardised regression coefficients and are shown with 95% confidence intervals (lines). Statistically significant predictor variables do not cross zero (black vertical line), with those above zero indicating positive associations with the engagement facets, and those below zero indicating negative associations with the engagement facets. Each regression model is grouped by colour: for example, in graph (a), the orange symbols represent the regression model where situational factors predict the nonjudgment facet.

Pearson, Wilson, & Witkiewitz, 2018), and demonstrates that those with higher trait mindfulness are more able to distance themselves from thoughts and emotions when experiencing nature. Trait nature connection was somewhat unexpectedly not associated with any engagement facets during the experience. We expect this is due to the stronger predictor of perceived restorativeness present in the regression analysis, noting the established relationship between trait nature connection and perceived restorativeness of various environment types (Johnson et al., 2022). A higher negative affect before the nature experience was strongly associated with a higher degree of nonjudgment and decentering, and more mind wandering during the experience. This result suggests that those with lower mood before the nature experience were more aware of their thoughts and emotions, and that their minds were off-task or distracted. This finding is consistent with research that demonstrates that lower mood is a precursor of mind wandering (Poerio et al., 2013; Smallwood, Fitzgerald, Miles, & Phillips, 2009). Further, although past research has found that nature experiences can reduce negative thought processes (rumination) as a regulatory mechanism (Bratman et al., 2021; Lopes, Lima, & Silva, 2020), our results suggest that one's level of mood prior to the nature experience may impact this potential and should be accounted for in studies testing these effects.

4.3. *Intervention instruction effect*

We examined whether engagement intervention instructions influenced the facets of state mindfulness and mind wandering (RQ1), and the effect of intervention instructions on psychological outcomes when controlling for facets of engagement in nature (RQ3b). First, the

Table 4
Regression models: mindfulness and mind wandering predicting psychological outcomes of the nature experience.

	Connection with nature (N = 210)			Positive affect (N = 211)			Negative affect (inverse) (N = 209)			Commission errors (N = 180)			Mean RT (log) (N = 180)			Standard deviation RT (log) (N = 180)		
	B (CI)	SE	β	*B (CI)*	SE	β	*B (CI)*	SE	β	*B (CI)*	SE	β	*B (CI)*	SE	β	*B (CI)*	SE	β
Baseline variable [a]	0.62 (0.51, 0.74)	0.06	**.57*****	0.67 (0.54, 0.80)	0.06	**.58*****	0.60 (0.49, 0.71)	0.05	**.63*****	0.70 (0.58, 0.82)	0.06	**.65*****	0.001 (0.001, 0.001)	0.00	**.79*****	0.00 (0.002, 0.003)	0.00	**.64*****
Group Unguided control (reference)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Group Mindful engagement	0.26 (−1.21, 1.73)	0.74	.02	−0.39 (−2.77, 1.98)	1.20	−.02	0.00 (−0.01, 0.01)	0.003	.01	1.36 (−0.50, 3.21)	0.94	.10	0.01 (−0.02, 0.03)	0.01	.02	0.07 (0.02, 0.12)	0.03	**0.20****
Group Directed engagement	−0.11 (−1.55, 1.33)	0.73	−.01	−0.87 (−3.17, 1.42)	1.16	−.05	−0.002 (−0.01, 0.01)	0.003	−.05	2.03 (0.18, 3.88)	0.94	**.14***	−0.02 (−0.04, 0.01)	0.01	−.07	0.08 (0.03, 0.13)	0.03	**0.20****
Group Mind wandering	−0.49 (−1.91, 0.92)	0.72	−.04	−0.71 (−3.00, 1.58)	1.16	−.04	0.004 (−0.00, 0.01)	0.003	.09	0.64 (−1.20, 2.48)	0.93	.05	0.01 (−0.02, 0.03)	0.01	.03	0.04 (−0.01, 0.09)	0.03	0.10
Body awareness	0.32 (−0.73, 1.36)	0.53	.04	0.67 (−0.99, 2.33)	0.84	.06	−0.001 (−0.003, 0.01)	0.002	−.02	−1.13 (−2.44, 0.19)	0.67	−.13	0.00 (−0.02, 0.02)	0.01	.02	−0.01 (−0.05, 0.03)	0.02	−0.05
Decentering	1.09 (0.13, 2.04)	0.49	**.16***	2.18 (0.66, 3.71)	0.78	**.20***	0.003 (−0.001, 0.01)	0.002	.11	−0.93 (−2.16, 0.29)	0.62	−.11	0.01 (−0.01, 0.03)	0.01	.06	−0.02 (−0.05, 0.01)	0.02	−0.09
Nonjudgment	−0.12 (−0.84, 0.61)	0.37	−.02	0.48 (−0.70, 1.67)	0.60	.05	−0.01 (−0.01, −0.02)	0.002	**−.21*****	0.68 (−0.23, 1.60)	0.47	.10	−0.01 (−0.02, 0.01)	0.01	−.07	0.00 (−0.03, 0.02)	0.01	−0.01
Mindlessness	−0.24 (−1.02, 0.53)	0.39	−.04	0.56 (−0.66, 1.79)	0.62	.06	−0.001 (−0.01, −0.001)	0.002	.01	−0.09 (−1.06, 0.89)	0.49	−.01	0.01 (−0.01, 0.02)	0.01	.05	0.02 (−0.01, 0.05)	0.01	0.09
Deliberate MW	0.78 (0.06, 1.49)	0.36	**.14***	−0.08 (−1.23, 1.06)	0.58	−.01	0.004 (0.001, 0.01)	0.001	**.17****	0.24 (−0.65, 1.13)	0.45	.04	0.00 (−0.01, 0.01)	0.01	.01	0.01 (−0.01, 0.04)	0.01	0.07
Overall model	R^2 = .51, F (9, 200) = 22.74, p < .001			R^2 = .51, F (9, 201) = 22.98, p < .001			R^2 = .52, F (9, 199) = 23.73, p < .001			R^2 = .50, F (9, 170) = 18.68, p < .001			R^2 = .64, F (9, 170) = 33.90, p < .001			R^2 = 0.50, F (9, 170) = 18.79, p < .001		

Note. Bold values indicate significant regression coefficients. *$p < .05$, **$p < .01$, ***$p < .001$.
Higher values on negative affect (reciprocal score) represents lower negative affect.
Variations in sample size are due to missing data (pairwise deletion across analyses).
[a] Baseline variables are those measured at pre-test.

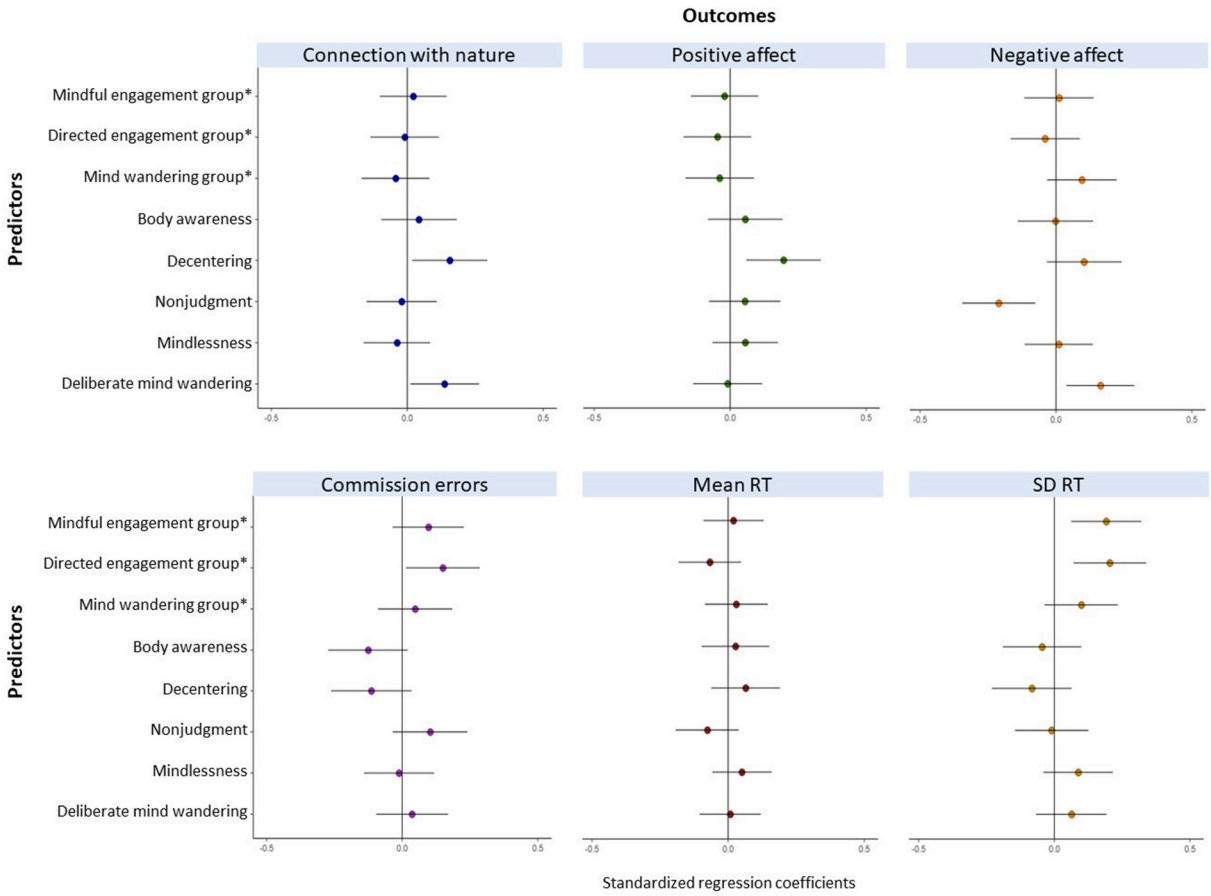


Fig. 3. Regression models where intervention groups and engagement facets predict separate psychological outcomes. *The engagement groups are compared against the unguided control as the reference group. Coloured circles are standardised regression coefficients and are shown with 95% confidence intervals. Statistically significant predictor variables do not cross zero (black vertical line), with those above zero indicating positive associations with the outcome variables, and those below zero indicating negative associations with the outcome variables. Each regression model is grouped by colour: for example, in the top graph, the blue symbols represent the regression model where the three intervention groups and the five engagement facets all predict the outcome of connection with nature. Pre-test scores and the model constants are omitted in these graphs so that the figures can be interpreted more clearly.

unguided control group experienced lower levels of nonjudgment, and decentering, compared with the other intervention groups (RQ1). The unguided group were not instructed to pay attention to anything, and this result aligns theoretically with the tendency for external attention when in outdoor natural environments (i.e., through fascination, Kaplan, 1995). It is noteworthy that the other intervention groups (mindful, directed, and mind wandering) did not differ on the facets of engagement in nature. Nisbet et al. (2019) similarly found that a mindful walking instruction delivered outdoors did not lead to higher decentering or curiosity compared with a control condition that received no instruction. The intervention instructions in the current study, and those in Nisbet and colleagues' study (2019), were not designed to specifically promote single aspects of mindfulness or mind wandering, and future interventions may benefit from instructions that attempt to target these forms of engagement (e.g., decentering).

Findings from this study largely indicate an absence of the intervention effect on outcomes when accounting for form of engagement during the nature experience. The effects of intervention instructions on psychological outcomes were largely insignificant when included in regression models that contained all facets of engagement in nature (RQ3b). Where other studies (e.g., Nisbet et al., 2019; Pasanen, Johnson, et al., 2018) find a direct effect of intervention group allocation on psychological outcomes of the experience, here we demonstrate that how individuals engaged during the nature experience gives a better prediction of how they will feel and function afterwards – independent of intervention group allocation. These findings provide important insights for future study design: to isolate and understand the effect of nature-based engagement interventions, researchers should use methods that allow analysis of how participants engage during the nature experience.

4.4. *Integration and future directions*

To provide guidance for future research pathways and engagement intervention design, we have integrated key findings and identified several patterns worth further exploration (Table 5). First, decentering was overall associated with positive psychological states before and after the nature experience, suggesting that engagement interventions could be designed to target pathways to a decentered experience, particularly for individuals who are already in a positive mood state. Second, nonjudgment and mindlessness were both associated with more negative psychological states before and/or after the nature experience. These findings indicate that nature-based engagement interventions may be beneficial if they direct attention toward the external (physical, sensory) rather than internal experience, particularly for individuals with low mood. Past research, however, demonstrates that internal awareness during a nature experience has benefits for restorative outcomes (Pasanen, Neuvonen, & Korpela, 2018); whether or not internal focus is beneficial may depend on prior mood levels and individual capacity for constructive reflection or reappraisal. Further investigation of these relationships is required. Finally, those who had a lower mood before the nature experience engaged in deliberate mind wandering,

Table 5
Summary of significant associations between engagement facets with situational factors and psychological outcomes.

Situational factors	**Engagement** during the experience	Psychological outcomes
Higher positive affect Perceived restorativeness	**Body awareness**	
Higher trait mindfulness *Higher negative affect* Perceived restorativeness	**Decentering**	Stronger connection with nature Higher positive affect
Lower positive affect *Higher negative affect* Perceived restorativeness	**Nonjudgment**	*Higher negative affect*
Higher negative affect Perceived restorativeness	**Mindlessness**	
Higher negative affect Perceived restorativeness	**Deliberate mind wandering**	Lower negative affect Stronger connection with nature

Note: Listed variables represent a significant association within multiple regression models. Blue text indicates positive/favourable outcomes, and orange and italicised text indicates negative/unfavourable outcomes.

which was associated with better mood after the nature experience. This result positions deliberate mind wandering as an adaptive form of engagement in response to low mood, and should be considered for future nature-based interventions (cf. studies where mind wandering has a negative effect on mood outcomes; Killingsworth & Gilbert, 2010).

Overall, our empirical model provides an integrated account of how mindfulness and mind wandering function in nature experience, by considering the situational context in which these engagement forms occur. While further research is required for specific guidance on intervention design and application, from these results we argue that environment perception, prior level of mood, and engagement form, are all important aspects to consider when implementing engagement interventions in nature. We provide tentative suggestions regarding aspects of mindful engagement and mind wandering that are suited to certain personal situations: for instance, while deliberate mind wandering may benefit individuals who are experiencing both higher positive and negative affect, nonjudgmental awareness is unlikely to benefit individuals with low mood.

The study has limitations that should be considered in future research. First, our selection of measures of mindfulness and mind wandering were limited to scales that target specific facets of (state) mindfulness and mind wandering. For mindfulness, most existing scales test a trait-level of mindfulness, and state-level mindfulness is often measured as a unidimensional construct (Blanke & Brose, 2017). We therefore selected three available scales to test facets of nature-based mindfulness, however some key facets of mindfulness remain to be measured in nature: for example, the *observing* facet of the (trait-level) Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) would allow for examination of the broader sensory experience in nature. Further, while single items of being away and fascination have been used in previous research to measure perceived restorativeness (Lindal & Hartig, 2013; Nordh et al., 2009), the items used in this study have not been validated for use on their own.

Finally, there are two further aspects of the study context that could be considered for future research. First, while the observed effects provide evidence for the influence of mindfulness and mind wandering in outdoor natural environments, further research is required to explore whether these effects are unique to nature – or are comparable in urban environments. Previous research findings indicate that noticing or engaging with nature improves wellbeing outcomes compared to an active control, while engaging with human-built environments does not (Passmore, Yang, & Sabine, 2022). Building on this research, we suggest that future research could examine the unique aspects of natural and urban environments that may support (or limit) the effects of mindfulness and mind wandering. Second, it is worth considering the effects of the COVID-19 pandemic on the study outcomes, as the study took place during different levels of lockdown in Australia. Research has shown that green space use in Australia changed during the pandemic (Berdejo-Espinola et al., 2021), but in divergent ways depending on individual and environmental characteristics (Berdejo-Espinola, Zahnow, Suárez-Castro, Rhodes, & Fuller, 2022). It is likely that participants in the current study interacted and engaged differently with their local green space during lockdown, and it would be worth investigating these research questions outside the lockdown context.

5. Conclusion

Effective nature-based engagement interventions must consider the facets and accompanying practices of engagement that are most likely to heighten psychological outcomes of nature. Our findings confirm the value of exploring these facets of mindfulness and mind wandering, as some positively influenced psychological restoration and nature connection while others had adverse effects on these outcomes. These results have implications for the design and implementation of engagement interventions in nature. Engagement practices that direct attention or awareness toward one's thoughts and emotions could elicit negative responses, particularly for individuals who do not have the capacity or experience to accept and be nonjudgmental towards such experiences (Coffey et al., 2010). Our results support existing literature where external engagement practices, such as directing attention to the sensory experience, are beneficial for psychological restoration. Further, this study provides initial evidence that deliberate mind wandering in nature is beneficial for mood outcomes and connection with nature. This latter finding adds an empirical contribution to a developing literature on the potential role for mind wandering in nature experiences (Macaulay et al., 2022b; Williams et al., 2018). Based on these findings, we

recommend that further research on engagement in nature considers the specific elements of engagement practices that can be integrated into interventions to target key outcomes.

Author notes

The study was preregistered at https://aspredicted.org/4BN_X3P. The dataset and syntax files will be available upon request. All authors state that they have no conflict of interest to disclose. RM's contribution is partly supported by a scholarship funded by the Victorian Government, as a joint initiative between the Department of Environment, Land, Water, and Planning, and the City of Melbourne, and a scholarship supported by The Albert Shimmins Fund.

CRediT authorship contribution statement

Rose Macaulay: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft. **Katherine Johnson:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. **Kate Lee:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. **Kathryn Williams:** Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2024.102253.

References

Atchley, R. A., Strayer, D. L., & Atchley, P. (2012). Creativity in the wild: Improving creative reasoning through immersion in natural settings. *PLoS One, 7*(12), Article e51474. https://doi.org/10.1371/journal.pone.0051474

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

Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., et al. (2008). Construct validity of the five facet mindfulness Questionnaire in meditating and nonmeditating samples. *Assessment, 15*(3), 329–342. https://doi.org/10.1177/1073191107313003

Barbaro, N., & Pickett, S. M. (2016). 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

Berdejo-Espinola, V., Suárez-Castro, A. F., Amano, T., Fielding, K. S., Oh, R. R. Y., & Fuller, R. A. (2021). Urban green space use during a time of stress: A case study during the COVID-19 pandemic in brisbane, Australia. *People and Nature, 3*(3), 597–609. https://doi.org/10.1002/pan3.10218

Berdejo-Espinola, V., Zahnow, R., Suárez-Castro, A. F., Rhodes, J. R., & Fuller, R. A. (2022). Changes in green space use during a COVID-19 lockdown are associated with both individual and green space characteristics. *Frontiers in Ecology and Evolution, 10*, Article 804443. https://doi.org/10.3389/fevo.2022.804443

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., et al. (2006). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*(3), 230–241. https://doi.org/10.1093/clipsy.bph077

Blanke, E. S., & Brose, A. (2017). Mindfulness in daily life: A multidimensional approach. *Mindfulness, 8*(3), 737–750. https://doi.org/10.1007/s12671-016-0651-4

Bratman, G. N., Young, G., Mehta, A., Lee Babineaux, I., Daily, G. C., & Gross, J. J. (2021). Affective benefits of nature contact: The role of rumination. *Frontiers in Psychology, 12*, Article 643866. https://doi.org/10.3389/fpsyg.2021.643866

Bravo, A. J., Pearson, M. R., Wilson, A. D., & Witkiewitz, K. (2018). When traits match states: Examining the associations between self-report trait and state mindfulness following a state mindfulness induction. *Mindfulness, 9*(1), 199–211. https://doi.org/10.1007/s12671-017-0763-5

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822–848. https://doi.org/10.1037/0022-3514.84.4.822

Cardaciotto, L., Herbert, J. D., Forman, E. M., Moitra, E., & Farrow, V. (2008). The assessment of present-moment awareness and acceptance: The Philadelphia mindfulness scale. *Assessment, 15*(2), 204–223. https://doi.org/10.1177/1073191107311467

Carriere, J. S. A., Seli, P., & Smilek, D. (2013). Wandering in both mind and body: Individual differences in mind wandering and inattention predict fidgeting. *Canadian Journal of Experimental Psychology, 67*(1), 19–31. https://doi.org/10.1037/a0031438

Cervinka, R., Schwab, M., & Haluza, D. (2020). Investigating the qualities of a recreational forest: Findings from the cross-sectional hallerwald case study. *International Journal of Environmental Research and Public Health, 17*(5), 1676. https://doi.org/10.3390/ijerph17051676

Choe, E. Y., Jorgensen, A., & Sheffield, D. (2020). 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*, Article 103886. https://doi.org/10.1016/j.landurbplan.2020.103886

Christoff, K., Irving, Z. C., Fox, K. C. R., Spreng, R. N., & Andrews-Hanna, J. R. (2016). Mind-wandering as spontaneous thought: A dynamic framework. *Nature Reviews Neuroscience, 17*(11), 718–731. https://doi.org/10.1038/nrn.2016.113

Coffey, K. A., Hartman, M., & Fredrickson, B. L. (2010). Deconstructing mindfulness and constructing mental health: Understanding mindfulness and its mechanisms of action. *Mindfulness, 1*(4), 235–253. https://doi.org/10.1007/s12671-010-0033-2

Djernis, D., Lundsgaard, C. M., Rønn-Smidt, H., & Dahlgaard, J. (2023). Nature-based mindfulness: A qualitative study of the experience of support for self-regulation. *Healthcare, 11*(6), 905. https://doi.org/10.3390/healthcare11060905

Faber, M., & D'Mello, S. K. (2018). How the stimulus influences mind wandering in semantically rich task contexts. *Cognitive Research: Principles and Implications, 3*(1), 35. https://doi.org/10.1186/s41235-018-0129-0

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191. https://doi.org/10.3758/BF03193146

Franklin, M. S., Mrazek, M. D., Anderson, C. L., Smallwood, J., Kingstone, A., & Schooler, J. W. (2013). The silver lining of a mind in the clouds: Interesting musings are associated with positive mood while mind-wandering. *Frontiers in Psychology, 4*. https://doi.org/10.3389/fpsyg.2013.00583

Gotink, R. A., Hermans, K. S. F. M., Geschwind, N., De Nooij, R., De Groot, W. T., & Speckens, A. E. M. (2016). Mindfulness and mood stimulate each other in an upward spiral: A mindful walking intervention using experience sampling. *Mindfulness, 7*(5), 1114–1122. https://doi.org/10.1007/s12671-016-0550-8

Grossman, P., & Van Dam, N. T. (2011). Mindfulness, by any other name…: Trials and tribulations of sati in western psychology and science. *Contemporary Buddhism, 12*(1), 219–239. https://doi.org/10.1080/14639947.2011.564841

Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science, 6*(6), 537–559. https://doi.org/10.1177/1745691611419671

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

Hartig, T., Korpela, K., Evans, G. W., & Gärling, T. (1997). A measure of restorative quality in environments. *Scandinavian Housing and Planning Research, 14*(4), 175–194. https://doi.org/10.1080/02815739708730435

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

Johnson, K. A., Kelly, S. P., Bellgrove, M. A., Barry, E., Cox, M., Gill, M., et al. (2007). Response variability in attention deficit hyperactivity disorder: Evidence for neuropsychological heterogeneity. *Neuropsychologia, 45*(4), 630–638. https://doi.org/10.1016/j.neuropsychologia.2006.03.034

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*, 144–156. https://doi.org/10.1093/clipsy.bpg016

Kaplan, S. (1993). The role of natural environment aesthetics in the restorative experience. In P. H. Gobster (Ed.), *Managing urban and high-use recreation settings* (pp. 46–49). Forest Service, USDA. General Technical Report. NC-163.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169–182. https://doi.org/10.1016/0272-4944(95)90001-2

Kaplan, S. (2001). Meditation, restoration, and the management of mental fatigue. *Environment and Behavior, 33*(4), 480–506. https://doi.org/10.1177/00139160121973106

Kiken, L. G., & Shook, N. J. (2014). Does mindfulness attenuate thoughts emphasizing negativity, but not positivity? *Journal of Research in Personality, 53*, 22–30. https://doi.org/10.1016/j.jrp.2014.08.002

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science, 330*(6006). https://doi.org/10.1126/science.1192439, 932–932.

Korpela, K., Borodulin, K., Neuvonen, M., Paronen, O., & Tyrväinen, L. (2014). Analyzing the mediators between nature-based outdoor recreation and emotional well-being. *Journal of Environmental Psychology, 37*, 1–7. https://doi.org/10.1016/j.jenvp.2013.11.003

Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., et al. (2006). The Toronto Mindfulness scale: Development and validation. *Journal of Clinical Psychology, 62*(12), 1445–1467. https://doi.org/10.1002/jclp.20326

Lengieza, M. L., Swim, J. K., & Hunt, C. A. (2021). Effects of post-trip eudaimonic reflections on affect, self-transcendence and philanthropy. *Service Industries Journal, 41*(3–4), 285–306. https://doi.org/10.1080/02642069.2019.1636966

Lin, Y.-H., Tsai, C.-C., Sullivan, W. C., Chang, P.-J., & Chang, C.-Y. (2014). Does awareness effect the restorative function and perception of street trees? *Frontiers in Psychology, 5*. https://doi.org/10.3389/fpsyg.2014.00906

Lindal, P. J., & Hartig, T. (2015). Effects of urban street vegetation on judgments of restoration likelihood. *Urban Forestry and Urban Greening, 14*(2), 200–209. https://doi.org/10.1016/j.ufug.2015.02.001

Lopes, S., Lima, M., & Silva, K. (2020). Nature can get it out of your mind the rumination reducing effects of contact with nature and the mediating role of awe and mood. *Journal of Environmental Psychology, 71*, Article 101489. https://doi.org/10.1016/j.jenvp.2020.101489

Lutz, A., Jha, A. P., Dunne, J. D., & Saron, C. D. (2015). Investigating the phenomenological matrix of mindfulness-related practices from a neurocognitive perspective. *American Psychologist, 70*(7), 632–658. https://doi.org/10.1037/a0039585

Lymeus, F., Lindberg, P., & Hartig, T. (2018). Building mindfulness bottom-up: Meditation in natural settings supports open monitoring and attention restoration. *Consciousness and Cognition, 59*, 40–56. https://doi.org/10.1016/j.concog.2018.01.008

Macaulay, R., Johnson, K., Lee, K., & Williams, K. (2022c). Comparing the effect of mindful and other engagement interventions in nature on attention restoration, nature connection, and mood. *Journal of Environmental Psychology, 81*, Article 101813. https://doi.org/10.1016/j.jenvp.2022.101813

Macaulay, R., Lee, K., Johnson, K., & Williams, K. (2022a). Mindful engagement, psychological restoration, and connection with nature in constrained nature experiences. *Landscape and Urban Planning, 217*, Article 104263. https://doi.org/10.1016/j.landurbplan.2021.104263

Macaulay, R., Lee, K., Johnson, K., & Williams, K. (2022b). 'Letting my mind run wild': Exploring the role of individual engagement in nature experiences. *Urban Forestry and Urban Greening, 71*, Article 127566. https://doi.org/10.1016/j.ufug.2022.127566

Marselle, M., Irvine, K., Lorenzo-Arribas, A., & Warber, S. (2014). Moving beyond green: Exploring the relationship of environment type and indicators of perceived environmental quality on emotional well-being following group walks. *International Journal of Environmental Research and Public Health, 12*(1), 106–130. https://doi.org/10.3390/ijerph120100106

Mattes, J. (2019). Systematic review and meta-analysis of correlates of FFMQ mindfulness facets. *Frontiers in Psychology, 10*, 2684. https://doi.org/10.3389/fpsyg.2019.02684

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?: The role of connectedness to nature. *Environment and Behavior, 41*(5), 607–643. https://doi.org/10.1177/0013916508319745

Mesimäki, M., Hauru, K., & Lehvävirta, S. (2019). Do small green roofs have the possibility to offer recreational and experiential benefits in a dense urban area? A case study in Helsinki, Finland. *Urban Forestry and Urban Greening, 40*, 114–124. https://doi.org/10.1016/j.ufug.2018.10.005

Mooneyham, B. W., & Schooler, J. W. (2013). The costs and benefits of mind-wandering: A review. *Canadian Journal of Experimental Psychology, 67*(1), 11–18. https://doi.org/10.1037/a0031569

Nisbet, E. K., & Zelenski, J. M. (2011). Underestimating nearby nature: Affective forecasting errors obscure the happy path to sustainability. *Psychological Science, 22*(9), 1101–1106. 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. (2011). Happiness is in our nature: Exploring nature relatedness as a contributor to subjective well-being. *Journal of Happiness Studies, 12*(2), 303–322. https://doi.org/10.1007/s10902-010-9197-7

Nordh, H., Hartig, T., Hagerhall, C. M., & Fry, G. (2009). Components of small urban parks that predict the possibility for restoration. *Urban Forestry and Urban Greening, 8*(4), 225–235. https://doi.org/10.1016/j.ufug.2009.06.003

Nordh, H., & Østby, K. (2013). Pocket parks for people – a study of park design and use. *Urban Forestry and Urban Greening, 12*(1), 12–17. https://doi.org/10.1016/j.ufug.2012.11.003

Pasanen, T., Johnson, K., Lee, K., & Korpela, K. (2018). Can nature walks with psychological tasks improve mood, self-reported restoration, and sustained attention? Results from two experimental field studies. *Frontiers in Psychology, 9*, 2057. https://doi.org/10.3389/fpsyg.2018.02057

Pasanen, T., Neuvonen, M., & Korpela, K. (2018). The psychology of recent nature visits: (How) are motives and attentional focus related to post-visit restorative experiences, creativity, and emotional well-being? *Environment and Behavior, 50*(8), 913–944. https://doi.org/10.1177/0013916517720261

Pasca, L., Aragonés, J. I., & Coello, M. T. (2017). An analysis of the connectedness to nature scale based on item response theory. *Frontiers in Psychology, 8*, 1330. https://doi.org/10.3389/fpsyg.2017.01330

Passmore, H.-A., Yang, Y., & Sabine, S. (2022). An extended replication study of the well-being intervention, the noticing nature intervention (NNI). *Journal of Happiness Studies, 23*(6), 2663–2683. https://doi.org/10.1007/s10902-022-00516-3

Pelagatti, C., Binda, P., & Vannucci, M. (2018). Tracking the dynamics of mind wandering: Insights from pupillometry. *Journal of Cognition, 1*(1), 38. https://doi.org/10.5334/joc.41

Poerio, G. L., Totterdell, P., & Miles, E. (2013). Mind-wandering and negative mood: Does one thing really lead to another? *Consciousness and Cognition, 22*(4), 1412–1421. https://doi.org/10.1016/j.concog.2013.09.012

Rickard, S. C., & White, M. P. (2021). Barefoot walking, nature connectedness and psychological restoration: The importance of stimulating the sense of touch for feeling closer to the natural world. *Landscape Research, 46*(7), 975–991. https://doi.org/10.1080/01426397.2021.1928034

Robertson, I. H., Manly, T., Andrade, J., Baddeley, B. T., & Yiend, J. (1997). 'Oops!': Performance correlates of everyday attentional failures in traumatic brain injured and normal subjects. *Neuropsychologia, 35*(6), 747–758. https://doi.org/10.1016/S0028-3932(97)00015-8

Sadowski, I., Böke, N., Mettler, J., Heath, N., & Khoury, B. (2020). Naturally mindful? The role of mindfulness facets in the relationship between nature relatedness and subjective well-being. *Current Psychology, 41*, 5358–5373. https://doi.org/10.1007/s12144-020-01056-w

Schooler, J. W., Mrazek, M. D., Franklin, M. S., Baird, B., Mooneyham, B. W., Zedelius, C., et al. (2014). The middle way: Finding the balance between mindfulness and mind-wandering. *Psychology of Learning and Motivation, 60*, 1–33. https://doi.org/10.1016/B978-0-12-800090-8.00001-9. Elsevier.

Schroevers, M. J., & Brandsma, R. (2010). Is learning mindfulness associated with improved affect after mindfulness-based cognitive therapy? *British Journal of Psychology, 101*(1), 95–107. https://doi.org/10.1348/000712609X424195

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

Seli, P., Carriere, J. S. A., & Smilek, D. (2015). Not all mind wandering is created equal: Dissociating deliberate from spontaneous mind wandering. *Psychological Research, 79*(5), 750–758. https://doi.org/10.1007/s00426-014-0617-x

Seli, P., Ralph, B. C. W., Risko, E. F., W. Schooler, J., Schacter, D. L., & Smilek, D. (2017). Intentionality and meta-awareness of mind wandering: Are they one and the same, or distinct dimensions? *Psychonomic Bulletin & Review, 24*(6), 1808–1818. https://doi.org/10.3758/s13423-017-1249-0

Seli, P., Risko, E. F., & Smilek, D. (2016). On the necessity of distinguishing between unintentional and intentional mind wandering. *Psychological Science, 27*(5), 685–691. https://doi.org/10.1177/0956797616634068

Seli, P., Risko, E. F., Smilek, D., & Schacter, D. L. (2016). Mind-wandering with and without intention. *Trends in Cognitive Sciences, 20*(8), 605–617. https://doi.org/10.1016/j.tics.2016.05.010

Shin, Y.-K., Kim, D. J., Jung-Choi, K., Son, Y., Koo, J.-W., Min, J.-A., et al. (2013). Differences of psychological effects between meditative and athletic walking in a forest and gymnasium. *Scandinavian Journal of Forest Research, 28*(1), 64–72. https://doi.org/10.1080/02827581.2012.706634

Smallwood, J., & Andrews-Hanna, J. (2013). Not all minds that wander are lost: The importance of a balanced perspective on the mind-wandering state. *Frontiers in Psychology, 4*. https://doi.org/10.3389/fpsyg.2013.00441

Smallwood, J., Fitzgerald, A., Miles, L. K., & Phillips, L. H. (2009). Shifting moods, wandering minds: Negative moods lead the mind to wander. *Emotion, 9*(2), 271–276. https://doi.org/10.1037/a0014855

Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin, 132*(6), 946–958. https://doi.org/10.1037/0033-2909.132.6.946

Stewart, M., & Haaga, D. A. F. (2018). State mindfulness as a mediator of the effects of exposure to nature on affect and psychological well-being. *Ecopsychology, 10*(1), 53–60. https://doi.org/10.1089/eco.2017.0033

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

Turkelson, L., & Mano, Q. (2021). The current state of mind: A systematic review of the relationship between mindfulness and mind-wandering. *Journal of Cognitive Enhancement, 6*, 272–294. https://doi.org/10.1007/s41465-021-00231-6

Vago, D. R., & Zeidan, F. (2016). The brain on silent: Mind wandering, mindful awareness, and states of mental tranquility: The brain on silent. *Annals of the New York Academy of Sciences, 1373*(1), 96–113. https://doi.org/10.1111/nyas.13171

Van Dam, N. T., Hobkirk, A. L., Danoff-Burg, S., & Earleywine, M. (2012). Mind your words: Positive and negative items create method effects on the five facet mindfulness Questionnaire. *Assessment, 19*(2), 198–204. https://doi.org/10.1177/1073191112438743

Van den Berg, A. E., Jorgensen, A., & Wilson, E. R. (2014). Evaluating restoration in urban green spaces: Does setting type make a difference? *Landscape and Urban Planning, 127*, 173–181. https://doi.org/10.1016/j.landurbplan.2014.04.012

Walach, H., Buchheld, N., Buttenmüller, V., Kleinknecht, N., & Schmidt, S. (2006). Measuring mindfulness—the Freiburg mindfulness inventory (FMI). *Personality and Individual Differences, 40*(8), 1543–1555. https://doi.org/10.1016/j.paid.2005.11.025

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

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Williams, K. J. H., Lee, K. E., Hartig, T., Sargent, L. D., Williams, N. S. G., & Johnson, K. A. (2018). Conceptualising creativity benefits of nature experience: Attention restoration and mind wandering as complementary processes. *Journal of Environmental Psychology, 59*, 36–45. https://doi.org/10.1016/j.jenvp.2018.08.005

Wyles, K. J., White, M. P., Hattam, C., Pahl, S., King, H., & Austen, M. (2019). Are some natural environments more psychologically beneficial than others? The importance of type and quality on connectedness to nature and psychological restoration. *Environment and Behavior, 51*(2), 111–143. https://doi.org/10.1177/0013916517738312