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Exploring individual engagement in urban nature experiences

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Abstract

The benefits of spending time in nature are well-documented, however, so too are the diminishing opportunities that urban populations have to experience nature. In an effort to increase such opportunities, a growing literature examines nature-based interventions that aim to enhance individual engagement with nature, for example, through mindfulness. These studies typically use short exercises that direct one to attend to some feature of their nature experience, with aims to strengthen outcomes such as psychological restoration or connection with nature. This emerging literature, however, lacks the integration that is needed to develop a useful evidence base to inform practical application of engagement interventions in nature. To address this gap, I first developed a conceptual framework based on the concept of mindfulness to identify and understand existing engagement forms in the literature. I then empirically investigated how individuals engage within urban nature, the efficacy of different nature-based engagement interventions, and the influence of personal and environmental aspects of the nature experience that shape engagement and nature outcomes.

This research used mixed methods to explore the role of individual engagement in nature experiences. An exploratory study first used a qualitative, semi-structured interview method, to explore how individuals engage in urban nature experiences. Participants ($n = 20$) were interviewed about their brief experience in an urban green space, and I used thematic analysis to identify engagement forms that connected to individual and environmental contexts of each experience. A second study used an experimental design to evaluate the effect of different engagement interventions in nature. Participants ($n = 215$) were randomly allocated into four different intervention groups, which were directed to engage in different ways during a 20min outdoor experience. The intervention groups were a mindful engagement group, a directed engagement group, a mind wandering group, and a control group who received no engagement directions. I analysed the effects of the interventions on post-experience restoration and nature connection and tested environmental and personal influences on engagement during the experience. Further, I analysed the subfactors of mindfulness and mind wandering to test their influence on outcomes of nature experiences.

A key empirical outcome was identifying diverse forms of engagement in nature, which expands understanding of the various ways individuals might experience and relate to nature. The findings across the two studies additionally revealed patterns in the forms of engagement best suited to improve restoration and nature connection. Enhanced sensory engagement, positive mind wandering, and decentering (an aspect of mindfulness that involves detachment from thoughts and emotions) were associated with improved mood and nature connection. Mindfulness in nature was beneficial for those who were familiar with the practice in the qualitative study; in the experimental study, there was little evidence that instruction to engage mindfully led to better outcomes. Forms of

engagement that required judgment and elaborative thought were associated with worse outcomes for restoration and nature connection. The analysis of contextual aspects of the nature experiences highlighted personal capacities (i.e., trait-level of mindfulness, current mood) that influenced how participants engaged during the experience; for instance, those with a lower mood were more likely to feel distracted and mindless in nature, while they benefitted from sensory engagement. The influence of environmental contexts showed that the perceived restorativeness of environments was strongly related to an individual's engagement with the experience.

Overall, this thesis contributes 1) an integrative framework that clarifies the characteristics of engagement forms in nature and their relation to psychological restoration and nature connection, and 2) empirical advancement of nature-based engagement interventions by evaluating their effectiveness. The results demonstrate meaningful differences in how engagement forms relate to psychological outcomes, and the practical feasibility of applying engagement interventions. The findings in this thesis encourage future examination of engagement forms that suit a diverse range of individual capacities and needs, specifically by targeting engagement that requires little effort and complements restorative qualities in nature (such as mind wandering and sensory engagement). I conclude with practical recommendations for designing and implementing nature-based engagement interventions. Refinement of such interventions offers future pathways to enhanced functioning and nature connection among urban populations.

Declaration

This is to certify that:

- i. The thesis comprises only my original work towards the Doctor of Philosophy except where indicated in the Preface;
- ii. Due acknowledgement has been made in the text to all other material used; and
- iii. The thesis is less than 100,000 words in length.

Rose Macaulay

October 2022

Preface

The material presented in this thesis is my original work. My supervisors, Prof Kathryn Williams, A/Prof Katherine Johnson, and Dr Kate Lee, all provided guidance and advice throughout, and reviewed and contributed to manuscript preparation. Three of the chapters in this thesis have been published in peer-reviewed academic journals. For each chapter that has been peer-reviewed, the author-accepted version of the manuscript is included, and the content is unchanged. The publication status of each chapter is as follows:

- Chapter 1: Unpublished material not submitted for publication
- Chapter 2: Unpublished material not submitted for publication
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- Chapter 5: Published in *Journal of Environmental Psychology*, 8 May 2022
- Chapter 6: Unpublished material not submitted for publication
- Chapter 7: Unpublished material not submitted for publication

I am the lead author on all published papers in this thesis, and Kathryn Williams, Katherine Johnson, and Kate Lee are co-authors. The author contributions are as follows:

Chapter 3: **Rose Macaulay:** Conceptualization, writing - original draft, writing – reviewing and editing. **Kate Lee:** Conceptualization, writing – reviewing and editing. **Katherine Johnson:** Conceptualization, writing – reviewing and editing. **Kathryn Williams:** Conceptualization, writing – reviewing and editing.

Chapters 4 and 5: **Rose Macaulay:** Conceptualization, data collection, formal analysis, writing- original draft preparation. **Kate Lee:** Conceptualization, supervision, writing- reviewing and editing. **Katherine Johnson:** Conceptualization, supervision, writing- reviewing and editing. **Kathryn Williams:** Conceptualization, supervision, writing- reviewing and editing.

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1 Chapter 1.

Introduction

In this thesis, I explored individual-level engagement within urban nature experiences. I aimed to understand the subjective, mental experience of nature, and to expand knowledge of the components of nature experiences that can benefit psychological and wellbeing outcomes. I began this thesis after completing a research project on the wellbeing benefits of mindfulness, and with a desire to integrate this knowledge with a personal interest in the wellbeing benefits of nature. Although the role of mindfulness in nature experiences remains a consistent focus in the thesis, a combination of empirical findings throughout the chapters and the global context in which the thesis was conducted, somewhat challenged inherent assumptions (my own and more broadly) about the benefits of both mindfulness and nature.

The global context included the onset of the COVID-19 pandemic, which saw strict lockdown measures and restrictions on movement and access to public spaces. Relationships to nature and nearby green spaces changed: for some, green spaces became places that were relied upon for psychological and physical wellbeing, however for others, interactions with green space diminished (Berdejo-Espinola et al., 2021), likely constraining potential benefits of nature. This changing relationship to nature during the pandemic led to some reflections: in what situations are nature experiences beneficial, and in what situations are they somewhat constrained? Could mindfulness, an individual-level practice or state of awareness, help to mitigate possible constraints or would one's capacity to be mindful also be constrained? What other forms of individual cognitive engagement in nature might benefit these changing experiences of nature? This context and subsequent reflections naturally shaped the course of this thesis and its objectives.

Specifically, I aimed to investigate the forms of individual engagement with nature that connect with psychological outcomes of nature experiences across a range of personal and environmental contexts. These questions and aims lend themselves to be analysed with paradigms and study designs that attempt to account for the myriad factors within the experience of nature. In this chapter, I lay out the research objectives that guide the thesis, and the frameworks and approach I use to understand and examine these factors.

1.1 Research objectives

A growing body of research explores the role of individual engagement in nature experiences (for example, through mindfulness or sensory awareness). Empirical studies demonstrate the potential value of heightened engagement in nature for improving outcomes such as psychological restoration and nature connection (e.g., Lin et al., 2014; Nisbet et al., 2019). The literature on engagement in nature, however, lacks a framework to organise, understand, and apply forms of nature-based engagement. Such a framework is needed to advance this body of work towards an integrated evidence base that can inform understanding of engagement experiences in nature, and the application of nature-based engagement interventions. This gap forms the basis of theoretical development in this thesis. A key aim of this thesis is to therefore develop a framework that can characterise diverse forms of engagement in nature, and integrate individual engagement with restoration and nature connection.

Without such a framework to connect and contrast forms of engagement in nature, the literature also lacks evaluation of engagement forms in comparison with each other (for exception, see Pasanen et al., 2018). An evaluation of engagement forms is needed to generate practical recommendations for implementing engagement practices in nature, including the forms of engagement that are most beneficial, and the settings and contexts under which they function best. This empirical gap forms the basis of the study design and empirical analysis in this thesis. A second aim of this thesis is therefore to compare and evaluate forms of engagement in nature experiences regarding their relationship with psychological outcomes, and contextual aspects of the experience.

Three overarching research questions address the aims of this thesis:

Research Question 1: In what ways do people cognitively engage within urban nature experiences?

Research Question 2: What are the mechanisms that link mindful and other forms of engagement with psychological restoration and connection with nature?

Research Question 3: What contextual aspects of urban nature experiences influence, support, or constrain engagement?

A mixed methodology is used to answer these research questions. A qualitative interview study first explores the many aspects of experiences of nature, including individual engagement and contextual aspects. Second, an experimental study uses an engagement intervention and survey methods to evaluate different forms of engagement in nature within a holistic model that accounts for contextual aspects of experience, and enables identification of the mechanisms that underpin engagement in nature.

1.2 Connecting with and being restored by nature in transactional nature experiences

Research paradigm: exploring the nature experience with a transactional approach

I ground this research in a transactional perspective that allows consideration of the variety of factors involved within a person's experience in nature. Nature experiences comprise many complex, interdependent, and dynamic qualities between a person and their environment. A transactional perspective treats the nature experience as a holistic entity, where the individual elements (person, processes, and context) are inseparable and mutually define one another (Altman & Rogoff, 1987; Hartig, 1993). In its essence, a transactional approach calls for recognition of all contextual qualities that bound person-environment systems (Altman & Rogoff, 1987). These qualities are described by the authors as:

“Contexts and settings include the qualities of the physical and social environment that may be psychologically relevant, the nature of tasks and instructions, the flow of events, how the setting relates to the other aspects of a person's life, the “meaning” and interpretation of the situation by participants, and the familiarity of the participants with the setting. Such factors apply to the laboratory experiment and naturalistic setting alike, and transactional researchers attend to these and related issues when using any specific method.” (Altman & Rogoff, 1987, p. 33)

Methodologies grounded in the transactional worldview aim to observe and understand patterns of relationships among aspects of the transaction. In the case of nature experiences, this approach urges researchers to consider the many aspects of the human-nature transaction: the participants and their social context, the psychological processes that connect people to other aspects in the experience, the physical context where the experience occurs, and how phenomena within the nature experience unfold over time (Werner et al., 2002). The social and environmental contextual aspects within the nature experience are framed in this thesis as ‘constraining’ or ‘supporting’ when considering how they relate with individual engagement of the nature experience, and more generally, ‘contextual’ when considering how they form the holistic nature experience.

Altman and Rogoff (1987) describe the flexibility of a transactional orientation in study design, noting that particular strategies may not satisfy all aspects of the human-nature unity, and that instead, studies might complement each other to achieve this holistic view. To analyse these patterns of relationships in this thesis, I therefore use two research designs to understand different aspects of the human-nature transaction: 1) a qualitative interview study that enables examination of patterns among contextual aspects of urban green space experiences; and 2) an experimental study, in which design and analysis considers the personal and environmental contexts and psychological processes within outdoor experiences.

Theoretical frameworks: restorative environments and connection with nature

I draw on two fields of research to understand the aspects of nature experiences that lead to psychological benefits: restorative environments and nature connection theories. Both can be understood with a transactional lens. Restorative environments research is situated within the discipline of environmental psychology, and aims to understand the processes through which experiences in certain environments can mitigate the demands of everyday living (Hartig, 2004). Prominent theories (Kaplan & Kaplan, 1989; Ulrich, 1983) propose specific qualities of person-environment transactions that permit or promote the restoration of depleted psychological resources. Natural environments tend to be rich in such qualities.

Nature connection theories span a range of disciplines and broadly aim to understand the relationship between humans and nature (Ives et al., 2017). As the human population has become more urbanised and direct interactions with nature less common, there is an urgency for a ‘reconnection’ or strengthening of individuals’ connections with nature (Soga & Gaston, 2016). In this thesis, I consider the branch of these theories that focuses on how connections with nature form through nature transactions, in the experience of natural environments (Lumber et al., 2017; Mayer et al., 2009). These theories examine the qualities of nature experiences that are likely to promote a sense of connection with the natural world.

Engagement with nature

Within these theoretical frameworks, an individual’s level of engagement within the nature experience is often implicitly regarded as an integral component of pathways to restoration or nature connection; however, the concept of engagement is weakly understood. There is a diversity of concepts that appear in the literature that can be considered forms of nature-based engagement – for example, paying attention to vegetation (Lin et al., 2014), thinking about the meaning of nature (Lumber et al., 2017), mindful engagement with nature (Nisbet et al., 2019) – and alongside these concepts, a variety of methods are used to operationalise and apply these engagement forms.

The framework used to understand engagement in nature in this thesis draws on the concept of mindfulness. Mindfulness research spans health and psychology disciplines. It is a form of awareness toward the present moment (Bishop et al., 2006) and mindfulness practices cultivate this style of awareness (Lutz et al., 2008). The conceptualisation of mindfulness – involving an object of awareness (i.e., to what does one attend) and quality of awareness (i.e., how does one attend) – offers a useful structure to examine the objects and qualities of awareness within other engagement concepts. Further, in a rapidly growing literature, mindfulness interventions are applied across a variety of settings and for different outcomes (e.g., Howarth et al., 2019), thus establishing feasible methods to apply and evaluate engagement forms in unique contexts, including effects of engagement on restoration and nature connection in nature experiences.

1.3 Thesis structure

Chapters 3-6 of the thesis are a series of papers (published or in preparation). Each chapter is therefore able to stand alone and contains some overlapping content, particularly in the introductions and methods of the empirical chapters.

In the current chapter (**Chapter 1**), I have outlined the research paradigm and theoretical frameworks that guide this thesis, and set up research objectives that build on and connect these knowledges. In **Chapter 2**, I review and integrate the literature on psychological restoration, nature connection, mindfulness, and engagement in nature. This chapter complements the conceptual development in Chapter 3. In **Chapter 3**, I develop a conceptual framework that draws together different engagement forms, and outcomes of nature experiences. In this chapter, the concept of mindfulness is the starting point for considering how the many forms of engaging with nature can be connected and evaluated together.

Chapter 4 is the first of the empirical chapters. In this chapter, I explore the experience of engagement in nature. This chapter includes a qualitative interview study that explores the various aspects of urban nature experiences, including how individuals engage with nature, what contexts shape that engagement, and the influence of engagement on psychological outcomes of nature. **Chapter 5** is an empirical chapter that develops and evaluates nature-based engagement interventions. This chapter includes an experimental study that tests the effect of three different engagement forms on psychological outcomes of nature experiences. **Chapter 6** is an empirical chapter that uses the study design and data collected in Chapter 5. In this chapter I draw on additional data to examine the mechanisms underpinning engagement in more detail, including the different contextual aspects of nature experiences that affect engagement. This chapter focuses on mindfulness and mind wandering as forms of engagement that are common to nature experiences.

In **Chapter 7**, I discuss and synthesise the findings of the thesis in response to the overarching research questions. This chapter concludes with recommendations for the practical application of nature-based engagement interventions.

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2 Chapter 2.

Literature review

2.1 Overview

This chapter provides a detailed review of the literature that forms the basis of this thesis. The current chapter supplements Chapter 3, which includes a published paper that develops a conceptual framework using mindfulness to integrate and understand other forms of engagement in nature, and considers mindfulness in nature under circumstances of constraint. Since Chapter 3 is more focused on this conceptual development, it is therefore necessarily constrained to review literature relevant for this specific aim. In the current chapter I review literature relevant to the wider thesis aims, to ensure coverage of theoretical background and empirical standing in the literatures that guide my research objectives. Specifically, I start with a brief overview of the current state of literature and theory to understand nature and wellbeing, before narrowing this focus to review the psychological benefits of nature experiences – through restoration and nature connection. In the latter sections of this chapter, I review studies that examine individual engagement in nature experiences (including but not limited to mindfulness and mind wandering) and overview the details of these studies in Table 2.1 and Table 2.2. From this overview, I identify the areas of the literature that should be clarified and explored further.

2.2 Nature and wellbeing

As a result of a large and growing literature across numerous disciplines, there is broad consensus that nature experiences lead to a host of psychological and wellbeing benefits (Bratman et al., 2019). In this research I define nature broadly, as Bratman et al. do, as the “elements and phenomena of Earth’s lands, waters, and biodiversity, across spatial scales and degrees of human influence” (Bratman et al., 2019, p. 2). Within this definition, nature can include immersive natural environments (e.g., a forest), environments constructed by humans that contain living nature (e.g., urban green spaces), and other entities of flora and fauna (e.g., a potted plant, a bird in the city). Nature experiences are therefore contact with these elements and phenomena, which can include physical interactions (e.g., visiting a forest), or virtual interactions (viewing photographs or videos of nature). Several large-scale reviews demonstrate that nature experiences benefit cognitive functioning, mental health, physical activity, and physiological indicators (Bowler et al., 2010; Hartig et al., 2014; Jimenez et al., 2021). Despite this evidence base, the key pathways between nature and wellbeing have less empirical standing. There are research efforts that aim to map and categorise the pathways through which nature leads to psychological benefit (e.g., Lachowycz & Jones, 2013; Markevych et al., 2017; Marselle et al., 2021), which can provide models to examine theoretical and empirical underpinnings of this literature.

Marselle et al. (2021) map pathways between nature contact and wellbeing. Two domains of pathways in their model are particularly relevant for examining the wellbeing outcomes in this thesis: restoring capacities and building capacities. The domain of restoring capacities refers to the recovery of depleted resources through experiences in nature (i.e., stress and negative emotions, and directed attention; Hartig, 2004; Kaplan & Kaplan, 1989; Ulrich, 1983). The restoring capacities function of nature experiences will be the focus of Section 2.3. The domain of building capacities refers to the strengthening of resources to cope with and manage demands of everyday living (Marselle et al., 2021), and includes physical activity, social cohesion, and transcendent experiences in nature. In this thesis, I position the pathways to connection with nature within this capacity-building domain and will focus on this domain in Section 2.4.

While there is some evidence for the ‘dose’ of nature *contact* that leads to benefits (Shanahan et al., 2015), there are calls to more rigorously examine the experiential characteristics of nature exposure that promote psychological benefit, and the types of interactions a person has with nature (Bratman et al., 2019). Richardson et al. (2021) test these interaction types in nature by measuring amount of time spent in nature and how often people engage in nature-based activities (e.g., listening to bird song or smelling wildflowers). Their study found that engaging in nature-based activities predicted general wellbeing, while time in nature was not a significant predictor. How individuals engage in nature is considered to be a key aspect of the nature experience in this thesis, and is the

focus of Section 2.5 in this chapter. A further way to examine the experiential characteristics of nature is considering the contextual factors within the experience. Marselle et al. (2021) suggest that environmental and individual characteristics in a nature experience can affect all pathways between nature and health, and should be examined to understand the nuanced effects of nature on different outcomes. Thus, to understand the complex pathways between nature and psychological outcomes, we need to use frameworks and methods that explicitly recognise the range of experiential characteristics within nature transactions. In Figure 2.1 below, I present an overview of the key concepts that form the structure of this chapter, and include key questions that will be investigated in this thesis. The figure builds on and extends established models of the links between nature exposure and psychological/wellbeing outcomes (e.g., Bratman et al., 2019; Marselle et al., 2021), by including the impact of engagement within the nature experience.

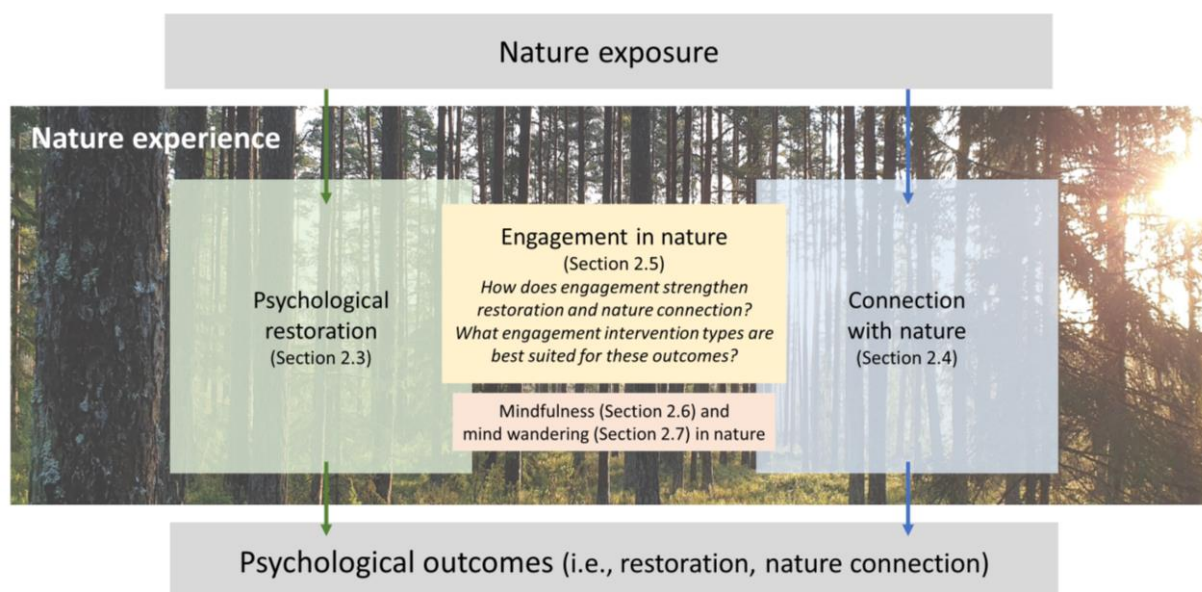


Figure 2.1. Overview of key concepts and structure for Chapter 2. In this chapter, I detail the connections between these aspects of the nature experience with the following structure: In [Section 2.3](#) and [Section 2.4](#), I review literature on the processes of psychological restoration and connection with nature in nature experiences, respectively. In [Section 2.5](#), I integrate and review studies that have explored how individual engagement in nature strengthens the processes and outcomes of both restoration and nature connection. The questions listed in the figure represent key parts of this literature that remain unclear and require investigation. In the final sections ([2.6](#), and [2.7](#)) I specify two forms of engagement in nature and discuss their importance to the thesis: mindfulness and mind wandering.

2.3 Psychological restoration in nature experiences

Two theories dominate the work on restorative nature experiences in environmental psychology literature: attention restoration theory (ART; Kaplan & Kaplan, 1989) and stress reduction theory (Ulrich, 1983). The two theories emphasise different antecedent conditions from which an individual

may need restoration, namely, attention fatigue and stress (Hartig et al., 2014). Some work has considered whether the theories can complement each other regarding these antecedent conditions (Hartig et al., 2003; Kaplan, 1995) and concurrent pathways to the recovery of cognitive and affective resources (Berman et al., 2008; Sato & Conner, 2013). The theories share overlap in the affective response through contact with nature, where the effects of the nature experience are suggested to include a pleasurable aesthetic dimension (Joye et al., 2013; Kaplan & Kaplan, 1989; Ulrich, 1983). While ART and stress reduction theory remain the leading theoretical frameworks for research on the restorative benefits of nature, there are ongoing calls for expansion within and beyond these two theories (Hartig, 2021; van den Berg & Staats, 2018). Recent critiques of ART in particular have specified areas requiring development that parallel the broader aims in this thesis of understanding engagement in nature: identifying the mechanisms and experiential characteristics of the drivers of restoration, including soft fascination (Joye & Dewitte, 2018; Neilson et al., 2019). Parallels between these tenets of ART and cognitive engagement forms have already prompted some investigation (Kaplan, 2001; Lymeus et al., 2018), providing a basis for further theoretical development. In this thesis, I therefore focus on ART to understand processes of psychological restoration, and advance theory in restorative environments research by considering the role of engagement within pathways to restoration (discussed in Chapter 3).

ART contends that depleted, directed attention can be restored in certain experiences and settings (Kaplan, 1995; Kaplan & Kaplan, 1989). Although it remains an ambiguous concept (Ohly et al., 2016), directed attention was initially defined as a voluntary, effortful attention (Kaplan & Kaplan, 1989). Since then, the concept has been further conceptualised as underpinning self-regulatory effort and executive control (Kaplan & Berman, 2010), and operationalised as a set of related cognitive processes (for example, working memory, vigilance, cognitive flexibility) that are sensitive to the restoration effect (Stevenson et al., 2018). Directed attention fatigue can result from sustained efforts to maintain focus on the demands of everyday life, and the restoring effect of this resource is proposed to occur in settings that negate these demands. Restorative experiences should therefore contain fascinating stimuli that one can engage with effortlessly, they should promote a sense of being away from everyday demands, they should contain coherent qualities that contribute to an extensive, immersive experience, and they should be compatible with an individual's needs (Kaplan, 1995).

Stephen and Rachel Kaplan (1989) proposed that natural environments in particular are rich in the qualities that lead to restoration, and there is empirical support for this argument. The Perceived Restorativeness Scale (PRS) was developed by Hartig et al. (1997) to measure the subjective evaluation of an environment's potential for providing restoration, using the factors outlined in ART: fascination, being away, extent, and compatibility. A recent meta-analysis of studies measuring the perceived restorativeness of natural compared with urban environments supports the Kaplans' arguments, finding a medium effect favouring natural environments (Menardo et al., 2021). The

authors, however, caution against the assumption that perceived restorativeness equates to actual cognitive benefit. While several studies have found mediating effects of perceived restorativeness on affective and self-reported outcomes of nature experiences (Malekinezhad et al., 2020; Marselle et al., 2014; Nghiem et al., 2021) there is little research that empirically links perceived restorative potential of environments to attention restoration outcomes (Pearson & Craig, 2014).

Research over the last two decades has shown evidence in support of the theorised restorative outcomes of natural environments. Walking in natural green spaces, compared to walking in urban spaces, benefits working memory (Bratman et al., 2015), executive control, and concentration (Berman et al., 2008; Hartig et al., 2003). Additionally, viewing photographs (Berman et al., 2008; Berto, 2005) and watching videos (Mayer et al., 2009; Pilotti et al., 2015) of natural environments compared with urban environments restores directed attention capacity, although these effects are generally smaller than actual nature exposure (Stevenson et al., 2018). In recent reviews of attention restoring effects of nature, the effects of nature on cognitive benefits are partitioned into different outcome measures (Ohly et al., 2016; Stenfors et al., 2019; Stevenson et al., 2018). While Ohly et al. (2016) were limited to few and heterogeneous studies with methodological inconsistencies, findings from Stevenson et al.'s (2018) systematic review demonstrate that the strongest evidence for nature improving cognition and attention is found in measures of working memory, cognitive flexibility, and attention control. Other research has demonstrated the affective outcomes of spending time in nature. Walks in nature have shown to improve positive affect (e.g., Berman et al., 2008; Bratman et al., 2015) and vitality (e.g., Korpela et al., 2014; Ryan et al., 2010). A recent meta-analysis on controlled studies examining beneficial effects of brief nature exposure on mood found a larger effect for increased positive affect than reduced negative affect (McMahan & Estes, 2015). For simulated natural environments, however, these effects are present only for reduced negative affect (rather than increased positive affect), providing evidence for the capacity-restoring function of simulated nature (Browning et al., 2020).

Critiques of ART and evidence from systematic reviews encourage several future research aims. Joye and Dewitte (2018) critically appraise the theoretical tenets of ART and argue that its central components are underdeveloped and require more systematic testing (e.g., soft fascination as a concept and mechanism supporting restoration). The authors suggest future research pathways that would help to develop theory and better place the evidence to optimise applications of ART, including standardising methods for measuring directed attention, and testing the environmental conditions that support soft fascination. More rigorous experimental methods have also been called for in recent reviews, recommending future studies to: clarify attention processes and the instruments that are likely to best measure the restoration effect; use baseline scores to control for variance; consider type (e.g., actual or simulated) and length of nature exposure (Ohly et al., 2016; Stevenson et al., 2018); and to include assessments of fatigue at the individual level to examine the restorative mechanism

under different levels of fatigue (Joye & Dewitte, 2018; Stevenson et al., 2018). More broadly, Hartig (2021) calls for theoretical expansion in this literature, first by demonstrating opportunities for broadening the restoration perspective by considering other forms of resource depletion (e.g., relational resources), and second by suggesting advancement of restorative theories through dialogue and integration with other bodies of theory. In this thesis, I respond to this latter call with an evolving integrated examination of restoration, connection with nature, and mindfulness theories.

2.4 Connecting with nature in nature experiences

The relationship between humans and the natural world has been studied across various disciplines and numerous concepts and measures have been developed. Connection with nature has been defined as a trait, stable over time (e.g., a sense of oneness with the natural world; Mayer et al., 2009), and as a state, dynamic and changing due to experiences with nature (Weinstein et al., 2009). Across disciplines, related measures capture environmental identity, attitudes, worldview, and values (Keaulana et al., 2021). In this thesis, I consider this relationship to be experienced and fostered through nature experiences and use the term ‘connection with nature’ to capture the sense of oneness an individual feels with the natural world. Tam (2013) analysed different measures of connection with nature and found strong convergence among the measures, demonstrating that they represent the same underlying construct. However, divergence among some measures likely highlights the multidimensionality within the scales and construct overall. These dimensions include cognitive (e.g., Mayer & Frantz, 2004), affective (e.g., Perkins, 2010), and experiential (e.g., Nisbet et al., 2009). The experiential dimension is particularly relevant to this thesis, as it can help to represent how connection with nature is understood within nature transactions. Lumber et al. (2017) operationalise this dimension by defining pathways through which nature transactions can lead to nature connection. These pathways and the role of individual engagement within them are discussed further in Chapter 3.

Connection with nature has consistently been associated with various positive outcomes for individual wellbeing. Capaldi et al. (2014) conducted a meta-analysis of the relationship between connection with nature and hedonic wellbeing (as measured with positive affect, vitality, and life satisfaction). Their results revealed a small positive effect, showing that people who are more connected with nature are generally happier. These results were corroborated by a second meta-analysis that found small and positive effects for the association between nature connection and both hedonic (e.g., positive affect) and eudaimonic wellbeing (e.g., autonomy, personal growth; Pritchard et al., 2019). In their review, Pritchard et al. overview the underlying reasons for this relationship between nature connection and wellbeing; some authors have proposed that nature connection strengthens eudaimonic wellbeing because it may satisfy some basic psychological needs (Cleary et

al., 2017; Howell et al., 2013; Hurly & Walker, 2019), while others have demonstrated that nature connection may lead to higher wellbeing through spiritual fulfillment (Trigwell et al., 2014).

Connection with nature can be considered an outcome of experiencing nature, but it can also influence how one experiences nature. Lengieza and Swim (2021) review the antecedents of nature connection, identifying experience with nature as one of the most widely studied predictors. While their review highlights the consistent evidence base for the links between spending time in nature and nature connection (through correlational analyses, e.g., Hinds & Sparks, 2008; and controlled experimental designs, e.g., Mayer et al., 2009), they also note that the contextual aspects of nature experiences (such as environmental features) that are most likely to strengthen nature connection are less known. For instance, environmental types such as coastal locations and urban green space have been found to differentially influence nature connection (Wyles et al., 2019), but there is little research examining the influence of specific environmental features. Further, nature connection as an outcome of nature experiences may depend more on individual perception of environments than the environment itself. Samus et al. (2022) found that participants who walked in a wilder environment (urban forest) compared with a landscaped park did not experience higher nature connection; however, the degree to which they perceived the environment to be ‘wild’ did predict state nature connection. The direction of these effects is contested: studies have found that people evaluate qualities of environments differently based on their (prior) level of connection with nature (I.-C. Tang et al., 2015), and a virtual reality eye-tracking study demonstrated that a higher level of connection with nature is associated with viewing more trees than buildings in an environment (Chen et al., 2022). Other research demonstrates that connection with nature may mediate the association between nature exposure and wellbeing (Mayer et al., 2009), influence affective appraisals of environments (Davis & Gatersleben, 2013), and is associated with perceived restorativeness of the natural environment (Berto et al., 2018).

This body of work demonstrates the various positions that connection with nature may have in the human-nature relationship: as an antecedent and outcome of nature experiences, and as a mediator of the nature—wellbeing relationship. There are calls for stronger theoretical frameworks that can be used to examine these relationships, including the contexts in which connection with nature is formed or strengthened through nature experience (Lengieza & Swim, 2021). Transactional models may be helpful here, where the multitude of contextual aspects within a nature experience can be included to understand these dynamic relationships.

2.5 Engagement in nature experiences

So far in this Chapter I have reviewed literature that examines psychological outcomes of nature experiences – restoration and nature connection. The human-nature transactions that lead to

such outcomes can be studied in terms of the environmental qualities or personal circumstances that combine to support restoration and nature connection. In recent literature, however, there are further calls for examining broader aspects of human-nature transactions, including the diverse psychological (Pramova et al., 2021) and behavioural (Colléony et al., 2020; Richardson, Passmore, et al., 2021) interactions that may promote these outcomes. How individuals engage with nature (i.e., their experiential awareness and cognitive activity in nature) is a key aspect of the transaction between people and their environment that is likely to shape outcomes of restoration and nature connection. In Chapter 3, I discuss how individual engagement is explicitly involved in the pathways to restoration and nature connection and how *mindfulness*, as a form of engagement in nature, can be implemented as a framework to understand and categorise different forms of engagement seen in existing literature. Here, I overview the literature that has developed this concept of engagement in nature, and the current evidence base for the benefit of altering engagement through nature-based engagement interventions.

To understand empirical literature regarding engagement during nature experiences, it is necessary to first understand the concept of engagement in nature. The psychological experience of nature has been explored by Pramova et al. (2021) as ‘dimensions of experience’, including cognitive, affective, and sensory dimensions. These dimensions sit within a broader framework including the setting (environmental, and ephemeral elements of nature) and activities (physical interactions such as hiking, and intellectual interactions such as daydreaming). It is in this latter aspect of the nature experience that I consider engagement – defined in this model as the cognitive interaction/activity in nature, that forms or leads to the cognitive/affective/sensory experience in nature. For example, the experience of fascination in a nature experience can be understood within this framework: the *setting* or environment contains stimuli that are interesting; the engagement *activity* involves ‘gently’ attending to those stimuli; the *sensory* dimension is active through visual perception; the *cognitive* experience is characterised by reflection and having room for memory and other thoughts; and fascination involves a positive *affective* dimension (Kaplan, 1995). The model by Pramova and colleagues helps to situate and define engagement.

Findings from both qualitative and quantitative studies highlight the diversity and complexity of engagement concepts that are relevant to psychological outcomes of nature experiences. First, qualitative studies have helped to identify aspects of transactions that connect to psychological restoration (Ratcliffe et al., 2013; Shrestha et al., 2021), nature connection (Pramova et al., 2021), and wellbeing (Brymer et al., 2021; Iqbal & Mansell, 2021). Common findings across these studies emphasise the heightened sensory experience in nature (e.g., enjoyment from varied sensory input; Iqbal & Mansell, 2021), the space for reflection and perspective in nature (e.g., feeling a sense of oneness in nature; Brymer et al., 2021), and the increased sense of presence (e.g., being immersed and grounded in the present moment; Shrestha et al., 2021). Other studies have aimed to quantify the

benefits of higher engagement with nature: correlational analyses reveal that a higher level of *immersion* while viewing photographs of nature is associated with higher nature connection (Weinstein et al., 2009); being more *absorbed* in a natural environment (Ballew & Omoto, 2018) and more *fascinated* during daily nature experiences (Sato & Conner, 2013) mediates nature's impact on positive emotions; and experiencing greater *awe* during a walk in an urban park reduces negative affect (Lopes et al., 2020). Further, higher engagement through nature activities (Richardson, Hamlin, et al., 2021) has shown to increase nature connection.

Nature-based engagement interventions

Nature-based interventions are typically designed to change the environment, or to change people's behaviours or their interactions with nature (Shanahan et al., 2019). Among the interventions designed to change interactions with nature, Shanahan et al. identified a range of interventions that aim to promote health and wellbeing outcomes through participation in nature-based activities such as Forest Bathing (the practice of immersing oneself in nature while paying attention to the senses; Kotera et al., 2020). While these types of interventions have some barriers – such as individual access to nature, physical/cognitive capability of individuals – these types of interventions are important to integrate with environment-level interventions, which are less effective without strategies that encourage people to use the space (Hunter et al., 2019). A form of intervention that can change individual interactions with nature are those that aim to heighten individual engagement in nature. The use of these types of interventions emerged with a study by Duvall (2011) who created 'awareness plans' for participants to use on daily walks – the plans included lists of tasks (e.g., to focus on one's senses, or to imagine different scenarios) that the participants could choose from to enhance engagement during their walks. Since then, several other studies have used interventions to heighten engagement in nature in some way; these include interventions that instruct participants to attend to some feature of their experience with a higher degree of awareness. In Table 2.1, I review experimental studies that heighten engagement and include a comparison or control group.

Some key findings can be highlighted from the review of studies in Table 2.1. There is considerable heterogeneity among the engagement interventions to date, with little knowledge of what intervention designs are most effective in which environments, for whom, and for which outcomes. In the studies reviewed, the length of intervention ranges from a single session (e.g., 10min, Rickard & White, 2021) to an eight-week intervention (Sturm et al., 2020). Outcomes measured include attention, affective outcomes, nature connection, and general restoration. There are mixed findings in terms of the effects on these outcomes: studies found significant benefits of engagement tasks for attention performance (Lin et al., 2014; Pasanen et al., 2018), and nature connection (Lumber et al., 2017; Rickard & White, 2021), however, there were inconsistent findings regarding affective outcomes (Colléony et al., 2020; Passmore & Holder, 2017). Locations range from forested

environments to urban green spaces to lab environments. Rickard and White (2021) tested the difference between two locations (beach and garden) and found no effect of location on outcomes. One intervention was guided by the researcher (Lumber et al., 2017) while others used signposts or a mobile application (Pasanen et al., 2018) or relied on instructions delivered at the start of the intervention (e.g., Sturm et al., 2020). A separate study comparing the effects of guided vs unguided nature immersion (akin to forest bathing) found that there were no differences between a group that was guided by a practitioner and a group that received a list of instructions (Lim et al., 2020). Finally, task type clearly ranges considerably, from short simple instructions (Lin et al., 2014) to more intensive and varied engagement instructions (e.g., Lumber et al., 2017).

In summary, with the exception of Pasanen et al. (2018, study 2) that directly compares different instruction types, there is little knowledge about the benefits of certain interventions over others, and how they might interact in different situations (e.g., for people with different capacities; in different locations, cf. Rickard & White, 2021). Further, how to select an appropriate form of engagement to design nature-based engagement interventions, and how to select this based on the outcomes being targeted, remain unknown. However, results from Pasanen et al. do demonstrate the value of drawing on theory to design and implement engagement tasks. Further research is therefore needed that compares different engagement forms in nature, ideally based on theoretical pathways between individual engagement and nature outcomes.

Table 2.1 Controlled experimental studies that test engagement tasks in nature experiences

Study	Design	Intervention	Length	Participants	Location	Outcome significant	Outcome null effects	Guided?
Duvall, 2011	3x2: Pre/post-test, follow up; 2 intervention groups. Groups: 1) Standard Care; 2) Engagement Group.	Standard Care group received a walking schedule. Engagement group received a list of tasks to heighten engagement during their walks.	2 weeks	$n = 117$; Adults, community recruitment	'Outdoor walking', any location	Reported attentional functioning and frustration improved after the intervention for the Engagement group (2) only.	No differences detected between the two groups. Four weeks after intervention - no overall improvements.	No
Lin et al., 2014	2x4: Pre/post-test, follow up; 4 intervention groups. Groups: Viewed photographs of 1) Urban; 2) Urban with short flashes of greenery; 3) Urban with greenery; 4) Same as 3, with added engagement instruction.	All groups told to "observe [the photographs] closely". Engagement group 4 told "Please observe the plants closely".	100sec	$n = 140$; UG students	Lab (indoor)	Attention on DSBT: Engagement group (4) scored better than all other groups. PRS – Engagement group (4) higher than Urban group (1).	PRS – Engagement group (4) scored similar to other greenery groups (2 and 3).	No
Pasanen et al., 2018 (Study 1)	2x2x2: Pre/post-test; 2 intervention groups; route direction. Groups: 1) Restoration tasks; 2) No tasks.	Restoration tasks: physical relaxation, observing surroundings, reflection.	6km; 100min	$n = 128$; Adults, community recruitment	Forest in countryside	Attention on SART: Reverse order of tasks led to fewest errors on attention task.	Self-reported restoration and valence similar across all groups	Signposts
Pasanen et al., 2018 (Study 2)	2x3: Pre/post-test; 3 intervention groups. Groups: 1) Restoration tasks; 2) Awareness-enhancing tasks; 3) No tasks	Awareness-enhancement tasks: focusing on senses; taking on a new 'role'/imagination.	4km; 1hr.	$n = 121$; Adults, community recruitment	Urban park	Attention on SART: restoration tasks (1) and no tasks (3) groups had fewer errors on attention task; but restoration tasks group (1) had more stability in responses on task.	Self-reported restoration and valence similar across all groups	Mobile app
Sturm et al., 2020	Pre/post-design, with daily surveys; 2 intervention groups. Groups: 1) Awe group; 2) Control walking group.	Awe group were asked to tap into their sense of wonder and to go somewhere new each week.	Weekly 15min for 8 weeks	$n = 60$. Older adults - 60-90. Community recruitment	Outdoor environments, any location	Awe group (1) experienced higher awe, and more positive emotions - joy and prosocial emotions	Anxiety, depression, and life satisfaction did not change for either group after intervention	No

Study	Design	Intervention	Length	Participants	Location	Outcome significant	Outcome null effects	Guided?
Rickard & White, 2021	2x2; 2 locations and 2 intervention groups. Groups: Walking with shoes (on beach (1) and garden (2)) and walking barefoot (on beach (3) and garden (4))	Engagement: walking without shoes on (higher sensory stimulation with environment)	10 min	56 adults	Beach, and garden next to beach	Self-reported restoration, and CN higher for barefoot walkers (2) than shod walkers (1), across both locations.	No effect of environment on outcomes.	No
Lumber et al., 2017	2x3: Pre/post-test, and 3 intervention groups. Groups – 1) Walk in nature with tasks; 2) walk in nature without tasks, 3) walk indoors with tasks .	Tasks: designed for nature connection. Include sensory stimulation, finding beauty in nature, recognising emotions, caring for nature, and finding meaning.	20min	<i>n</i> = 72 UG students	Urban green space; indoor built environment.	CN increased pre- to post-test for nature tasks group (1). CN did not increase significantly for other two groups.	No difference between groups for vitality.	Yes
Colléony et al., 2020	9 experimental conditions given different ‘cues to experience’ to conduct on an outdoor walk.	5 groups received cues that prompted closeness to nature (eg smelling flowers); 3 groups received cues with more distance to nature (eg walk slowly); 1 group no cues.	30min	<i>n</i> = 303 Students	Outdoors on campus	Two groups that received cues prompting closeness to nature (smell flowers, and touch natural elements) had a higher number of ‘nature interactions’ during their walk.	No difference between groups for positive affect	No
Passmore & Holder, 2017	2x3: Pre/post-test, and 3 intervention groups. Groups: 1) Nature; 2) human-built; 3) and control	Nature and human-built conditions were instructed to notice and be mindful of how nature or human-built scenes feel, and take photos of them. Control group, regular routine.	2 weeks	<i>n</i> = 395 Students	Any location	Positive affect, levels of elevating experiences, sense of connectedness, and prosocial orientation were all higher in the nature group (1) compared to the other two groups (2 and 3).	No significant difference between groups on sense of meaning.	No
Note: Guided refers to whether participants received instruction guidance from a researcher or practitioner on how to engage during their nature experience. CN = Connection with nature; PA = Positive affect; NA = Negative affect; DSBT = Digit span backwards task; SART = Sustained attention to response task; PRS = Perceived restorativeness								

2.6 Mindfulness – in nature

An additional type of engagement that has been applied in nature experiences is mindfulness. In contemporary literature, mindfulness is defined as a cognitive practice or a quality of mind, that involves a purposeful, nonjudgmental perception of the current moment (Kabat-Zinn, 2003). Mindfulness has been described as paying attention to the current internal and external experience (Shapiro et al., 2006). Operational models of mindfulness (Bishop et al., 2006; Tanay & Bernstein, 2013) extend these definitions to portray mindfulness as containing two levels: a present-moment awareness that involves sustained attention to current external phenomena, physical sensations and mental events; and a quality or orientation of awareness that involves acceptance, curiosity, and perceptual sensitivity. The practice of mindfulness can be categorised into two distinct forms: focused attention, which involves having a stimulus to orient attention towards, such as the movement or sensation of the breath, and open monitoring, which involves active observation of internal (cognitions, emotions) and external (physical environment, senses) experiences, while remaining accepting and nonjudgmental towards perceptions (Ainsworth et al., 2013; Lutz et al., 2008). While some authors conceptualise mindfulness as a unidimensional construct (involving present-moment awareness, Brown & Ryan, 2003), others have examined multiple dimensions of mindfulness. Baer et al. (2006) identify five facets of trait mindfulness: observing internal and external stimuli, describing or labelling internal experiences, acting with awareness, accepting an experience without judgment and being non-reactive. Studies have demonstrated the value in differentiating between these facets when examining mindfulness and wellbeing outcomes (e.g., Coffey et al., 2010), and suggest that interventions should consider how different facets can be trained to benefit key outcomes (Blanke & Brose, 2017).

Mindfulness interventions are increasingly varied, and although there are many studies examining the benefits of mindfulness interventions with positive results, there are cautions about the implications of its widespread use. Mindfulness-based stress reduction (MBSR) is an eight-week course that was the first formalisation of mindfulness as a secularised therapy, departed from its Buddhist origins (Kabat-Zinn, 1992). While MBSR is still one of the most common mindfulness interventions (Mars & Abbey, 2010), there are now many shorter and varied interventions designed to target a range of psychological, cognitive, physiological, and behavioural outcomes. Howarth et al. (2019) reviewed these brief mindfulness-based interventions (less than 2 weeks) and found consistent evidence that such interventions improve psychological outcomes (negative mood, anxiety, rumination) and significant effects for the improvement of cognitive functioning (e.g., attention, memory). Among a relatively varied set of interventions, the authors call for further investigation of dose effects (length of intervention), long-term follow up analyses, and standardization of

interventions, control groups, and outcome measures. Further, some researchers have raised concerns over the ambiguous definitions and methodologies found in the mindfulness literature, and urge researchers towards more precise terminology and intervention design features (Van Dam et al., 2018). Despite these concerns, the evidence base for the benefits of mindfulness practice in a range of disciplines for wellbeing outcomes continues to develop, and the application of mindfulness is broadening.

Mindfulness and nature

The past two decades have seen an evolving conversation about the complementary benefits of mindfulness and restorative nature experiences for attention restoration and cognitive functioning. Kaplan (2001) wrote about the synergistic properties of meditation and restorative nature, proposing that they have similar cognitive patterns and share capacities to revive cognitive functioning. Tang and Posner (2009) argue that both meditative practices and restorative nature experiences can strengthen attention regulation capacity via a process of ‘attention state training’. Attention state training occurs through practices that cultivate a balanced and relaxed state and – in more advanced stages of development – require little effort. The differences between mindfulness and nature experiences are also acknowledged. Where mindfulness involves an effortful and volitional form of attention that is cultivated through practice, nature experiences are proposed to capture attention effortlessly through ‘bottom-up’, exogenous mechanisms (Lymeus et al., 2018; Menardo et al., 2022). Relatedly, a study that interviewed practitioners of both mindfulness and Forest Bathing identified key differences between the two practices (Clarke et al., 2021). Of note, interviewees suggested that externally oriented attention in forest bathing places less risk on wellbeing for individuals who may face challenges in engaging with internal thoughts and emotions (as in mindfulness); they also noted that mindfulness is less accessible than forest bathing, as it requires greater effort and may contain significant barriers, particularly for individuals who experience mental health challenges. The similarities and differences between mindfulness and nature-based experiences provide opportunities for integration, as some researchers have begun to explore.

A set of studies have tested this integration by examining whether a natural environment can support learning mindfulness and the benefits of the practice (Table 2.2). Three studies assess mindfulness courses in natural environments compared with indoor/built environments (Choe et al., 2020; Djernis et al., 2021; Lymeus et al., 2018), while others compare mindful walking in nature to mindful walking in urban or indoor environments (Ma et al., 2022; Nisbet et al., 2019; Shin et al., 2013). In contrast to the engagement studies reviewed in Table 2.1, almost all mindfulness interventions in nature use a guide to deliver instructions during the intervention. Outcomes measured are similar to those in Table 2.1 (i.e., nature connection, affective outcomes, and attention), and depict

Table 2.2 Controlled experimental studies that test mindfulness tasks in nature experiences

Study	Design	Intervention	Length	Participants	Location	Outcome significant	Outcome null effects	Guided?
Nisbet et al., 2019	3 intervention groups: 1) Outdoor walk with mindfulness; 2) outdoor walk without mindfulness; 3) indoor walk without mindfulness	Mindfulness intervention: guided walk with instructions to pay attention to walking sensations, and other sensory experiences, without judgment or elaboration.	20min	<i>n</i> = 100 Students	Urban green space; indoor built environment.	CN higher for mindful group (1) compared to both other groups (2 and 3). PA and vitality higher for both outdoor groups (1 and 2). NA lower for outdoor mindfulness group (1) than indoor group (3).	Outdoor mindfulness (1) doesn't reduce NA or improve PA or vitality more than outdoor walking group (2).	Yes
Lymeus et al. (2018, 2019, 2020)	Surveys conducted pre- and post-test, during intervention, and at 6 month follow up; 2 intervention groups. Groups: 1) Restoration skills training (ReST); and 2) conventional meditation training (CMT)	ReST: Mindfulness instructions that draw on sensory natural environment CMT: MBSR based instructions focusing attention on body, thoughts, emotions.	5 weeks	<i>n</i> = 139, across four rounds of data collection. Students	Botanic garden; indoor campus building	Key findings: Enhanced attention performance for ReST group compared to CMT on LDST and TMT; compliance to course better for ReST participants, this result mediated by PRS and state mindfulness.	No differences between ReST and CMT for trait mindfulness, cognitive functioning, or chronic stress.	Yes
Choe et al., 2020	Surveys conducted pre- and post-test, during intervention, and 1 month follow up; 3 intervention groups. Groups: 1) Outdoor nature meditation; 2) Outdoor built meditation; 3) Indoor built meditation	All groups completed mindfulness-based stress reduction course.	6 weeks	<i>n</i> = 99 Students and staff	Natural park; campus courtyard; indoor seminar room	CN, stress relief, and rumination, all improved at post-test for nature meditation group (1) compared to other two groups (2 and 3). Sustained differences at 1 month follow up.	No group effects on PA or NA.	Yes
Djernis et al., 2021	Surveys conducted pre- and post-test and 3 month follow up; 3 intervention groups. Groups: 1) Outdoor meditation; 2) Indoor meditation; and 3) waitlist control (3)	Meditation groups completed a short version of the mindfulness-based stress reduction course.	5 days	<i>n</i> = 60 Students	Therapy garden; indoor built environment.	At 3-month follow-up, both meditation groups (1 and 2) had higher trait mindfulness and self-compassion compared to the control group.	No group differences for perceived stress or self-compassion at post-test. No differences between nature or indoor meditation groups for any outcomes.	Yes

Study	Design	Intervention	Length	Participants	Location	Outcome significant	Outcome null effects	Guided?
Ma et al., 2022	Surveys conducted at baseline, pre- and post-test and follow up; 2 groups. Groups: 1) mindful walking in nature; 2) mindful walking in urban environment	Mindfulness instructions: to observe body movements, breath, and present moment, while walking.	7 days	<i>n</i> = 104 Students	Public park; urban street	All participants improved on sleep quality, mood, and trait mindfulness, from pre- to post-test, but there were no differences between the two groups.	No effect of intervention on CN. No effect on state mindfulness after each walking session.	No
Unsworth et al., 2016	2x2: Pre/post-test, 2 intervention groups. Groups: 1) Meditation; 2) no meditation control group	Guided meditation, focusing on breath and present experiences	2x15min sessions over 3 days	<i>n</i> = 71 Students	Nature camp	Significantly larger increase in CN for meditation group (1) compared to no meditation group (2).	No significant difference between groups in trait mindfulness after intervention.	Yes
Shin et al., 2013	2x4: Pre/post-test, 4 intervention groups. Groups: meditative walking (gymnasium (1) or forest (2)); athletic walking (gymnasium (3) or forest (4));	Instruction: meditative groups used technique that focuses on breath and sensations while walking.	90min	<i>n</i> = 139 Female students	Forest trail; indoor gym track	Anxiety, self-esteem, and happiness all better for meditative walking than athletic walking (in both environments). Happiness higher for meditative walking in forest than meditative walking in gym.	No difference between meditative walking in gym vs forest for anxiety and self-esteem.	Walking guides only

Note: Guided refers to whether participants received instruction guidance from a researcher or practitioner on how to engage during their nature experience. CN = Connection with nature; PA = Positive affect; NA = Negative affect; MBSR = Mindfulness-based stress reduction; TMT = Trail making test; LDST = Letter digit substitution test; PRS = Perceived restorativeness

a range of mixed findings for these outcomes. There are no negative effects of mindfulness in nature (compared to control groups), but all studies report several null effects for different outcomes. There are some important differences in study designs. Of note, two studies specifically integrate the mindfulness practice with the nature experience (Lymeus et al., 2018; Nisbet et al., 2019). Nisbet et al. (2019) created a 20min nature-based mindfulness intervention that drew on the sensory experience associated with nature (e.g., “allow all your senses to become absorbed in nature”, p. 9). Lymeus et al. (2018, 2019, 2020) developed a 5-week course that integrated mindfulness practice (based on open monitoring training) with restorative processes in a natural environment (i.e., fascination and being away). These studies are important as they indicate the mutually reinforcing pathways between mindfulness and nature. In contrast, the other studies in Table 2.2 compare conventional meditation practices across natural or non-natural environments.

Mindfulness is a promising form of nature-based engagement for a range of psychological outcomes. However, there are likely boundaries around its efficacy in different environments, for different populations, and different outcomes (Clarke et al., 2021). There is considerable heterogeneity in nature-based mindfulness interventions to date (Table 2.2, and Djernis et al., 2019), and little knowledge about best practice for implementation. Further, some conceptual clarification is needed around how it relates to other common engagement types in nature experiences – for instance, what are the differences and comparative benefits of mindfulness compared with a restoration program (e.g., Pasanen et al., 2018)? And do these comparisons suggest further ways to integrate mindfulness with restorative nature experiences? Research efforts to answer these questions are needed to progress this group of studies (Table 2.1 and Table 2.2) toward practical outcomes for nature-based engagement interventions and wellbeing.

2.7 Mind wandering – in nature

In this section I discuss mind wandering in nature experiences as a common and potentially beneficial form of engagement for restoration. Mind wandering did not initially have a focus in this thesis: in the conceptual development (Chapter 3) and planning of the first study (Chapter 4) my focus was on intentional and heightened forms of engagement in nature (e.g., mindfulness, and noticing sensory experiences). However, the outcomes of Chapter 4 revealed mind wandering as a very common and beneficial way to engage during nature experiences. Interpreting these outcomes alongside existing literature and theoretical models aided the formulation of engagement exercises in Chapters 5 and 6 that use mind wandering as an engagement form to shape and benefit the experience of nature. The emergence of mind wandering through Chapters 4-6 demonstrates a progression of understanding of engagement in nature, and contributions that this thesis makes in the literature on nature-based engagement. Note that mind wandering is therefore absent in the published Chapter 3.

The research on mind wandering identifies both costs and benefits of the mental state. Mind wandering involves an internal orientation of awareness characterised by task-unrelated thoughts – that is, thoughts unrelated to one’s current task or external environment (Seli et al., 2015; Smallwood & Schooler, 2006). Mooneyham and Schooler (2013) review the costs and benefits of mind wandering and find that mind wandering negatively impacts performance on reading and cognitive tasks, but that mind wandering also has positive associations with creativity and goal-directed planning. Mood outcomes related to mind wandering likely depend on the content of thoughts: while mind wandering is generally associated with lower mood (Killingsworth & Gilbert, 2010), Franklin et al. (2013) found that mind wandering is associated with positive mood when the thought content is interesting. The outcomes of mind wandering also depend on the form it takes. Across two studies, Seli et al. (2017) used thought probes during a sustained attention task and found that intentionality and awareness in mind wandering are distinct dimensions that should be accounted for when testing the effects of mind wandering.

There is a theoretical basis for the role of mind wandering in nature. Early theoretical development of ART hinted at the role of mind wandering in the stages of a restorative process, where after attention recovery occurs, one can confront and process unresolved ‘internal clutter’, leading to a deeper reflective mode and restoration (Kaplan & Kaplan, 1989). Internal clutter (thoughts) is proposed to emerge effortlessly and the properties of restorative environments (in particular, soft fascination) should allow one the mental space to engage with and resolve them (Basu et al., 2018). Descriptions of this process by Basu et al. (2018) and Herzog et al. (1997) illustrate a dynamic relationship between external and internal attention processes, which parallels descriptions of mind wandering (Christoff et al., 2016) and conceptions of mind wandering in nature (Williams et al., 2018). Williams et al. refer explicitly to the role of mind wandering in nature for restoration and creativity benefits. Their argument is that restoration could be supported in nature by a shifting between internally oriented mind wandering, and externally oriented soft fascination, which both require little attentional effort. Joye and Dewitte (2018), however, note that the level of softly fascinating characteristics of the nature experience that give rise to mind wandering and reflection is not yet understood, urging further research into this domain.

There is some empirical support for mind wandering in nature. Evidence from qualitative studies demonstrate that nature experiences prompt episodes of mind wandering and reflection (Ratcliffe et al., 2013; Schertz et al., 2018; Shrestha et al., 2021). Other studies have operationalised the experience of internal task-unrelated activity in nature, though only include mind wandering within a broader set of similar mental processes (Basu et al., 2018; Cervinka et al., 2020). Basu et al., guided by theoretical processes of ART, define the concept of ‘mental bandwidth’ in nature experiences as free mental space in which an individual can reflect on thoughts. It is operationalised in their paper as mental states that would be easily permitted under high bandwidth conditions – i.e.,

mind wandering, self-awareness, and planning. Cervinka et al. (2020) designed and validated a measure, Widen One's Mind, aimed to measure the potential of a place to foster contemplation, new perspectives and ideas, and mind wandering (for example, “At this place one can let thoughts wander”, p. 7). Their study found associations between this concept and settings that are more restorative. While these two scales (Mental Bandwidth and Widen One's Mind) offer ways to measure the potential of activities or places to lead to introspection, missing from this literature is a measure of (state) mind wandering during nature experiences, and quantification of the potential benefits of these mental states. Mind wandering itself has not been quantitatively examined in nature experiences. Questions therefore remain about its potential to enhance the experience and outcomes of a nature experience for restoration.

2.8 Conclusion

This chapter has reviewed the literature on the psychological benefits of nature experiences (through frameworks of restoration and nature connection) and engagement interventions that are used to heighten these benefits. Through reviewing existing nature-based engagement interventions (Table 2.1 and Table 2.2) it is clear that to progress this literature further, an organising framework is needed that defines and clarifies key engagement concepts and provides a basis for empirical comparisons of the efficacy of engagement forms. Evaluation of nature-based interventions is also needed that tests the influence of contextual aspects of the nature experience, so that a more holistic understanding of engagement in nature is achieved. For instance, engagement practices like mindfulness may be more effective in natural environments that are immersive and can support higher engagement through interest and aesthetics, or, they may be more effective in less immersive environments because they enhance engagement in an otherwise unengaging environment. These unknowns have implications for the practical implementation of nature-based engagement interventions and thus warrant investigation.

2.9 References

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3 Chapter 3.

Mindful engagement, psychological restoration, and connection with nature in constrained nature experiences

3.1 Overview

This chapter develops a conceptual framework with the aim of understanding the qualities of different engagement forms in nature and how they relate to psychological outcomes of the experience. The focus of this development is on mindfulness as a form of nature-based engagement, and contextual aspects of nature experiences that may constrain engagement. Thus, this chapter builds on the literature reviewed in Chapter 2 by drawing on an understanding of mindfulness to specify 1) the role of individual engagement in the pathways to outcomes of restoration and nature connection, and 2) the function of these relationships within constrained contexts of nature. The development in this chapter is essential for the analysis of individual engagement seen in Chapters 4, 5, and 6.

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3.2 Abstract

Research indicates that heightened individual engagement in nature can improve psychological benefits of nature experiences, yet the current literature lacks robust consideration for how this occurs. Constrained nature experiences – such as busy, noisy urban environments – may undermine individual capacities to engage with nature, prompting the question of how engagement functions across different nature experiences. To address this gap, we draw on mindfulness as a framework to examine the pathways in which engagement in nature supports psychological restoration and connection with nature. We appraise existing literature and identify three key mechanisms underpinning mindful engagement in nature: perceptual sensitivity, decentering, and non-reactivity. This new framework provides a basis to examine mindful engagement in constrained nature experiences, where we find that the self-regulatory mechanisms of mindful engagement have a more direct role in supporting outcomes.

3.3 Introduction

A growing body of research indicates that the benefits derived from nature experiences partly depend on how we cognitively engage with nature. Psychological restoration - as described in attention restoration theory (ART; Kaplan & Kaplan, 1989) - and connection with nature (Mayer et al., 2009) are known outcomes of nature experiences and are important for psychological wellbeing (Capaldi et al., 2014; Hartig et al., 2014). The psychological benefits of *nature experiences*, the subjective experience of all forms of the natural world (Hartig et al., 2014), will certainly be influenced by environmental attributes (Hartig, 2004), but also by an individual's perspective, including how one engages with their experience (Clayton et al., 2017). Everyday nature experiences, such as in urban areas or near one's home, offer opportunities for spending time in nature. However, these contexts may also be a source of *constrained nature experiences*, where psychological outcomes are limited or even negatively impacted. The built environment, work stress, individual attitudes and other factors potentially constrain the benefits of these experiences (Bonnes et al., 2004; von Lindern et al., 2016). The role of individual engagement in constrained nature experiences is worth considering, where higher levels of engagement may improve the benefits of everyday nature experiences.

Cognitive engagement in nature has been explored in several studies, and is defined by a range of concepts that include awareness of both sensory, externally oriented experience (Korpela et al., 2017) and mental, internally oriented experience (Lumber et al., 2017). We use the term 'engagement' in nature experiences to refer to conscious awareness of experiential phenomena, including attending to vegetation or noticing sounds. Existing studies have demonstrated that psychological restoration and connection with nature are impacted by one's level of engagement in nature (for example, Duvall, 2011; Lin et al., 2014; Nisbet et al., 2019). While these findings are promising, further development is hampered by the wide array of concepts used to portray engagement, and heterogenous empirical approaches. This literature would benefit from a synthesis of relevant theoretical interpretations. In this paper we draw together existing lines of thought to focus on the potential mechanisms underpinning engagement in nature experiences and psychological outcomes.

We draw on the concept of mindfulness to help to interpret existing concepts of engagement and more clearly explain how heightened engagement in nature leads to psychological benefit. In this paper we consider mindful engagement in nature experiences to encompass a form of mindfulness known as open monitoring, a practice that has previously been applied in nature experiences (Lymeus et al., 2018). In this form, mindful engagement is distinct from other concepts of engagement for two key reasons. First, mindful engagement involves continuous awareness of both external, sensory experiences, and internal, mental experiences (Cardaciotto et al., 2008). This distinction highlights that a mindfulness framework may help researchers understand and clarify existing engagement

concepts that direct awareness to external or internal experiences in nature (cf. externally focused fascination; Kaplan & Kaplan, 1989, and noticing mood being changed by nature; Korpela et al., 2017). Second, mindfulness is characterised by non-reactive, nonjudgmental awareness (Bishop et al., 2006; Kabat-Zinn, 2003). These qualities of mindfulness present a way of understanding how one might engage mindfully, and also offer a theoretical approach to exploring the mechanisms underpinning the association between engagement in nature and psychological outcomes. We draw on research into links between mindfulness, psychological restoration (Djernis et al., 2019; Lymeus et al., 2018) and connection with nature (Nisbet et al., 2019) to describe how different forms of engagement in nature might support psychological benefits.

With a clearer picture of how heightened engagement in nature leads to improved psychological outcomes, we can better examine the range of contexts that may facilitate or constrain engagement in nature. We argue that the mechanisms underpinning the benefits of forms of enhanced engagement in nature where mindfulness is not explicitly applied may be contingent on specific types of nature experience – e.g., highly restorative environments. Less restorative, or constrained experiences may therefore require alternative forms of engaging. While it is evident that some individuals prefer urban environments for restoration (Patuano, 2020), constrained nature experiences are likely to be common in busy urban green spaces or where access to high quality natural environments is restricted (Hartig et al., 2007; von Lindern et al., 2013). We propose that mindful engagement may be particularly valuable in constrained nature experiences because mindfulness helps to mitigate negative reactions to stressful situations (Crescentini et al., 2016) due to self-regulatory mechanisms such as non-reactivity and nonjudgment. The role of nature in self-regulation has been an important topic of research, with a focus on regulation through change of environment (Korpela et al., 2018; Richardson, 2019). Building on that tradition, we focus on self-regulation in the intersection of environmental and cognitive strategies. Interventions to overcome constraints and improve psychological benefits of constrained nature experiences would support wellbeing among certain populations (for example, urban residents). To our knowledge mindful engagement has not been applied as an intervention in these specific circumstances. This paper makes a theoretical contribution to such endeavours, and our resulting framework will require empirical testing to guide practical implementation of mindful engagement in constrained nature experiences.

In the following sections we first demonstrate the importance of cognitive engagement with nature for both attention restoration and nature connection, before drawing on the concept of mindfulness to distinguish between different forms of cognitive engagement. While other literature has considered the relationship between mindfulness and nature in various ways (for example, Van Gordon et al., 2018), the specific intersection of cognitive engagement, nature experiences, and psychological benefits, forms the focus of this paper. Thus, we do not intend to present a complete picture of all links between mindfulness and human-nature relations, but rather focus on mindfulness

as a form of engagement in nature experiences, and highlight plausible mechanisms that may underpin benefits of these processes. Based on this framework, we propose pathways through which mindful engagement with constrained nature experiences can maximise psychological outcomes in this context, including psychological restoration and connection with nature. We conclude by discussing what remains unresolved within this theoretical integration and suggest research questions for further investigation.

3.4 Role of individual engagement in nature for psychological outcomes

In this section we propose that cognitive engagement underpins both psychological restoration and connection with nature. Psychological restoration refers to renewal of mental resources, as described in ART (Hartig, 2004; Kaplan & Kaplan, 1989). Connection with nature can be defined as an experiential oneness with the natural world (Mayer & Frantz, 2004), that develops through experiences with nature. We understand nature experiences as a complex transaction between a person and the surrounding natural environment (Hartig, 1993), where certain processes give rise to short and long-term psychological outcomes that depend in part on an individual's level of engagement with their experience. Nature experiences are defined both by the natural features of an environment, but also the way a person perceives their environment; thus, outcomes of nature experiences are in part mediated by how an individual engages with and perceives their environment (Clayton et al., 2017).

Psychological restoration and connection with nature processes have been explored together in empirical literature and appear to mutually reinforce one another. Correlations between psychological restoration and connection with nature have been demonstrated (Capaldi et al., 2014; Howell et al., 2011; Whitburn et al., 2019) and other studies have explored the direction of these associations, with mixed findings (Mayer et al., 2009; Nisbet & Zelenski, 2011). Wyles et al. (2019) tested different mediation pathways between nature contact, nature connection, and restoration, and concluded that there is likely a bi-directional, mutually reinforcing relationship between connection with nature and psychological restoration. The theoretical reasons for these associations remain speculative; some authors propose that those with a higher level of nature connection tend to seek out and benefit psychologically from nature more readily (Mayer et al., 2009), or position nature connection as a moderator of benefits of nature exposure (Shanahan et al., 2015), while others propose that psychological benefits of nature experiences strengthen level of connection with nature (Nisbet & Zelenski, 2011). By viewing psychological restoration and connection with nature together in this paper, including the intersections between them in mindful engagement processes, we begin to identify potential overlapping elements between the pathways in nature experiences that support these outcomes.

Cognitive engagement with nature is inherently critical to psychological restoration as described in ART (Kaplan & Kaplan, 1989). ART was developed to consider the recovery of directed attention fatigue in environments that have certain restorative qualities: environments that are *softly fascinating*, that evoke a sense of *being away* from everyday demands, have enough *extent* or scope to constitute an immersive experience, and are *compatible* with one's expectation and purpose. These properties are often considered as traits of a 'restorative environment', but might better be attributed as properties of the person-environment transaction (Hartig, 1993), with each mechanism reliant on how one cognitively engages with a nature experience. Two examples can be drawn to illustrate this. For soft fascination to occur, an environment should contain an interesting stimulus *and* the individual must be receptive enough to their environment that attention can be gently captured by that stimulus (Kaplan, 2001). Likewise, to experience a sense of being away from everyday demands, an environment should present physical differences to demanding situations, *and* the individual should be mentally engaged with that different environment (and not, for example, reading work emails). Although we acknowledge the key role of environmental properties for psychological restoration to occur, we focus on individual engagement as an underpinning attribute of all four restorative qualities of person-environment transactions.

In this paper we consider connection with nature as an outcome of nature experiences that explicitly depends on engagement with nature. Connection with nature has been conceptualised in various ways, including a state-like, experiential construct, where contact with nature fosters a stronger sense of connection with the natural environment (Mayer & Frantz, 2004), and as a trait-like construct, that represents one's identification with the natural environment (Clayton, 2003). Connection with nature has also been defined to encompass one's cognitive beliefs and attitudes towards nature (Brügger et al., 2011; Nisbet et al., 2009), emotional affinity towards nature (Kals et al., 1999), and behaviours and experiences in nature (Nisbet et al., 2009). Less attention has been given to how a connection with nature is formed and researchers have called for a better understanding on the mechanisms underpinning its development (Cleary et al., 2017). There is, however, some evidence that connection with nature can be strengthened through experiences. For example, spending time in natural environments (Lumber et al., 2017; Mayer et al., 2009; Nisbet et al., 2019) and viewing photographs of nature (Richardson & Sheffield, 2015) heighten one's sense of connection with nature. In this paper we explore psychological outcomes arising through transactional, person-environment experiences, so we focus on nature connection at the moment of development: that is, within the transaction itself.

Recent research by Lumber, Richardson and Sheffield (2017) explores connection with nature as it develops through nature experiences, identifying multiple 'pathways' to nature connection through specific forms of engagement with nature. The pathways to connection with nature are defined by Lumber et al. (2017), as: *contact*, the act of engaging with nature through the senses;

beauty, the perception of aesthetic qualities in nature; *meaning*, using nature to interpret or communicate a concept; *emotion*, an affective state that occurs as a result of engaging with nature; and *compassion*, extending the self to include nature, leading to a concern for other natural entities. Viewing these pathways within a transactional perspective can help to identify the different ways that individual engagement can support connection with nature, where pathways rely on both environmental and individual qualities. This can be illustrated for the contact with nature pathway: for one to experience *contact* with nature, there must be an environmental presence of natural elements, and the observer must perceive those elements as ‘natural’ features. Identifying the environmental and individual qualities of transactions that lead to both psychological restoration and nature connection allow us to more closely examine the range of factors that can support or constrain outcomes of nature experiences.

The role of individual engagement is important to understand across different forms of experiences in nature. We should not assume that the pathways to restoration and nature connection – and the role of engagement within those pathways – function in the same way across all contexts of nature experiences. For example, the sense of being away may be promoted by becoming immersed in a highly restorative natural environment; while in a constrained, non-immersive environment, being away may rely on selective engagement to aspects of the experience that achieve a sense of distance from work. To allow for exploration of the pathways to psychological restoration and nature connection in a wider range of contexts, a more detailed account of the operation and mechanisms of engagement in nature is needed.

3.5 Distinguishing forms of engagement with nature

Having established that both restoration and nature connection involve cognitive engagement with nature, we now take a closer look at different forms of engagement with nature. Specifically, we differentiate between mindful and other forms of engagement with nature by highlighting the distinctive qualities of mindful engagement. With existing empirical literature that shows associations between varied types of engagement and psychological outcomes, we propose that different forms of engagement might function to promote outcomes in a variety of ways.

Mindfulness is a term that may characterise a practice, a process, or a form of awareness, and needs to be clearly defined within the context of nature experiences. Kabat-Zinn (2003) defines mindfulness as a form of awareness that arises from a purposeful, nonjudgmental perception of the current moment. Some operational definitions of mindfulness distinguish between *to what* one attends, and *how* they attend. Cardaciotto et al. (2008) proposed a two-part model to conceptualise mindfulness: 1) the *behavioural component of mindfulness* (what one does), which involves awareness of the totality of experience, including the internal and external experience, and 2) *the way*

this behaviour is conducted (how one is mindful), which involves acceptance, nonjudgment, and openness. Similar models also include qualities such as curiosity and perceptual sensitivity (Bishop et al., 2006; Tanay & Bernstein, 2013). Drawing on this body of work, we use the term *mindful engagement* in nature experiences to refer to the intentional act of maintaining awareness of the ongoing internal and external experience, with curiosity and without reactivity or judgment. This form of mindful engagement in nature reflects open monitoring, a practice of mindfulness that is distinct from those that focus on specific objects of attention (Lutz et al., 2008).

There is evidence that some forms of mindfulness can support restoration in nature experiences, but the definitions and operationalisations of mindfulness vary widely in this literature and are not always theoretically clear. In studies of interventions of mindful engagement with nature, effects on psychological restoration outcomes have been reported, including attention (Lymeus et al., 2018), anxiety (Shin et al., 2013), and mood (Nisbet et al., 2019; Shin et al., 2013). While these studies point to the potential benefits of mindful engagement in nature for restoration, only one explicitly employs a design where a need for restoration is assumed (Lymeus et al., 2018). These studies define and operationalise mindfulness in different ways: for example, open monitoring mindfulness practice in nature (Lymeus et al., 2018), and mindful walking interventions that direct attention to physical and sensory phenomena (Nisbet et al., 2019; Shin et al., 2013). Further, the theoretical tenets of the mindfulness intervention are not made clear in some studies (e.g., Shin et al., 2013), creating ambiguity around the concept and application. We highlight here the need to clarify the theoretical underpinnings of mindful engagement in nature, and distinguish such interventions from other broad applications of engagement in nature.

Experimental studies have demonstrated that mindfulness practice can promote connection with nature (Aspy & Proeve, 2017; Choe et al., 2020; Nisbet et al., 2019; Wang et al., 2016). These studies also vary considerably in their approach to the mindfulness intervention, including a mindful walking intervention in nature (Nisbet et al., 2019); an intervention where participants were required to perform abstract cognitive tasks (Wang et al., 2016); and an audio-guided mindfulness intervention that directed participants to focus on the breath and body (Aspy & Proeve, 2017). While Choe et al., (2020) used a typical mindfulness program that likely fostered awareness of the external environment and thoughts and emotions, other interventions only direct focus to sensory (external) or physical sensations, and lack a central aspect of established approaches to mindfulness practice – awareness of thoughts and emotions. The approaches in this literature lack consistent alignment with mindfulness theory, hindering theoretical evaluation of the underlying processes and application in nature experiences.

As we turn our attention to other forms of engagement that have been used to promote psychological outcomes of nature experiences, we consider how other engagement concepts can be

understood in relation to the qualities of mindful engagement. Studies have demonstrated the efficacy of engagement exercises in improving numerous psychological benefits from nature experiences, including attention (Lin et al., 2014), psychological wellbeing and contentment (Duvall, 2011), memory (Unsworth et al., 2016), connection with nature (Lumber et al., 2017; Weinstein et al., 2009), and satisfaction with the environment (Duvall, 2011). These empirical studies use a variety of engagement exercises that tend to draw attention to either the *external*, sensory elements of nature, including the visual array of the environment; or to the *internal* experience where one notices thoughts and feelings associated with the environment (e.g. Korpela et al., 2017; Lin et al., 2014). Further, some engagement methods prompt some elaborative and judgmental qualities (for example, forms of engagement that promote noticing the “good things” in nature; Richardson & Sheffield, 2017).

The characteristics of mindful engagement offer a framework in which we can identify forms of engagement in terms of object of engagement (to *what* one engages) and the qualities of engagement (*how* one engages). Figure 3.1 highlights these key qualities of mindful engagement in nature experience, while drawing on these qualities to distinguish other forms of engagement in nature. Thus, engagement concepts are grouped into internally or externally oriented awareness, and into reactive/non-reactive quality of engagement (Figure 3.1). Figure 3.1 illustrates how mindful engagement is distinct from other engagement concepts, but also highlights overlapping qualities of some forms of engagement – for example, contact with nature and fascination involve nonjudgmental, external awareness. Figure 3.1 also presents concepts that show greater divergence from key qualities of mindfulness. The positioning of each form of engagement on the dimensional space in Figure 3.1 represents a way to understand our hypothesised portrayal of relationships between forms of engagement alongside qualities of mindful engagement. In the following section we examine the mechanisms through which mindful engagement heightens outcomes of restoration and nature connection, and consider associations with the other forms of engagement that lead to these outcomes.

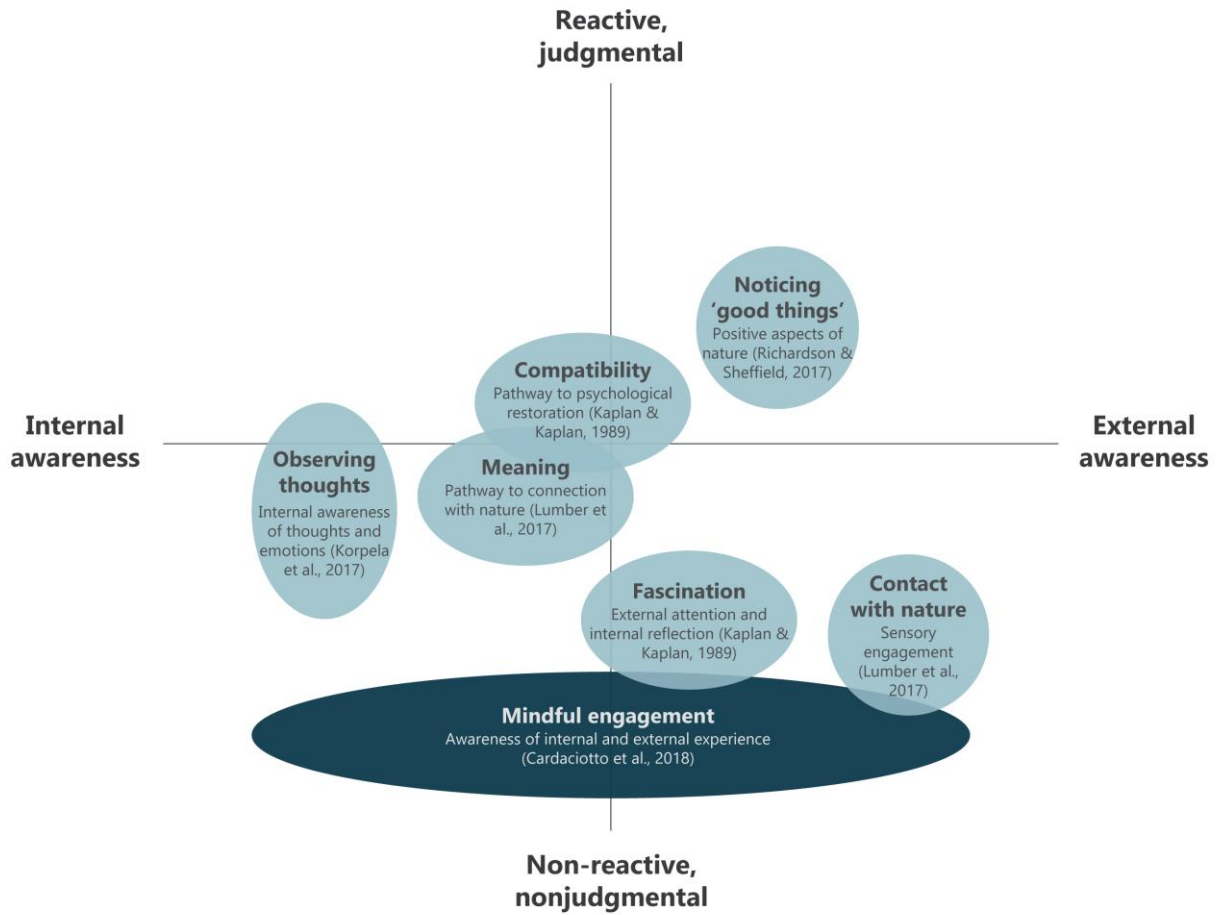


Figure 3.1. A representation of the qualities of mindful engagement and how other forms of engagement relate to these qualities. Mindful engagement involves internal and external, non-reactive and nonjudgmental awareness. Six other forms of engagement in nature are mapped to show how they relate to qualities of mindfulness. Position and form of each shape indicate whether forms of engagement would typically span across the dimensional qualities.

3.6 Mindful engagement in nature and psychological outcomes: proposed mechanisms

In this section we identify the key mechanisms that underpin the psychological benefits of mindful engagement in nature. Our first step is to appraise existing accounts in the literature for why mindful engagement in nature promotes psychological restoration and nature connection. We identify three main mechanisms of mindful engagement in nature: perceptual sensitivity, decentering, and non-reactivity. Drawing on theoretical mindfulness models (Bishop et al., 2006; Hölzel et al., 2011; Tanay & Bernstein, 2013) to review these explanations, we develop an integrated model that highlights the multiple dimensions of mindful engagement and psychological outcomes in nature experiences. Second, we more closely examine the links between these mechanisms and pathways to

restoration and nature connection, and suggest specific mindful engagement pathways that support these outcomes.

A common explanation in the existing literature is that mindful engagement heightens perceptual sensitivity of the experience. Mindful engagement enhances awareness of the environment, thus supporting restoration through fascination (Nisbet et al., 2019), curiosity and openness (Lymeus et al., 2018). Relatedly, authors argue that mindful engagement intensifies experiences in nature – through enhanced sensory impact and present-moment awareness – and thus the potential of connecting with nature is strengthened (Barbaro & Pickett, 2016; Howell et al., 2011). This is consistent with models of mindfulness. In a review of mindfulness models that depict the mechanisms underpinning mindfulness and wellbeing outcomes, Hölzel et al. (2011) establish attention regulation as a central mechanism that acts a ‘pre-requisite’ for other mechanisms, including body awareness. Further, Tanay and Bernstein (2013) highlight perceptual sensitivity as a quality of mindful awareness, where there is a heightened sensory experience that arises through mindfulness.

Authors have suggested that a change in perspective on the self through mindful engagement may support restoration (Lymeus et al., 2018) and connection with nature (Hanley et al., 2017). The change in perspective on the self refers to a sense of ‘detachment’ from identifying with the self and other internal experiences (Hölzel et al., 2011), also referred to as *decentering*. Decentering can be defined as observing cognitions as transitory mental events rather than centrally representative of self-worth or truth (Baer, 2009). The process of decentering in mindfulness creates psychological distance from thoughts and emotions, and worries with daily life become less intrusive. With regard to restoration in nature, Lymeus et al. (2018) suggest that mindful decentering allows an individual to be grounded in present experience and may strengthen the sense of *being away*, supporting restoration in nature experiences. Hölzel et al. (2011) refer to even minor changes in how one identifies with their internal experiences as a change in perspective on the self, and find this to be a central mechanism underpinning mindfulness and wellbeing outcomes.

Hanley and colleagues (2017) argue that deidentifying with the contents of consciousness provides opportunity for stronger identification with and involvement in the external environment, and connection with nature is subsequently strengthened. In support of this theory, results from two studies find that decentering partially mediates the relationship between mindfulness (specifically factors of *observing* and *non-reactivity*) and connection to nature (Hanley et al., 2017), and that decentering is associated with self-transcendence (Hanley et al., 2018). Taken together, results suggest that through the practice of mindfulness, and specifically the facets of observing (or awareness) and non-reactivity, one deidentifies with their subjective experience, can become more grounded/present in the natural environment, and has an expanded self-concept that allows one to

connect more deeply with the external world. These findings also highlight the interdependencies between mindfulness mechanisms – observing, non-reactivity, and decentering.

Emotion regulation and non-reactivity to the internal experience are related mindfulness mechanisms (Hölzel et al., 2011) and may be particularly involved in the association between mindful engagement and nature connection. Non-reactivity to thoughts and emotions is the ability to allow thoughts to come and go without elaborating on them (Baer et al., 2008). Some authors maintain that mindfulness is effective in strengthening connection with nature because it is a shift in perspective that is required to overcome cognitive limitations, such as pessimistic attitudes towards nature (Aspy & Proeve, 2017), and a typical mindset that ‘human’ is wholly separate from ‘nature’ (Wang et al., 2016). These explanations, however, seem to reflect a form of cognitive *reappraisal*, rather than an accepting ‘non-appraisal’ that would develop from a non-reactive and nonjudgmental mindful awareness (for contestations on the role of appraisal in mindfulness, see Chambers & Hassed, 2015; Chiesa et al., 2013; Garland et al., 2015). In contrast, we position non-reactivity (and *non-appraisal*) to be key mechanisms involved in the process of mindful engagement in nature, that facilitate the regulation of internal responses within nature experiences. This is consistent with evidence that non-appraisal in mindfulness is associated with connection with nature (Hanley et al., 2017). Further, we draw on an established operational framework of mindful open monitoring, where emotions and cognitive reactions are monitored with a non-reactive orientation (Lutz et al., 2008). This framework has previously been applied in nature experiences (Lymeus et al., 2018), supporting the notion that an open orientation in nature can support psychological outcomes. Non-reactivity in nature experiences may strengthen the potential for nature connection through regulating negative reactions to challenging aspects of the experience.

Having identified three central mechanisms, we propose how each can support psychological restoration and nature connection through nature experiences. The regulation and grounding of attention in the present experience is required to enable these mechanisms (Hölzel et al., 2011), along with an awareness characterised by openness and curiosity. First, mindful engagement heightens sensitivity to perceptual experiences in nature – through enhanced sensory impact and present-moment awareness (Barbaro & Pickett, 2016; Howell et al., 2011; Nisbet et al., 2019). Second, mindful engagement leads to decentering, where a detachment from the subjective experience allows one to fully engage with their experience in nature. Third, non-reactivity is proposed to link mindfulness to nature connection (Hanley et al., 2017), where mindful engagement can overcome unhelpful thought patterns relating to the distinction between ‘human’ and ‘nature’ (Wang et al., 2016).

The links between these mechanisms and the pathways to psychological restoration and connection with nature are specified in Figure 3.2. Not all pathways identified as important to nature

connection and psychological restoration are fully consistent operationally with mindful engagement because they may involve a level of reactivity or judgment. The meaning and compatibility pathways (Lumber et al., 2017; Kaplan, 1995), for example, may involve a degree of judgment in nature. To provide clearer links between all pathways and mindful engagement, we suggest non-reactive/nonjudgmental forms of engagement that would support the pathways to restoration and nature connection.

With this model of mindful engagement in nature, we aim to more clearly depict how engagement may lead to improved psychological outcomes. This leads to the possibility of examining contexts beyond highly restorative nature experiences and exploring when and how the mechanisms of engagement in nature function. In the next section we build upon previous literature that explores mindful engagement in restorative natural environments (Lymeus et al., 2017, 2018), and consider how mindful engagement may be applied in constrained nature experiences.

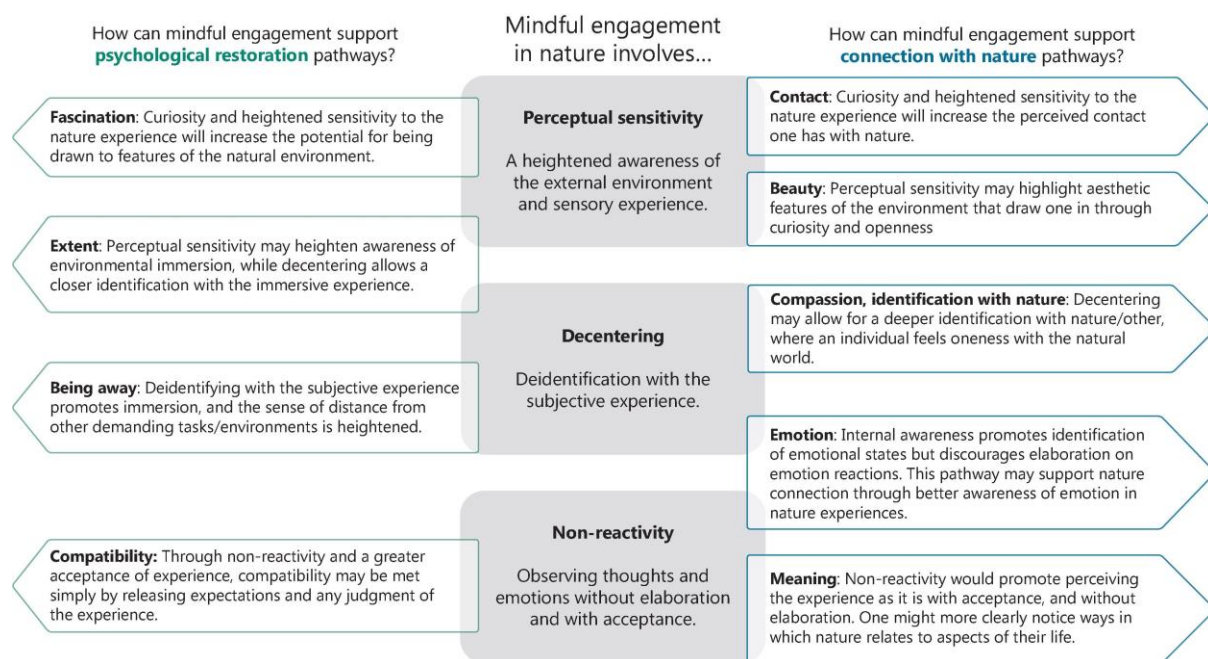


Figure 3.2. Conceptual model representing how mindful engagement functions within a nature experience. Perceptual sensitivity, decentering and non-reactivity arise through mindful engagement in nature and support psychological restoration and connection with nature. Overlapping text boxes represent links between mindful engagement mechanisms and pathways to outcomes. Two pathways (extent and emotion) connect with two mindful engagement mechanisms.

3.7 Applying mindful engagement to constrained nature experiences

While we have developed our model considering engagement in restorative nature experiences, people often encounter nature in urban settings where the experience of nature may be somewhat

constrained – for example, noisy, busy, green spaces. There is reason to question whether the mechanisms underpinning engagement and related psychological outcomes would function in the same way across settings of varying levels of restorativeness and constraint. For example, forms of engagement that adopt only external awareness in nature may be particularly beneficial in more restorative environments (Howell et al., 2011). Here, perceptual sensitivity to the aesthetic and enjoyable qualities of the environment may lead to better restoration and connection with nature, and other mechanisms may not be so involved. In environments that are somewhat constrained – such as busy urban green spaces or unattractive landscapes - heightened perceptual sensitivity alone may not be adequate to support these benefits. We argue that mindful engagement would be valuable in these contexts, where internal awareness and self-regulatory mechanisms of decentering and non-reactivity can mitigate negative qualities of the subjective experience. In this section we demonstrate how mindful engagement mechanisms might function in a constrained environment. We first consider examples of constraining situations in nature experiences and illustrate how constraints on psychological outcomes occur.

Constraints on psychological outcomes of nature experiences may occur in two general ways. First, circumstances may limit access to high quality natural environments that are usually relied upon for restoration and nature connection. Second, the qualities of nature experiences that lead to these outcomes (for example, fascination, or meaning), are reduced or impacted (von Lindern et al., 2013). In practice, these two forms of constraint may interact to impact psychological outcomes. For example, if illness or injury prevents one from travelling to a highly restorative natural environment (limited access), that person is restricted to nature experiences close to or in their home and over time, their sense of being away in that experience is diminished. Considering the interaction of these two general forms of constraint is helpful when discussing common, everyday experiences of nature. Previously, von Lindern et al. (2013) have outlined these forms of constraint with regard to restoration, but to our knowledge, connection with nature has not been explored in relation to constraining circumstances.

Everyday nature experiences provide us with some contexts that are useful in exploring constraints on restoration and connection with nature. Examples of situations that limit access to natural environments include illness (Duggan et al., 2008), old age (van Heezik et al., 2020), and poor weather (Duffy & Verges, 2010) – we extend this to include the circumstances associated with the COVID-19 pandemic restrictions, as well as nature experiences in the urban environment. The restrictions associated with the COVID-19 pandemic may constrain restoration and nature connection because of restrictions on movement and access – for example, although far from ‘everyday’ circumstances, in Victoria, Australia, public health measures were introduced including limited outdoor gatherings and restricted travel beyond a certain distance from the home (Saul et al., 2020). In these contexts, access to high quality natural environments is limited, and nature experiences may

become confined to nature around one's home. However, during strict lockdowns in Australia, those with access to nearby green spaces tended to visit green spaces more, and experiences were potentially more meaningful due to the imposing demands of lockdown (Astell-Burt & Feng, 2021). Living in an urban environment more generally can also present constraints on restoration and nature connection, as work and social responsibilities may limit opportunities to access and be restored by high quality natural environments (Hartig et al., 2003; Staats et al., 2016; von Lindern et al., 2013).

Psychological outcomes of everyday nature experiences may be hampered via an impact on the transactional qualities that lead to restoration or connection with nature. Studies have demonstrated that the following factors negatively impact the quality of urban green spaces for psychological restoration: traffic, city noise, poor design (Mesimäki et al., 2019; Nordh & Østby, 2013; Peschardt et al., 2016; Taylor et al., 2019), environmental reminders of the work place or of demanding situations (von Lindern, 2015), and congestion/presence of others (Arnberger & Eder, 2015; Nordh & Østby, 2013). The listed factors may impact restorative qualities through, for example, reduced fascination with the environment or a disrupted sense of being away from demanding situations, and we suggest that mindful engagement with the nature experience would be beneficial in mitigating these impacts. Proposed links between specific mechanisms and the restorative qualities of nature experiences that may be impacted by constraining factors are shown in Figure 3.3.

A significant constraining factor on feeling connected with nature in everyday urban nature experiences seems to be a restricted perception of 'nature', and we suggest that mindful engagement can be implemented to notice and re-engage with nature in urban environments. The perception that urban green spaces are *not* 'nature' can be pervasive in some instances to the extent that individuals do not believe they can connect with nature in these spaces (Earl & Heinitz, 2017). Indeed, it is common for people to underestimate the capacity for urban nature to provide emotional benefit and foster connection with nature (Nisbet & Zelenski, 2011). Underlying these beliefs appears to be perspectives of what 'nature' is relative to humans and the built environment; that is, whether one considers urban green space within one's definition of nature, or excludes it. For instance, respondents in some studies perceive nature to be characterised by the absence of human-made objects or artifice (Church, 2018; Earl & Heinitz, 2017), which may be driven by the widespread ideal of nature as pristine wilderness (Cronon, 1996; Dickinson, 2018). In a qualitative study on perceptions of urban green roofs, Loder (2014) found that some participants felt that any form of wildlife or plants is nature – including those on an urban roof – while others believed nature to be 'out there' and untouched by humans. We argue that a restricted perception of what 'nature' is can constrain the qualities or pathways that lead to nature connection, such as reduced perceived *contact* with nature. Mindful engagement in urban nature experiences may support the perspective that urban green spaces *are* 'nature', and overcome this constraint on connection with nature in everyday nature experiences.

Where constraining factors disrupt the beneficial qualities of nature experiences, mindful engagement can be employed to redirect attention, respond to internal phenomena with less reactivity, and gain clearer perspectives of the ongoing external and internal experience. The mechanisms underpinning mindful engagement and enhanced psychological outcomes (Figure 3.2) may be particularly applicable to constrained experiences, where negative perspectives or reactions to constraining factors benefit from self-regulation strategies such as non-reactivity and decentering. Figure 3.3 builds on the pathways outlined in Figure 3.2: with examples of constraints on the beneficial qualities in nature experiences, we use these pathways to demonstrate how mindful engagement may operate to support psychological restoration and connection with nature in constrained settings. While the mechanisms remain consistent, we specify slight differences in how mindful engagement may function in constrained nature experiences: for example, the benefit of decentering in a restorative experience may be greater immersion in the (external) restorative environment, while in a constrained experience decentering may provide some psychological distance from negatively impactful aspects of the experience and support the potential to gain a sense of being away. These insights are useful in broadening the research on engagement to wider contexts, where we can specify how engagement functions in different types of nature experiences.

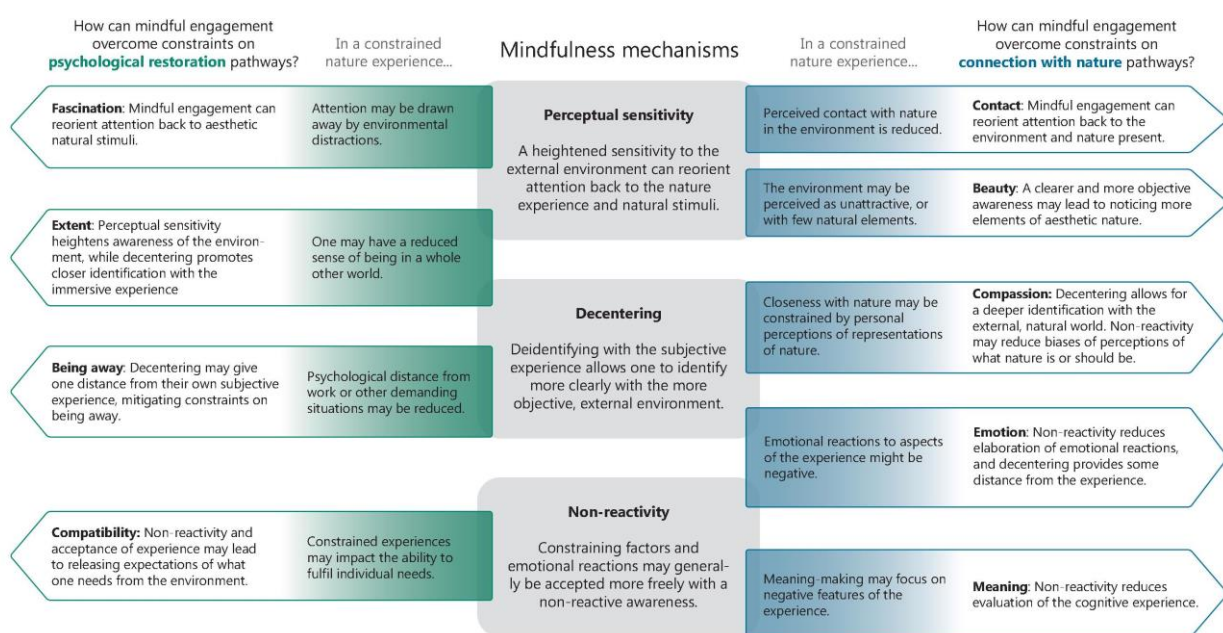


Figure 3.3. Mindful engagement overcoming constraints in nature experiences. Examples of constraints on each pathway to psychological outcomes are shown, and the outer pathways represent how mindful engagement mechanisms may mitigate these constraints.

3.8 Future research directions

Drawing from existing approaches in the literature we provide recommendations to advance research on the benefit of mindful engagement in nature experiences, and summarise these future research directions and questions in Table 3.1. First, the connection with nature pathways (Lumber et al., 2017) that our model draws upon need to undergo more empirical testing to understand how each pathway actively contributes to a sense of connection with nature. An approach to exploring the contribution of each pathway might be to examine them separately and analyse potential mediating pathways. To analyse the separate and combined contribution of these pathways, an effective instrument is required. Richardson et al. (2019) developed the Nature Connection Index (NCI) for children and adults, which is based off the proposed pathways to nature. However, the NCI measures a trait-like nature connection, and would not be suitable to measure the contributions of pathways through nature experiences. A self-report scale that measures state-like, experiential connections via each pathway (such as the Perceived Restorativeness Scale that measures theoretical components of psychological restoration; Hartig et al., 1997) would be a valuable future research effort. The development of such a scale would enable evaluation of the pathways and a better understanding of how nature experiences lead to nature connection.

Second, further research is required on constraining factors of nature experiences. There is some research on constraints on restoration through nature experiences, and we suggest this research could provide a model for evaluating constraints on nature connection pathways. For example, over two studies, von Lindern and colleagues (2015; 2013) aimed to find out whether various forms of constraint would negatively impact restoration via a reduction in the sense of being away. Other research has examined the environmental features of different sites that may contribute to or constrain psychological effects of nature experiences (Janeczko et al., 2020). However, consideration of multiple aspects of constraint (including subjective experiences and attitudes) is important, as some results suggest that measuring only environmental factors is not enough to detect differences in restorative outcomes of different environments (Janeczko et al., 2020). These approaches offer directions for testing constraints on opportunities to connect with nature, provided measures of nature connection pathways are available. For instance, studies could be designed to determine how factors (for example, perceived naturalness of urban green space) constrain connection with nature, using models that include the pathways as potential mediators.

Third, a key area for future research is empirical testing of our mindful engagement model, including the role of specific mindfulness mechanisms in promoting psychological outcomes of nature experiences. A first step towards this is testing whether mindful engagement interventions in nature lead to an increase in state mindfulness during that experience (above and beyond groups that do not participate in mindful engagement interventions). Previous empirical studies have used state

mindfulness measures immediately after nature experiences (for example, Nisbet et al., 2019; Stewart & Haaga, 2018), which are sensitive to differences between experimental groups. Our model involves three main mechanisms that underpin the association between mindful engagement in nature experiences and improved psychological outcomes: perceptual sensitivity, decentering, and non-reactivity. The relative contributions of these mechanisms to psychological benefits of nature experiences should be critically evaluated, by testing the mediating roles of each mechanism (see Coffey et al., 2010, for an example of this statistical approach in a cross-sectional design). The role of different mechanisms may differ across population groups (for example, experienced and unexperienced mindfulness practitioners), and in different environments.

Table 3.1. Summary of future research directions and questions

Topic	Questions
Assessing connection with nature pathways	• Do proposed pathways lead to a sense of connection with nature? • What is the contribution of each proposed pathway in developing a sense of connection with nature through nature experiences?
Constraints on restoration and connection with nature	• What factors constrain restoration and/or connection with nature in experiences with everyday nature – e.g., urban environments, nature at home? • How do certain factors or situations constrain psychological benefits from nature experiences (i.e., via which pathways)?
Mindfulness mechanisms and their role in boosting psychological outcomes	• Are changes in psychological outcomes seen in mindfulness interventions in nature the result of increased state mindfulness? • To what extent are the proposed mindfulness mechanisms involved in enhancing psychological outcomes of nature experiences?
Role of environment on mindful engagement	• Can mindful engagement be feasibly applied by the general population in constrained circumstances? • Is mindfulness more beneficial in environments that are somewhat constrained, rather than highly restorative/unconstrained environments?

Finally, we recommend that future research explores the role of the environment on mindful engagement in nature experiences. In this paper, we argue that mindful engagement may be more beneficial in environments that are somewhat constrained, in comparison to environments that are highly restorative and unrestricted in their capacity to provide psychological benefit. However, research conducted by Lymeus and colleagues (2017) suggests that a restorative environment is

important in supporting mindfulness practice, particularly for novice practitioners. Further, while open monitoring mindfulness practice requires less effort than other mindfulness practices such as focused attention (Lutz et al., 2008), it is likely more effortful for novice practitioners than for more experienced meditators (Lutz et al., 2015), so the question arises whether mindful engagement is feasible for the general public in constrained environments. A second question is, if mindful engagement can be usefully applied in constrained circumstances, are the benefits greater than the use of mindful engagement in unconstrained, or more restorative environments? We recommend exploring these questions in future research to understand the best practice of implementing mindful engagement in nature experiences.

3.9 Conclusion

Our primary goal in this paper was to develop a theoretical model of how mindful engagement in nature experiences supports psychological restoration and connection with nature (Figure 3.2). Empirical studies have demonstrated the effects of engagement and mindfulness on psychological outcomes, and some authors have provided explanations for the underpinning mechanisms. We work from a theoretically grounded knowledge of mindfulness to draw together these lines of thoughts, and clearly articulate the multiple mechanisms associated with mindful engagement in nature and psychological outcomes. Such an approach provides a step towards more rigorous intervention design of mindfulness in nature experiences, where proposed mechanisms can be tested and appraised empirically. The integrated model presented in this paper provides a basis for examining other contexts of nature experiences, including constrained nature experiences as we have done in this paper.

This paper highlights the value of an interdisciplinary approach to the field of nature and health. Applying theory from mindfulness and environmental psychology literatures to the built environment in the context of constrained urban nature advances the discussion beyond mere exposure to nature, to draw attention to the impact of individual agency and engagement in nature. There are practical implications of this for urban green space design and use. Everyday nature experiences or interactions may be constrained to some degree – for example, in the busy urban setting, on work breaks, or in the home environment – and improving urban health and liveability through experiences of urban green space and nature is important. Of course, a necessary area of this work is in developing green infrastructure in the built environment for health and wellbeing. By demonstrating the factors in the urban environment that may constrain the processes that lead to positive outcomes, we highlight the importance of individual cognitive strategies, where an individual can improve health and wellbeing opportunities in the urban context by engaging mindfully with nature. We believe that these approaches complement and support each other and should be considered alongside each other: high

quality urban green space should be made accessible for all, and so too should the ability and opportunity to engage with nature in green spaces effectively.

3.10 References

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4 Chapter 4.

‘Letting my mind run wild’: Exploring the role of individual engagement in nature experiences

4.1 Overview

This chapter examines the experience of urban nature with a qualitative interview study. The purpose of this chapter is to provide an exploratory foundation for the understanding of individual engagement in nature, and how engagement relates to aspects of the nature experience and outcomes. The contribution of this chapter to the thesis is providing a holistic, transactional account of how individual engagement in nature functions alongside personal and environmental contexts of the nature experience.

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4.2 Abstract

Mindfulness and mind wandering are among distinct forms of cognitive engagement proposed to occur during nature experiences. Little is known however about how these forms of engagement support psychological benefits of urban nature experiences, and under what environmental and personal circumstances. We aimed to explore these associations through interviewing 20 individuals after they had spent time in an urban green space on a work break. Interviews examined different aspects of their experience, including how they cognitively engaged during that time. We used a framework approach to thematically analyse interviews, allowing us to identify links between key experiential categories such as form of engagement and environmental context. As a result, we describe five common forms of engagement during urban nature experiences: heightened sensory engagement, allowing the mind to wander, mindful engagement, negative judgment of the experience, and acceptance of experience. Further, we identified associations between forms of engagement, the contextual attributes of the experience, and psychological outcomes. For instance, participants who reported mind wandering during the experience often explained this as a response to work-related stress and subsequently reported feeling a sense of psychological distance from work. By examining such associations in the current study, we contribute insights into the subjective experience of engagement in urban nature and demonstrate the value of considering individual engagement alongside other key attributes of urban nature experiences.

4.3 Introduction

Empirical research has shown that a heightened level of cognitive engagement in nature experiences can lead to better psychological outcomes. Engagement in nature can be defined as a conscious awareness of experiential aspects of being in nature (Macaulay et al., 2022). Our definition of engagement is founded on the concept of mindfulness, encompassing cognitive processes of attention to and awareness of all mental phenomena during a nature experience (Bishop et al., 2006; Cardaciotto et al., 2008). Engagement can thus be objectless (e.g., open monitoring, Lymeus et al., 2018), external (noticing the environment, e.g., Lin et al., 2014), or internal (oriented towards thoughts and emotions, e.g., Korpela et al., 2017), and can have different qualities (for example, ‘effortless’ fascination, Kaplan & Kaplan, 1989; or nonjudgmental sensory awareness, Nisbet et al., 2019). Research has shown that individual engagement can play a key role in shaping the outcomes of a nature experience: heightened sensory engagement in nature increases positive emotions (Ballew & Omoto, 2018), mindfulness in nature leads to stronger nature connection (Nisbet et al., 2019), and mind wandering in nature may support attention restoration and creativity (Williams et al., 2018). Yet the diversity of engagement concepts in the literature prompts questions of how different forms of engagement support outcomes of nature experiences, and under what circumstances. The function and role of engagement in nature is likely influenced by both environmental characteristics, such as landscape design, and personal attributes, such as familiarity with the environment. These contextual attributes may give insight into the circumstances that constrain or support engagement within nature experiences. To date, however, the association between context and engagement has not been explored empirically.

4.3.1 Contextual attributes of nature experiences

Characteristics of the environment and person contribute to and shape the experience of nature across different settings and are inevitably involved in shaping the form of engagement that occurs. We draw on past theoretical models (Gobster et al., 2007; Marselle et al., 2021), to broadly categorise contextual attributes into two types – environmental and personal. Although previous models have positioned these as factors that *moderate* the influence of nature experience on certain outcomes, we consider contextual attributes as *forming* the nature experience. This small conceptual shift reflects a divergence from typical interactional perspectives of human-nature relationships, and enables a transactional approach that considers the entire unfolding nature experience (Hartig, 1993), including how an individual engages within the experience. This approach is consistent with the focus of this paper, which treats engagement as embedded within the context of a nature experience. To explore the associations between engagement and context, we consider processes where environmental and personal context intersect: pathways to psychological outcomes of attention restoration (Kaplan, 1995) and nature connection (Lumber et al., 2017).

A first step in understanding these relationships is to identify common contextual attributes that contribute to the potential of a nature experience to promote psychological benefit. Environmental factors found to impact the restorative potential of urban green spaces include traffic and city noise (Nordh & Østby, 2013; Taylor et al., 2019), design of the space (Nordh & Østby, 2013; Peschardt et al., 2016), congestion (Arnberger & Eder, 2015), presence of the built environment, and quantity of vegetation (Mesimäki et al., 2019). Personal contextual factors that impact outcomes of spending time in nature include current individual needs for restoration (Colley et al., 2017; Degenhardt & Buchecker, 2012) and level of nature connection (Nghiem et al., 2021). Work-related factors also impact the experience of nature: while nature breaks from work are shown to benefit cognitive performance and mood (e.g., de Bloom et al., 2017), studies have shown that level of demands at work (Colley et al., 2017) and whether one's profession relates to the environment (von Lindern et al., 2013) both impact the restorative potential of visiting nature. Other studies focus on the intersection of environmental and personal context, demonstrating the importance of considering the holistic experience of nature (e.g., Stoltz & Grahn, 2021).

We build on this foundation by examining the intersection of environmental context, personal context, and the role of cognitive engagement, in pathways to key psychological outcomes of nature experiences. Attention restoration theory (ART; Kaplan & Kaplan, 1989) proposes mechanisms through which environments can promote psychological restoration: a soft fascination with the environment, a sense of being away from everyday demands, the feeling of being in a whole other world, and compatibility between what an individual needs and what an environment provides. Lumber et al. (2017) identified mechanisms that strengthen nature connection during nature experiences: sensory contact with nature, finding aesthetic qualities in nature, experiencing emotion in nature, drawing meaning from nature, and feeling compassion or concern towards nature. We argue that these processes all rely on involvement from both an individual and their environment, and that engagement plays a key role within these processes. For example, the degree of awareness one has in an environment is likely to impact one's appreciation of aesthetic qualities in a natural environment. Although these pathways highlight the involvement of environmental characteristics, personal context and engagement in nature experiences, empirical exploration is needed to identify specific associations between them. To achieve this, engagement should be considered alongside contextual attributes when examining how pathways to psychological outcomes unfold within a nature experience (Figure 4.1). We consider engagement in nature an emergent phenomenon, temporally bounded within the nature experience itself. Thus, engagement is represented as a distinct component of the nature experience that may evolve through complex associations within the personal and environmental context. Figure 4.1 illustrates our contention that individual engagement plays a central role in shaping the nature experience and subsequent psychological outcomes.

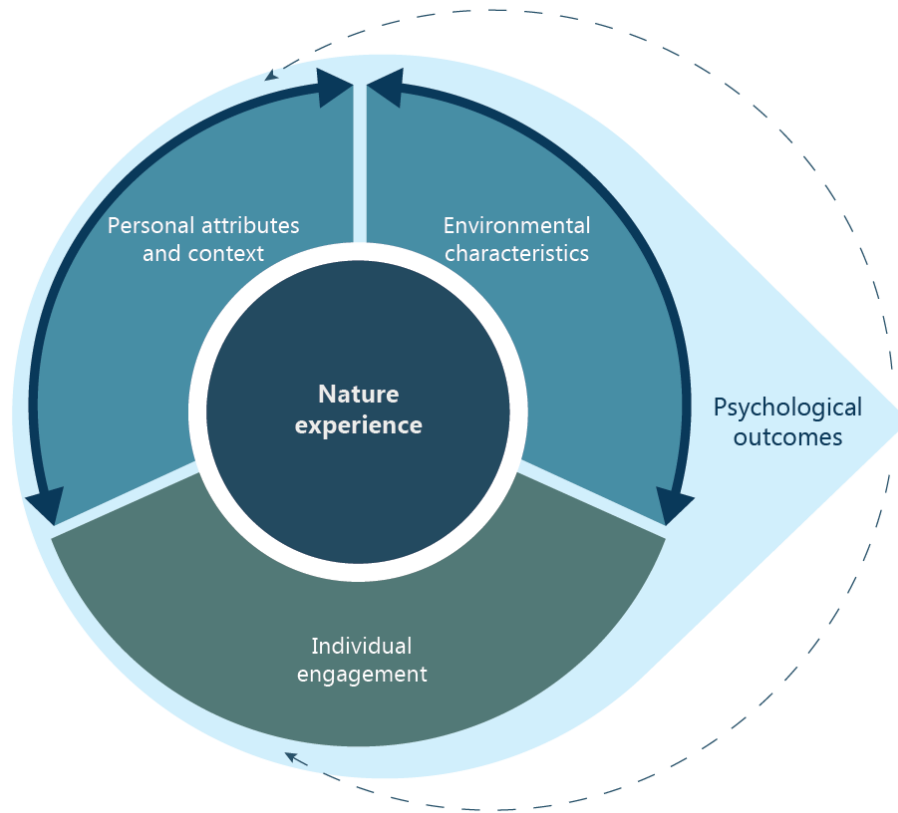


Figure 4.1. Associations between contributing factors within a nature experience. Psychological outcomes (e.g., attention restoration, connection with nature) occur within the nature experience, and beyond the direct experience – dashed lines represent likely links back to personal attributes and individual engagement in nature.

4.3.2 Cognitive engagement in nature

We propose that a key element of the experience of nature is how an individual cognitively engages within that experience. In this section we outline a framework for understanding and defining engagement in nature. We then outline two forms of engaging in nature: mindfulness and mind wandering. Both concepts illustrate how engagement in nature can play a key role in pathways to psychological outcomes. The comparison between them reveals ways that engagement may function differently across contexts, demonstrating the need to examine engagement in relation to contextual attributes of nature experiences.

Forms and qualities of engagement in nature are diverse and need to be understood clearly in order to address their function across contexts of nature experiences. Our starting point for defining and distinguishing forms and qualities of engagement in nature draws on the concept of mindfulness (Macaulay et al., 2022). Mindfulness involves paying attention to the present moment, with curiosity and acceptance, and without judgment or reactivity (Bishop et al., 2006; Kabat-Zinn, 2003). Mindfulness has been conceptualised as an ongoing monitoring of the total experience, including

internal (mental events) and external (sensory information) awareness (Cardaciotto et al., 2008). Applying mindfulness to understand broader concepts of engagement offers a way to classify what individuals engage with (internal or external awareness) and how they engage (with or without judgment and reactivity). We recognise that not all forms of engaging in nature can be understood completely with this framework of mindfulness. However, the framework provides a basis to understand and interpret qualities of various forms of engagement in nature experiences.

Mindfulness has been applied to nature experiences and supports outcomes including attention restoration (Lymeus et al., 2018), mood and nature connection (Nisbet et al., 2019; Unsworth et al., 2016). However, the qualities of the environment may impact the ability to be mindful: Lymeus et al. (2018) found that a highly restorative natural environment supports beginners' experiences of practising mindfulness, and that an indoor, less restorative environment can put strain on one's experience of practising mindfulness. Other factors – such as individual needs and capacities – may influence the ability to engage mindfully (Brown & Ryan, 2003), however to our knowledge, this query has not been explored in the context of nature experiences.

Theoretical work has also examined the role of mind wandering within nature experiences (Williams et al., 2018). Mind wandering involves internally oriented attention, where thoughts are not related to the present task (Smallwood & Schooler, 2006). Williams et al. (2018) proposed that mind wandering in nature may support attention restoration via a synergistic process where attention moves between mind wandering and soft fascination. While some authors have positioned mind wandering as opposite to mindfulness (e.g., Mrazek et al., 2012), others have placed these and other forms of awareness on spectrums of experiential dimensions, such as meta-awareness, object orientation and clarity (Lutz et al., 2015; Vago & Zeidan, 2016). For example, while meta-awareness is a quality that is typical of mindfulness, one may experience a moment of meta-awareness while they are mind wandering (e.g., realising that the mind has wandered; Lutz et al., 2015). The attention that both mindfulness and mind wandering have received in the context of nature experiences, along with the complex association between them, urges further examination of the function of different forms of engagement in nature.

This study seeks to qualitatively examine engagement under a range of individual experiences in urban nature. The study aims to answer a) how do people engage within urban nature experiences; b) how are environmental characteristics and personal context associated with engagement within an urban nature experience; and c) how is engagement in nature associated with the psychological outcomes of an urban nature experience? This qualitative, semi-structured interview study addresses calls for richer, in-depth analysis of the experience and benefits of nature (Kosanic & Petzold, 2020; Russell et al., 2013). Further, this method enables exploration of the subjective experience of engagement across different nature experience contexts.

4.4 Method

Semi-structured interviews were conducted with individuals after they spent some time in an urban green space on a work break, and interviews were analysed using a thematic, framework approach. To achieve the aims outlined above, our objective was to analyse a wide range of experiences of nature. Our strategy to achieve this was to have a diverse sample of personal and environmental contexts, by recruiting a variety of participants and selecting diverse sites to visit (i.e., some participants visited low-vegetated, noisy environments, and others visited more nature-rich, restorative green spaces). Restrictions associated with the COVID-19 pandemic were introduced part-way through the study, resulting in some participants selecting sites near their homes. Data from participants visiting researcher-selected sites and participant-selected sites were analysed together, as the altered method was consistent with study aims of exploring diverse personal and environmental contexts under which urban nature could be experienced.

4.4.1 Participants

A sample of 20 adults (six males) aged between 24 and 55 years ($M = 41.9$, $SD = 10.3$), were recruited through a combination of online advertising and snowball sampling. An advertisement for the study was sent in online newsletters to staff at the University of Melbourne, and in newsletters of nearby organisations. Eleven interviews were conducted in-person at green spaces nearby to participants' workplaces. The remaining 9 interviews were conducted after COVID-19 restrictions were introduced, so were held via Zoom after participants had visited a green space near their home or workplace – these different procedures are detailed below. Sample characteristics (age and gender) were comparable between those interviewed in-person and via Zoom. Recruitment and interviewing continued until a rich dataset was obtained that included sufficient information of the varying and in-depth experiences of nature on a work break and allowed for analysis of patterns within and across interviews, to achieve our study aims (as per Braun & Clarke, 2021). All participants lived in the Melbourne area and were reimbursed with a \$20 gift card for their time. The study was approved by the Faculty of Science Human Ethics Advisory Group, University of Melbourne (ID: 1955500.2).

4.4.2 Procedure

All participants were asked to take a work break and spend 20 minutes by themselves in an outdoor environment. Up to 20 minutes spent in nature has shown to have restorative benefits (e.g., Jiang et al., 2019; Nisbet et al., 2019) and is a feasible amount of time for a work break in nature (Brown et al., 2012). Participants were told that aspects of the experience would be explored during the interview, but specification of the types of questions or concepts (e.g., engagement, nature connection) was not disclosed. Following this 20-minute experience, participants took part in an interview with the first author, either on-site or via Zoom. The interview protocol was developed in

line with the theoretical framework developed above (Figure 4.1) and study aims. Questions were designed to understand the potential environmental and personal contexts impacting their experience in nature (e.g., environmental constraints, and personal perspective of ‘nature’), how participants interacted and engaged within their experience (e.g., attention, awareness of thoughts), and the types of psychological outcomes of their experience (Table 4.1). Interviews lasted between 15 and 33 minutes and were audio-recorded and transcribed. The interview content and structure were consistent for the participants interviewed in-person and those interviewed via Zoom.

Table 4.1. Interview protocol with categories and example questions

Interaction with the environment
What did you do during the experience?
Thoughts and emotions about the experience
Do you recall any thoughts during the experience that you could describe?
Attention / awareness in the experience
What did you pay attention to while you were here?
Impacts on experience
Was there anything in the environment that detracted from your experience here?
Anticipated outcomes of spending time in the environment
How do you think you will feel after spending time here today?
Perception of place
Do you perceive this place to be natural, or somewhere you can be in nature?

For the first 11 interviews, participants visited an urban green space chosen by the researchers. To address the range of environmental characteristics that might be associated with engagement, we selected urban green spaces that varied on a range of environmental factors that are known to impact restorativeness (for example, amount of vegetation, presence of water, noise; Nordh & Østby, 2013). The sites were considered suitable for the study purposes, as they were close to the university campus where participants worked, and had walkways and space for seating. Of the 11 participants interviewed in-person, four participants visited a less restorative site, three visited a mid-range restorative site, and four visited highly restorative sites. The remaining 9 participants, who were interviewed after COVID-19 restrictions were introduced, were asked to select an urban green space that was nearby their working environment, with the following instructions: *The environment that you decide on should have some elements of ‘nature’, such as plants, trees, birds, waterways, sky.* There were a range of outdoor space types visited by these participants: a home balcony or backyard (two participants), nearby park or greenspace (five participants), nearby urban square (two participants).

Participants provided verbal descriptions and photographs of these environments. The researcher-selected and participant-selected sites represented a range of the types of experiences in outdoor environments that one can have on a work break, varying on environmental features known to impact restorativeness. This diversity is demonstrated in Figure 4.2. and Figure 4.3. Participant identifiers (P1 to P20) were created in order of being interviewed: P1 to P11 were interviewed on-site at researcher-selected locations, and P12 to P20 were interviewed via Zoom.



Figure 4.2. Three sites selected for in-person interviews. Left to right: low-restorative site, mid-restorative site, and high-restorative site.



Figure 4.3. Three sites visited by participants at/near home. Left to right: outdoor home environment (balcony), nearby urban square, nearby park/greenspace. Photographs were provided by participants.

4.4.3 Analysis

The interviews were analysed in accordance with the framework method, a form of thematic analysis that uses charting of data to compare, summarise and interpret qualitative data (Ritchie et al., 2014). A key benefit of the framework method is the ability to compare data within individual cases and across cases and themes with ease (Gale et al., 2013). This aligns with our aim of identifying links between phenomena in nature experiences (e.g., between engagement and outcomes). The first author conducted the analysis, and all authors met at each stage of the analysis to discuss and review the process. During these meetings, all authors analysed some interview data to review the method and the interpretation and application of the coding framework.

The first author transcribed the interviews and imported them into NVivo, becoming familiar with the transcripts and taking notes. During this stage, codes were developed inductively where meaningful or relevant aspects of the experience were observed and labelled. After generating initial

codes, where applicable these codes were organised around the main experiential categories developed a priori that stemmed from the research questions and theory: for example, qualities of engagement in nature such as mindfulness (Lymeus et al., 2018) and mind wandering (Williams et al., 2018). This process generated a coding framework that was grounded in the data and organised with relevant theory according to our research questions (see Table 4.2 with descriptions of the main coding categories). The framework was then used to code all interview transcripts.

Table 4.2. Descriptions of experiential categories and mapping of common experiences

Key experiential categories	Engagement	Environmental or personal attributes	Outcomes – Restoration	Outcomes - Connection with nature
Description of category	What was attended to; thoughts and emotions; level of awareness of the mental experience. Qualities of awareness such as openness and curiosity, judgment.	Features of the physical and social environment impacting on experience; individual attributes such as prior mood or expectations.	A sense of restoration or relaxation. Pathways that may facilitate restoration: fascination, being away, extent, compatibility (Kaplan, 1995)	The sense of being with nature or interacting with nature. Pathways that may facilitate this connection: contact, beauty, emotion, meaning, compassion (Lumber et al., 2017)
Interview 1	Participant summary	Participant summary	Participant summary	Participant summary
All Interviews	<i>Summaries from all interviews...</i>			
Mapping of experiences down key experiential categories	Immersion in the sensory experience Being “distracted” by sensory experience – and fascination Openness to experience Intentional present-moment awareness	Environmental noise Proximity to workplace Design of the space, infrastructure Work stresses Desire to be among others or alone	Relaxation and feeling calmer Benefit of getting away from the workplace Design of environment supports being away	Connection with nature driven by perception of ‘nature’ in the space Common pathways: sensory contact and aesthetic appreciation

Once interviews were coded, the interview data was charted into a matrix of cases and experiential categories identified in the previous phase (Table 4.2). Charting involved categorising the data and describing the experiences of each case across each main category. These descriptions are useful to summarise and organise data, without losing the original meaning of the data and retaining a view to the wider context of the interview (Gale et al., 2013). Once the data was charted into the matrix, we could work across and within cases to map and interpret the range of experiences. This process was driven by our research questions: how were people engaging during these experiences, what shaped this engagement, and what does this mean for outcomes? Between cases (down columns), this process involved mapping the range of experiences and identifying patterns of

engagement and its associations. Within cases (across rows), this interpretation involved contextualising the experience of engagement within the wider interview, by identifying associations between contextual factors and engagement, and the outcomes of the experience. This was an iterative process of working both across and down the framework matrix to generate and test themes against the data.

4.5 Results

Here we report on experiences of engagement that were prevalent within the data. We present five themes relating to how individuals engaged in their experience, and within each theme we report on the factors that commonly shaped this engagement, as well as the outcomes of those types of experience (Table 4.3). *Engagement* as a construct is intentionally broad, and the themes presented here are not mutually exclusive. Similarly, participants engaged in many ways during their experience and the data do not confine one experience to one form of engagement.

Table 4.3. Identifying common associations between engagement, contextual attributes and outcomes

Forms of engagement	Links with contextual attributes	Links with psychological outcomes
Heightened sensory stimulation	Natural sensory stimuli, e.g., colourful flowers	Higher <i>contact</i> with nature; tactile, visual, auditory
	Noise, e.g., bird sounds or traffic	Psychological distance from work thoughts
	Personal need for a break, distance from work, or indoor environment	
Allowing the mind to wander	Change in environment, moving indoors to outdoors	Calmness and relaxation
	Environmental characteristics – broader physical scope, sensory stimuli	Psychological distance from demanding thoughts
	Having no task set, freedom to mind wander	
Mindful engagement with the present experience	Individual experience or familiarity with a mindfulness-type practice	Higher contact with nature, through heightened sensory experience Calmness
Negative judgment towards environmental experience	Environmental features perceived as disruptive/negative – e.g., construction noise, ‘unnatural’ looking design.	Low levels of restoration or connection with nature.
	Imposing built environment.	Some distance from work.
	Individual context, such as level of relaxation and attitude towards nature	
Acceptance towards environmental experience	Individual framing of experience – e.g., noting that built environment is ‘expected’ in certain places.	Some restorative outcomes – distance from work, calmness.
	Familiarity with the environment	Drawing <i>meaning</i> from contact with nature, aware of relationship between humans and nature in these spaces.

4.5.1 “Enjoying the blossoms”: Heightened sensory stimulation

Participants reported engaging with the external, sensory experience in heightened ways during their outdoor experience. When participants were engaging with the external experience, this involved attending to the range of sensory phenomena, including the visual environment, sounds, smells, and any tactile encounters.

The *presence* of diverse sensory stimuli in the outdoor environments was a necessary precursor to this experience of heightened external engagement. This is exemplified by the following:

...One of the things I like about walking, and particularly through here, 'cos a lot of people use this space, is just that you can, you know, have this very sensory experience I suppose, of the sounds of the traffic, the sounds of the birds, you know, the gum flowers. (P1)

The experience of engaging with the senses was associated with the prior need to have a break from work, or ‘get away’ from cognitive demands. This was seen in two different ways. First, some participants reported that engaging with the sensory experience outdoors was beneficial because it specifically contrasted with the sensory experience in their indoor work environment. For some, this was an intentional practice on their work break: “*I tried to use some of my other senses that I'm not using when I'm inside working. So hearing and smell.*” (P12). For others, there was an appreciation of the present stimuli in the outdoor environment that differed from indoors:

I like being around others, and I like background noise. 'Cos I often feel like at work, like it's very sterile silence, and I really dislike that. So I like just background random things happening. (P8)

Second, attending to the external environment helped some participants move away from thinking about work or other thoughts. The ‘distractions’ in the environment, as some participants referred to them, seemed to support a shift in their attention away from work or thoughts that were demanding or stressful:

A lot of the other trees are quite healthy and big and nice. So I was just observing them, enjoying the blossoms, that sort of thing... Because of, my mind, and things that have happened in my life, that I can't get out of my head that I'm trying to, that I go there and I'm trying to force myself to just think of other stuff... And going to the park does help do that. (P19)

Engaging with the sensory experience was associated with a higher contact with nature: “*And when I wander around, I'll start digging up weeds out of the ground... so I like to feel the weeds and feel the plants and check the soil and feel with my finger if it's wet or dry.*” (P12). This form of engaging was also associated with a sense of getting away, or psychological distance from work or other demands: “*I was thinking about work things... but towards the end I started to eventually be*

able to separate myself from that and think about other things instead as I got a little more distracted...” (P14).

4.5.2 “Letting my thoughts go further”: Allowing the mind to wander

The experience of allowing the mind to wander was a common form of engagement during the time spent outdoors. Several participants commented on the benefits of not attempting to control their thoughts towards certain tasks, giving way to task-unrelated, internal thought processes.

Though mind wandering involved internal attention, this form of engagement was often associated with external observations of the environment. A change in the environment, and observing the physical environment were associated with the experience of letting the mind wander. For instance, being outdoors rather than inside changed the quality of thoughts for some participants:

I can't see outside the four walls of the room I'm in when I'm working, but outside because I can see trees from a couple of - two or three houses away, and I can see sky that's way up there, and I can see helicopters that are a suburb away. And I think that that seems to align with letting my thoughts go further. (P12)

Additionally, one participant experienced a “flitting of thoughts” as she observed nature around her, indicating some associations between mind wandering and external, sensory engagement:

I felt smaller in relation to the world and that felt better rather than being sort of focused on my little world and the issues in it... seeing this expansive view was very beneficial to how I felt. Um, and the sounds and sights are calming so the wind rustling, and the flitting of thoughts through the mind as you kind of observed different things around, um, is... I found very calming. Yeah, so, I felt a lot better afterwards. (P13)

Regarding personal attributes, allowing the mind to wander was associated with the experience of having no tasks to think about or do, or no social interactions to focus on – a quality afforded by having a break away from other demands. This freedom to let thoughts go was often contrasted with attention at work:

...Because there's no one pressuring me about a particular task. Um, I don't need to think of, like, how to deal with people in this circumstance. So it's more about letting my mind run wild and free, so sometimes I was like 'why am I thinking about this?' (P5)

The outcomes of mind wandering in these experiences were overall positive. Participants reported feeling calmer or more relaxed: “*So it wasn't like super focussed, but it was calming.*” (P8); or achieving a sense of psychological distance from work or other demanding thoughts through the process of letting their mind wander. “*Um, and the role I have... can take a little bit of mental strain*

some of the time... I don't actually have to go and walk everywhere, I can just sit and... think about nothing really." (P16).

4.5.3 "Being in the space": Mindful engagement with the present experience

Some participants intentionally 'tuned in' to the present moment experience, paying attention on purpose to their sensory and internal experience. Characterised as a mindful engagement, these participants were intentionally focusing and regulating their attention to the present experience, including awareness of the sensory experience and their thoughts/emotions:

...Different thoughts come in, mostly work or things that I need to do later or deal with later or plans, future plans. But yeah, normally I go, oh, I'll think about that, kind of, later – at a later time. And then I try to go back to just listening to music and sounds. (P15)

As this form of engagement is partly defined by the intention that an individual brings to it, the key factor that shaped mindful engagement was the individual's familiarity with and capacity to engage in this way. The participants that engaged in a mindful way reported having prior experience with this type of awareness, either on their work breaks or in other contexts:

And so I did think about being in a space and actually just being in it for a bit... I've got a small meditation practice... so being aware of that practice, I was aware of just not necessarily expecting anything out of it, not doing anything else, rather than being in it. (P7)

Like the nature form of meditation. And so, I have been trying to bring into my daily walks, that whole idea of mindfulness as you're going through the walk. (P20)

Engaging mindfully was associated with the outcome of having a high perceived contact with nature:

I suppose it's the beauty in minute things that you might stumble across, that if I didn't actually stop and look, I would not have seen a beautiful red mushroom. Um, but also there's things like the texture of bark on the trees, the way the tree has grown and created ripples.... (P6)

Some participants also noted that their way of engaging mindfully helps to feel calmer:

I think through, trying to kind of meditate as I'm walking through the pathway, yes, I will have tried to calm down a bit and gain a bit of clarity... I feel better. (P20)

4.5.4 "I don't know if I'd come here if I was a bird": Judgment towards environmental experience

For some participants, there were significant constraining features that were impactful to the extent that they could not engage with the experience positively for their benefit. In part, this was due

to poor environmental design or features. But how a participant framed or perceived the environment also impacted participant engagement – some participants faced with these constraints were negatively judgmental towards the environment and felt that they could not relax, feel restored, or connect with nature.

The environmental characteristics and design influenced this negative judgmental engagement with the experience, including noise, the perceived naturalness of the space, and the impact of the built environment. The following examples illustrate these various impacts:

- noise: *“Well first I tried to go away from tunnel noise, there’s lots of noise.”* (P10);
- the perceived naturalness of the space: *“Obviously they’re trying to get more wildlife through... and I was just like, ‘Ooh I don’t know if I’d come here if I was a bird’.”* (P9); *“It’s quite barren, really. And unnatural.”* (P10);
- the built environment: *“It’s just this weird contrast of like, poor architecture and you know, nature... Because it’s - yeah, like they’re too overpowering, the buildings.”* (P11).

One participant noted that if she had been more relaxed, she may have been able to think about other things, and notice nature more:

I think like if I had come over on a weekend or something like that, you know, when I’m just kind of more relaxed, then I would probably be thinking about other things... I would have taken in the nature a bit more. (P11)

Others reflected on their general attitudes towards nature to explain their lack of connection with nature in the environment:

A sense of a break from the city, yes. But nature... that would be pushing it, to say I felt like that. Yeah. But maybe that’s ‘cos yeah, my ideas of nature are, a bit more unbroken... more of an unbroken history. (P10)

I come from the country, and grew up in like a regional town, so any kind of city space that’s green, um, I just feel as though it’s not completely natural. (P9)

In terms of outcomes for these participants, there were low levels of restoration and relaxation, and connection with nature:

And you know, I love architecture personally, but I don’t feel like they [gestures to buildings] kind of have a good mental impact for someone. (P11)

It feels like you’re in a little bit of a, um, like a new home development area... where everything’s kind of new and the trees aren’t fully developed and that sort of thing... I don’t

really like that style I guess, of things, and it makes me feel a bit disconnected, and like a bit of a cog in the machine. (P9)

However, most participants who described this experience still reported some positive outcomes of simply getting away from the office: *“I think it just gives you a time to, you know, remove yourself from work – like your workstation or your workspace and reflect on things that are happening.” (P9)*; and some aspects of the experience where there was a degree of contact with nature: *“I just find this park so unnatural looking. But, it’s still – you can see the sky, which is a huge part of it.” (P10).*

4.5.5 “Could qualify as a park”: Acceptance towards environmental experience

For some participants, a certain cognitive framing of the experience led to an acceptance of the environment and its features. In the face of various constraining aspects of the environment – such as urban noise and ‘distracting’ features of the built environment – some participants were able to engage in more positive ways and be less judgmental towards their experience. This contrasted with experiences described above, where participants were relatively judgmental towards their experiences in constrained environments.

This quality of acceptance stemmed from individual expectations or familiarity with the environment:

No, it was pretty, pretty much as - as I thought it was going to be because, as I said, I’ve sat there often enough to know that it’s noisy and it’s busy and you know, but yeah, you can still turn off... (P16)

Um, especially like in the city environment, is that, you know, there are going to be buildings and they don’t really bother me, I’m not thinking about them when I’m there, not really noticing that they’re there... I understand that there are buildings, everywhere... (P8)

For one participant, his framing of the environment stemmed from an event just before the experience:

I was thinking, ah it’s not nearly as good as a park... But then, unexpectedly, shortly after I took that first picture, I saw a couple walking by with their dog. And the dog stopped and sniffed around the grass in the micro square. So from that moment on, I thought, actually this space could qualify as a park or green space, right... And it might have allowed me to enjoy being there more than I otherwise would have. (P18)

A positive framing and acceptance of the experience was associated with some aspects of restoration: *“I felt that I could take a deep breath and still get something resembling a park sensation of taking a green breath.” (P18)*; and connection with nature: *“This is never going to be natural per*

se. But it's where we meet nature, like we're human, and that desire to do a pattern in concrete to reflect nature is kind of symbolic to where we are." (P7)

Although this form of engaging was feasible in these participants' experiences, for some participants there seemed to be a threshold, where their perceived ability to accept the environment may become implausible:

...If I associate being calm in the space it'll happen – well it may happen, unless a truck beeps at me, which won't happen in nature [laughs]. (P7)

4.6 Discussion

The first aim of our research was to explore how people engage within urban nature experiences. Five forms of engaging were documented and demonstrate a range of engagement forms and qualities experienced across and within nature experiences. These forms were a heightened sensory stimulation and awareness, mind wandering, mindful engagement with the present experience, judgment towards the environmental experience, and acceptance towards the environment. Identifying these forms of engagement within urban nature experiences provides a greater depth to existing concepts and pathways that link nature experiences with wellbeing outcomes (Kaplan & Kaplan, 1989; Lumber et al., 2017). In this section, we discuss these concepts and build on theoretical development in Figure 4.1 by identifying and synthesising connections between forms of engagement, and their associations with contextual factors and outcomes. The result is an overview of observed features in the current study, forming a guiding framework for research examining the various dimensions within the experience of nature (Figure 4.4).

Some engagement forms occurred concurrently or supported one another during the nature experience. An example can be illustrated with the frequently reported experience of heightened engagement with the sensory experience, when observing the natural qualities of the environment. This form of engagement can be understood through the concepts of soft fascination (Kaplan & Kaplan, 1989), and *contact* with nature (Lumber et al., 2017), both of which are proposed to lead to psychological benefits. In this study, sensory engagement was found to be associated with mind wandering during the nature experience; forms of engagement that are proposed to mutually support attention restoration (Williams et al., 2018). Further, sensory engagement was associated with psychological distance from work or other demands. These concepts are theorised to be key mechanisms leading to psychological restoration (Kaplan, 1995) and our findings demonstrate the experiential links between them. Consistent with earlier findings in wilderness experiences (Borrie & Roggenbuck, 2001), we find that multiple forms of engagement can co-occur within urban nature experiences. These results respond to calls from authors to consider the multi-dimensional experience

of nature (Brymer et al., 2021) that may provide a more holistic account of mechanisms underpinning nature benefits.

Our second research question asks how engagement relates to environmental and personal attributes. We found that individuals engage in response to features of their experience, and often in adaptive ways to achieve different psychological outcomes. For instance, participants intentionally attended to the external environment to gain distance from work or stressful thoughts. Our findings are consistent with studies demonstrating that individuals self-regulate through choosing to spend time in certain environments (Korpela et al., 2018), and that level of mental demands at work impact an individual's green space use and the extent of restoration they experience (Colley et al., 2017). We expand on this body of work by revealing that individuals regulate their subjective experience by choosing how to pay attention and engage in environments, often engaging in various ways within their experience. But there may be some restrictions on how people can regulate their experiences through engagement. Participants who engaged mindfully had prior experience with this form of engagement, so had the capacity and intention to apply mindful engagement to their nature experience. Consistent with research demonstrating the effort involved in learning mindfulness (Lutz et al., 2015), mindful engagement in nature is likely more effortful for those less familiar with the practice.

To answer our third research question, our analysis identified variation in psychological outcomes associated with the different forms of engagement. A notable contrast was observed between participants who were negatively judgmental towards aspects of their experience, and those who had a more accepting attitude, where the latter form of engagement was associated with more positive outcomes of restoration. Acceptance in this study was associated with a certain framing of the experience and can be interpreted alongside the concepts of drawing meaning or perspective from symbolic and insightful experiences of nature, that have positive associations with nature connection (Lumber et al., 2017; White, 2012). While mindful engagement tended to lead to calmness and higher sensory contact with nature, mind wandering in the experience was commonly associated with the need to remove oneself from work-related thoughts, feeling relaxed, and achieving a heightened sense of 'being away'. Despite some studies that depict a negative relationship between mind wandering and mood (e.g., Killingsworth & Gilbert, 2010), Schooler et al. (2014) argue that mind wandering can be associated with a positive mood when thoughts are personally interesting or stimulating. The context of 'having a work break' in this study may have led to positive thought content, along with the pleasurable component of being fascinated by nature (Kaplan & Kaplan, 1989). In these ways we can see that environmental and personal attributes combine to shape engagement in nature. The connections between these elements of the nature experience are represented in Figure 4.4 which includes the range of concepts within the nature experiences explored in the current study. Figure 4.4 provides a framework to guide future research, where researchers are encouraged to identify personal

and environmental contexts, and individual engagement in nature experiences, and examine how they associate with relevant outcomes.

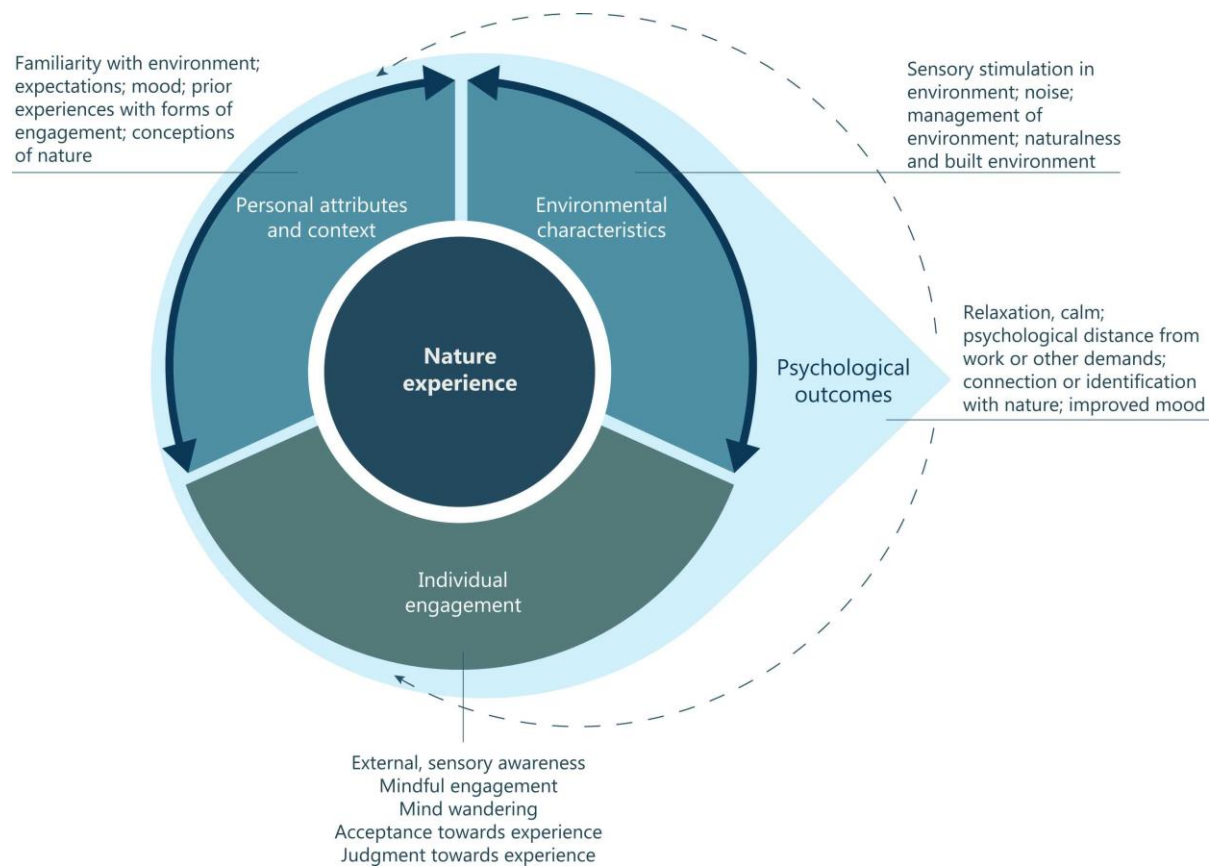


Figure 4.4. Representations of the observed features of nature experiences. The figure provides a framework for exploring dimensions of human-nature relations and potential associations between context, environment, engagement, and outcomes.

In the context of a relatively small set of qualitative papers exploring nature engagement and associated wellbeing outcomes (Iqbal & Mansell, 2021), our approach to analysis in this paper contributes to the current understanding of the mental experience of urban nature. Existing qualitative studies tend to explore human-nature relations with either bottom-up, inductive approaches grounded in the data (e.g., Brymer et al., 2021; Iqbal & Mansell, 2021), or with deductive methods that analyse and interpret data based on theoretical pathways (for example, ART mechanisms; Nordh et al., 2017). We bridge these methods in this study with a framework approach to our analysis, where themes were generated openly, yet continuously examined and re-interpreted alongside our research questions and theoretical understanding. We believe this a strength of the study that enables critical reflection of both the resulting themes and the theories we use to interpret them.

The study, however, is not without limitations. First, reporting on the deeply subjective experience of cognitive engagement presents a significant challenge. In this study, we used semi-structured interviews with prompting questions to uncover participants' experience of engagement. Although this is a strength of our study design, we note that analysis of these subjective reports requires abstract interpretation. The restrictions due to the COVID-19 pandemic required significant changes to data collection. While the changes were compatible with achieving the study goal of sampling a range of nature experiences, we acknowledge that it resulted in different and unexpected circumstances under which participants experienced nature. For instance, participants who could visit an environment near their homes were mostly familiar with the space, likely impacting how they engaged and spent time on their break. The pandemic itself may also present unique personal and environmental contexts (for example, working from home) that influence experiences of and benefits derived from green spaces (Astell-Burt & Feng, 2021). These contexts may change the way individuals subjectively engage in nature; however, we did not find such patterns in our analysis. Despite potential contrasts between the participants' experiences, we reasoned that the changes to design provided an opportunity to analyse a broader range of personal and environmental contexts under which engagement in urban nature could be experienced.

4.7 Conclusion

This study provides insight into the experience of engagement in urban nature in the face of varying environmental and personal contexts. The qualitative methods used in this study contribute to a deeper understanding of the various forms of engagement in nature, and allowed us to identify unique associations between engagement, contextual attributes, and psychological outcomes of nature experiences. Mapping these combinations of factors in the nature experience may be helpful in considering the design, use, and implementation of interventions that aim to optimise psychological benefits of nature. For instance, if mind wandering can support psychological distance from work for those who need it, and is enhanced with sensory stimulation, interventions can be designed to support this specific need. Overall, this study contributes a framework for understanding human-nature relations (Figure 4.4) that may be useful in future research or green space experience design to better examine and promote the role of engagement in nature.

4.8 References

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5 Chapter 5.

Comparing the effect of mindful and other engagement interventions in nature on attention restoration, nature connection, and mood

5.1 Overview

This chapter evaluates the effect of different engagement interventions on outcomes of a short nature experience with an experimental design and measures of attention restoration, connection with nature, and mood. The intervention was initially designed to be implemented in-person and held at several urban green space sites that differed in restorative quality (such as those selected in Chapter 4). However, lockdown measures associated with the COVID-19 pandemic disrupted these plans and the intervention had to be delivered remotely – i.e., via online instructions and surveys, where participants could complete the tasks and nature experience at home or nearby.

The chapter builds on the explorative work in Chapter 4 by examining whether common engagement forms can be instructed and used to enhance outcomes of nature, and importantly, evaluating different engagement forms against each other to determine which are more effective in doing so. This chapter focuses on the effect of the intervention on outcomes directly, so that the influences of broader contextual aspects of the experiences can be analysed in depth in the following Chapter 6.

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5.2 Abstract

Mindful engagement interventions have been shown to improve psychological benefits of nature experiences but to date there has been little evaluation of their efficacy compared with other forms of engagement. An online experimental study was conducted to compare different forms of engagement with nature. Before and after a 20-minute outdoor experience, participants ($n = 215$) completed surveys on state mindfulness, connection with nature, and mood, and then the Sustained Attention to Response Task (SART). Participants were randomly allocated to one of four engagement intervention groups: mindful engagement, directed engagement, mind wandering, and an unguided control group. The groups did not differ on connection with nature or positive affect after the nature experience, when accounting for the baseline measures, however the mind wandering group reported significantly lower negative affect than the directed engagement group. Overall, SART outcomes indicated that the unguided control group had the greatest level of attention restoration, suggesting that all three engagement interventions taxed the attention system. Mediation analyses indicated that there was an indirect effect of state mindfulness on the psychological outcomes, primarily for the mindful engagement group when contrasted with the unguided control. The findings challenge the idea that all forms of heightened engagement enhance the experience of nature and resulting psychological outcomes. We use these findings to outline considerations for designing and applying engagement interventions in nature for specific outcomes.

5.3 Introduction

Research over the past decade has explored the effect of various nature-based engagement interventions on psychological benefits of spending time in nature (Duvall, 2011; Korpela et al., 2017; Lumber et al., 2017). Several of these interventions apply qualities of mindfulness to the nature experience, such as non-reactivity and curiosity (e.g., Lymeus et al., 2018; Nisbet et al., 2019), setting them apart from other engagement interventions including those using imagination and abstract thought (e.g., Duvall, 2011). Concurrently, researchers have hypothesised and observed varying psychological outcomes associated with engagement interventions, including mood (Korpela et al., 2017) and connection with nature (Lumber et al., 2017). Despite this diversity, only one study to date has compared outcomes of different engagement interventions on a single set of psychological outcomes (Pasanen et al., 2018). Further, theoretical accounts are emerging of mind wandering as an alternative form of engagement in nature (Williams et al., 2018), warranting its consideration alongside existing engagement concepts. To progress understanding of engagement in nature, it is essential to compare and contrast mindful and other engagement interventions, so that they can be designed to support desired outcomes.

Heightened engagement in nature may influence commonly reported psychological outcomes of nature experiences. They include attention restoration (Ohly et al., 2016; Stevenson et al., 2018), mood (McMahan & Estes, 2015), and connection with nature (Lumber et al., 2017; Mayer & Frantz, 2004). Improved attention performance has been observed after two-weeks of engagement-enhancing tasks conducted in nature (Duvall, 2011), after a walking intervention with restoration-based engagement exercises (Pasanen et al., 2018), and when participants were simply instructed to ‘pay attention closely’ to vegetation in photographs (Y.-H. Lin et al., 2014). While satisfaction with engagement tasks has been associated with mood enhancement (Korpela et al., 2017), experimental studies have not found effects of engagement exercises on self-reported mood (Lumber et al., 2017; Pasanen et al., 2018). Heightened engagement with nature may also improve one’s feeling of connection with nature, through a sense of *immersion* in nature (Weinstein et al., 2009), or specifically designed engagement exercises (Lumber et al., 2017). Within these studies, there is a relatively consistent finding that engagement in nature improves attention performance, with little evidence for engagement impacting mood. The mixed findings may be the result of diverse designs of engagement interventions, though associations between specific engagement forms and outcomes remain unclear. The current study aimed to experimentally examine the effect of various forms of engagement on psychological outcomes of nature. In the following section, we review development of engagement exercises in the literature, and specify theoretical contrasts between forms of engaging in nature.

5.3.1 Diverse engagement interventions in nature experiences

Kaplan (2001) proposed that a heightened engagement or mental resonance with the environmental experience would support restorative outcomes, and since then several studies have designed engagement tasks to strengthen outcomes of nature experiences. Duvall (2011) developed exercises to heighten interest of the environment during a two-week walking intervention. Some exercises were quite abstract (e.g., “How would this area be different if everyone had to grow their own food?”), while others were more directed (e.g., “Focus on sounds”, Duvall, 2011, p. 29). The theoretical foundation for the exercises did not clearly relate to psychological restoration in Duvall’s study, but other researchers have built on these ideas and designed exercises that test theoretical pathways to restorative outcomes (Korpela et al., 2017; Pasanen et al., 2018) and nature connection (Lumber et al., 2017). For example, Pasanen et al. (2018) developed restoration-enhancement exercises that conceptually align with theoretical pathways described in attention restoration theory (ART; Kaplan, 1995), and compared their efficacy with Duvall’s awareness-enhancing exercises (2011). Participants in the restoration-enhancement condition had better sustained attention after the nature experience, while both the restoration- and awareness-enhancing groups reported comparable improvements in positive mood (Pasanen et al., 2018). These studies demonstrate that the form of engagement is clearly important in the effect on outcomes and thus needs to be carefully considered when designing such exercises. The current study follows this line of reasoning: we developed and contrasted theoretically driven engagement exercises, and extend past research by using mindfulness as a starting point to identify and distinguish key qualities of nature-based engagement exercises.

Mindfulness has received growing interest as a form of engagement intervention in nature experiences, and its characteristics can provide a basis to compare qualities and forms of engaging in nature (Macaulay et al., 2022). Mindfulness involves awareness of the present moment, which includes the external (sensory experience) and internal experience (thoughts and emotions), with qualities of curiosity, acceptance, and without judgment or reactivity (Bishop et al., 2006; Cardaciotto et al., 2008; Kabat-Zinn, 2003). Mindfulness thus differs from other engagement exercises that direct attention to nature: where other forms of engagement may be external (e.g., focusing on sounds and smells; Weinstein et al., 2009) or internal (e.g., observing one’s mood; Korpela et al., 2017), mindful engagement can be characterised as an awareness of the whole experience – external and internal – that includes acceptance and nonjudgment (Bishop et al., 2006; Cardaciotto et al., 2008).

Mindfulness has been applied in heterogenous ways in studies of nature experience. Studies have compared the effects of established mindfulness interventions in natural settings with indoor or built environments, finding benefits of mindfulness in nature on attention performance (Lymeus et al., 2018), connection with nature, and stress reduction (Choe et al., 2020). Short walking interventions in nature with mindful engagement have demonstrated benefits for connection with nature and negative affect (Nisbet et al., 2019), and anxiety and happiness (Shin et al., 2013). Additionally, studies have

found that being in nature can facilitate state mindfulness or present-centred awareness (Brymer et al., 2021), and that state mindfulness can mediate the effect of nature exposure on affect (Stewart & Haaga, 2018). Brymer et al. (2021) call for further research on the mediating effects of mindfulness in nature, to better understand its role in psychological outcomes of nature experiences. This would help delineate the key differences between mindful engagement interventions in nature and other forms of engagement in nature.

Mind wandering is a form of engagement that has received some attention for its role in supporting restoration in nature experiences (Williams et al., 2018), yet has not been applied as an engagement technique in empirical studies. Mind wandering involves an internally oriented awareness (Schooler et al., 2014), with relatively little cognitive effort or control (Christoff et al., 2016). While mind wandering is commonly linked with negative outcomes such as lower mood (Killingsworth & Gilbert, 2010), it may lead to improvements in mood when the content of thoughts is interesting or stimulating (Franklin et al., 2013; Schooler et al., 2014). Mind wandering in nature has also been proposed to support attention restoration via a process of gentle shifting between internal mind wandering and external fascination with nature (Williams et al., 2018). There is some evidence for these ideas, where settings that are highly rated for restorativeness are also rated highly for the potential for introspection and mind wandering (Cervinka et al., 2020). Mind wandering offers an interesting research direction in the context of engagement in nature experiences. However, with mixed findings on the potential for mind wandering to improve or lower mood (Franklin et al., 2013; Killingsworth & Gilbert, 2010), we would expect exercises that are designed to draw awareness to nature (e.g., through mindfulness or other awareness-enhancing activities) would be more restorative than internally oriented mind wandering.

5.3.2 The current study

This study aimed to compare the effectiveness of three different engagement interventions in nature on psychological outcomes. During a brief nature experience, a *mindful* engagement, a *directed* engagement, and a *mind wandering* intervention were compared with an *unguided* control condition. The interventions were designed to be theoretically distinct from one another. The mindful engagement intervention was designed with reference to prior studies that implement short, guided mindfulness interventions focusing on the breath and physical sensations (Arch & Craske, 2006; Aspy & Proeve, 2017) and to internal sensations (Kiken & Shook, 2011), and studies that apply mindfulness in nature (Lymeus et al., 2018; Nisbet et al., 2019). The directed engagement intervention was designed by drawing on exercises shown to be effective in encouraging attention to the nature experience (e.g., Duvall, 2011), but with qualities that contrast with mindfulness (for example, encouraging elaborative and judgmental thought). Additionally, we drew on designs of active control groups in mindfulness literature, that use physical relaxation exercises (Aspy & Proeve, 2017; Rahl et

al., 2017), movement, and imagery (MacCoon et al., 2012). The mind wandering intervention was based on studies that use mind wandering as a control condition for mindfulness interventions, where participants are instructed to let attention move away from the present moment (Arch & Craske, 2006; Kiken & Shook, 2011).

To examine whether mindfulness itself is an important factor in such interventions, we additionally aimed to test whether the level of state mindfulness during the experience played a key role. We aimed to contribute to existing literature that explored the role of state mindfulness during nature exposure (e.g., Brymer et al., 2021; Stewart & Haaga, 2018) by testing whether state mindfulness mediated the effects of the engagement interventions on psychological outcomes of the nature experience.

Hypothesis 1. A mindful engagement intervention will improve outcomes of, a) state mindfulness, b) connection with nature, c) positive affect, d) negative affect, and e) sustained attention, to a greater degree than other intervention groups.

Hypothesis 2. The directed engagement intervention will improve all outcomes greater than the mind-wandering intervention and the unguided control group.

Hypothesis 3. Engagement interventions in nature will be indirectly associated with psychological outcomes through a higher level of state mindfulness during the experience.

5.4 Method

5.4.1 Design

Surveys and an attention task were completed online before and after a 20-minute outdoor experience. Participants were randomly allocated to one of four intervention groups that engaged in different ways during their outdoor experience: mindful engagement, directed engagement, mind wandering, and an unguided control group. The study design and hypotheses 1 and 2 were preregistered (Appendix A.1), and the study was approved by the Faculty of Science Human Ethics Advisory Group, University of Melbourne (ID: 2057374.2).

5.4.2 Participants

Minimum sample size was determined with a power analysis that considered several factors. Prior research that tested group differences on engagement in nature demonstrated reasonably large effects on nature connection (Lumber et al., 2017) and attention (Y.-H. Lin et al., 2014). Our intervention groups were designed to have some conceptual overlap, so we anticipated smaller effects between groups and used a more conservative effect size in a GPower analysis (Faul et al., 2007) with the following specifications: $\alpha = .05$, power level = .80, and $f = .25$, sample size = 175. Fritz and

Mackinnon (2007) suggest a sample size of 148 will power a mediation analysis with small-medium effect sizes on both *a* and *b* pathways. Considering these analyses, and expected attrition rates on online surveys, we aimed to recruit a minimum of 250 participants and retain at least 175 in final analyses.

Participants were recruited using online advertising (staff and student newsletters). Psychology undergraduate students were eligible for 1% credit to their grades for participating. Other participants were eligible to go in the draw to win a gift voucher. Inclusion criteria were age (18 years or older), currently working or studying on some days, access to an outdoor space to take a break, access to a computer and a smartphone. The final sample of participants that completed the pre- and post-test measures was 215 (Figure 5.1). Demographic characteristics of the total sample and each intervention group are listed in Table 5.1. The four intervention groups did not differ on demographic variables.

Table 5.1. Demographic characteristics of participants in full sample and each intervention group

	Mindful engagement <i>n</i> = 49		Directed engagement <i>n</i> = 55		Mind wandering <i>n</i> = 57		Unguided control <i>n</i> = 54		Full sample <i>N</i> = 215		χ^2 or ANOVA testing group differences
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Gender											$\chi^2(2, 3) = 7.65, p = .57$
Female	36	74	45	82	40	70	39	72	160	74	
Male	13	27	10	18	16	28	14	26	53	25	
Non-binary	0	0	0	0	1	2	0	0	1	<1	
Highest education level											$\chi^2(3, 3) = 15.27, p = .08$
Year 12 or equivalent	24	49	19	35	25	44	29	54	97	45	
Vocational qualification	1	2	0	0	1	2	0	0	2	1	
Undergraduate degree	15	31	23	42	17	30	23	43	78	36	
Postgraduate degree	9	18	13	24	14	25	2	3.7	38	18	
Employment											$\chi^2(2, 3) = 3.78, p = .71$
Student	38	77	40	73	40	70	41	76	156	73	
Employed	11	22	14	26	17	30	13	24	58	27	
Unemployed	0	0	1	<1	0	0	0	0	1	<1	
Country of current residence											$\chi^2(2, 3) = 9.59, p = .14$
Australia	39	80	31	56	42	74	38	70	150	70	
China	6	8	16	29	7	12	8	13	37	16	
Other	4	12	8	15	8	14	8	17	28	14	
	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	Mean	<i>SD</i>	
Age	24.1	8.9	24.7	9.5	26.3	11.1	22.3	7.3	24.3	9.4	$F(3, 210) = 1.69, p = .17$

5.4.3 Procedure

The study was conducted entirely remotely, between October 2020 to March 2021. Participants received a survey link and were instructed to participate during their work or study day and treat the outdoor experience as a work break. The survey began with information about the study – without specific information about the experimental conditions – and informed consent to proceed. The pre-test survey followed, and contained a series of demographic questions, measures of trait connection with nature, trait mindfulness, current mood, and the Sustained Attention to Response Task (SART). The pre-test SART was expected to induce attentional fatigue to increase the potential for restorative effects during the nature experience (Kaplan, 1995).

Immediately after the SART, participants were instructed to go to an outdoor space near their workplace (at home, if they were working from home), and access the survey on their smartphone. The survey software randomly allocated participants to groups at this point. The intervention for all participants was to spend 20 minutes in an outdoor environment. This time frame is suitable for the context of a work break (Brown et al., 2012), and has been shown in similar studies to lead to restorative outcomes (Lumber et al., 2017; Nisbet et al., 2019). Participants in the experimental conditions (mindful engagement, directed engagement, and mind wandering) received short text instructions on their smartphone, at 5-min intervals, about how to engage during the experience. The unguided control group was instructed to set a timer and finish their break after 20 minutes. No further instructions were given to participants on what to do during this break. An overview of intervention exercises is presented in Figure 5.1 and full instructions are detailed in Appendix A.2.

After the outdoor break, participants were instructed to commence the post-test measures on their computer. The post-test began with the SART, followed by measures of current mood, state mindfulness and mind wandering during the outdoor experience, state connection with nature, items about the characteristics of the site visited, and the perceived restorativeness of the nature experience (perceived restorativeness is not reported on in this study).

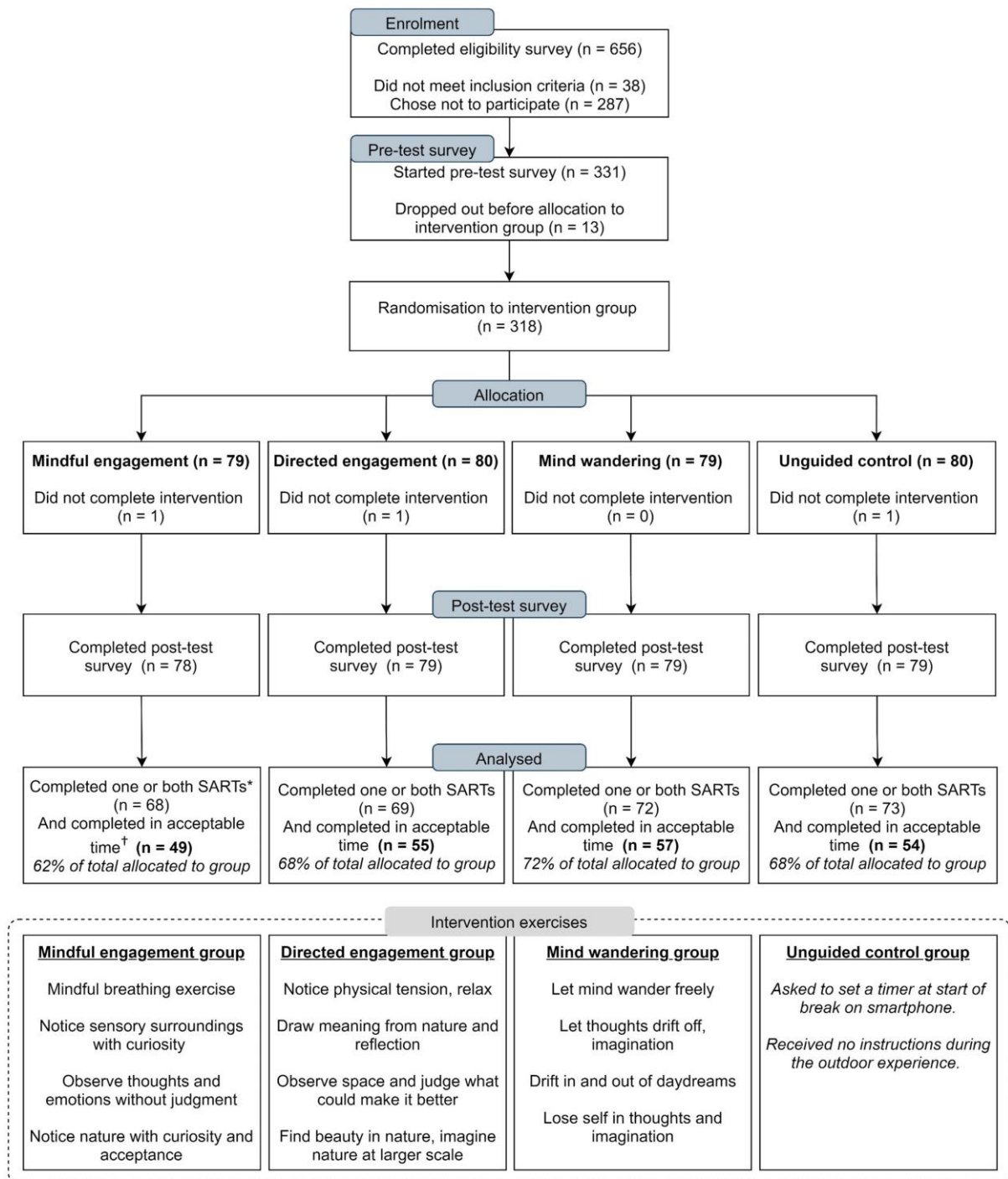


Figure 5.1. Flowchart of participant enrolment, completion rates, and overview of intervention exercises.

*Participants who completed one or both the pre- and post-test SARTs were included in the final analysis for other outcome measures.

†Participants ‘completed in acceptable time’ if the time spent during the intervention was between 20-45mins.

5.4.4 Measures

5.4.4.1 Trait and State Mindfulness

Trait mindfulness was measured with the 14-item version of the Freiburg Mindfulness Inventory (FMI-14; Walach et al., 2006). The FMI-14 was developed for the general population, and uses items that measure tendency to be present, such as *“I am open to the experience of the present moment”*, and to have an accepting attitude: *“I accept unpleasant experiences”*. The Likert-response scale ranges from 1 (rarely) to 4 (almost always). One item was reverse-coded and scores were summed, resulting in good internal consistency (Cronbach’s $\alpha = .81$; Cronbach, 1951).

State mindfulness was measured with items from three validated measures: the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013), the Multidimensional State Mindfulness Questionnaire (MSMQ; Blanke & Brose, 2017), and the Toronto Mindfulness Scale (TMS; Lau et al., 2006). The measures were chosen to reflect the multidimensional qualities of state mindfulness (Blanke & Brose, 2017) and the theorised mechanisms underpinning mindful awareness in nature experiences (Macaulay et al., 2022). The SMS-12 measures the mental and physical qualities of mindfulness (Cox et al., 2016), and includes items such as *“I noticed emotions come and go”*. The decentering subscale of the TMS was used, and includes items such as *“I was aware of my thoughts and feelings without overidentifying with them”*. MSMQ subscales of nonjudgmental acceptance and non-reactivity were included, using items such as *“I judged the things that were running through my head”*. In total, state mindfulness was measured with 26 items. Participants were asked to respond how well each statement reflected their outdoor experience, with responses ranging from 1 (Not at all) to 5 (Extremely). The nonjudgmental acceptance items were reverse-coded, and scores were summed: higher scores indicate a higher level of state mindfulness ($\alpha = .91$).

5.4.4.2 Connection with nature

The connectedness with nature scale (CNS) measures a sense of oneness with nature (Mayer & Frantz, 2004). The CNS-7 (Pasca et al., 2017) was used to measure both pre-test trait-level connection with nature (for example, *“I often feel disconnected from nature”*; $\alpha = .84$), and post-test state-level connection with nature (items re-worded to suit the current state, for example, *“At the present moment, I don’t feel connected to nature”*; $\alpha = .90$). Scores were summed and higher scores indicate a person feels more connected with nature.

5.4.4.3 Positive and negative affect

To measure mood, we used the positive affect (PA) and negative affect (NA) scales (PANAS; Watson et al., 1988). We asked participants to indicate the extent that they felt different feelings and emotions *‘right now, that is, at the present moment’*. Responses range from 1 (very slightly or not at all) to 5 (extremely), and were summed as separate scales (post-test PA $\alpha = .91$; post-test NA $\alpha = .90$).

5.4.4.4 *Sustained attention*

The random version of the Sustained Attention to Response Task (SART; Johnson et al., 2007; Robertson et al., 1997) was administered online using Pavlovia (<https://pavlovia.org>). In the task, a random sequence of single digits was presented on the screen. Participants were instructed to respond quickly and accurately by pressing the spacebar of the keyboard to all digits except '3'. Each digit was shown for 250ms followed by a white cross in a circle, for 900ms. The interstimulus interval was 1150ms, there were 225 trials, and each SART lasted 4m 30s. Both the pre-test and post-test tasks started with a 10-digit practice trial.

The mean and standard deviation (SD) response time (RT) were measured for responses to each digit except '3'. Omission errors were counts of failures to respond to the go digits, and commission errors were counts of incorrect responses to the no-go '3'. Participants were excluded if they scored >30 omission errors, indicating that they had not performed the task correctly (pre-test $n = 5$, post-test $n = 9$). Moment-to-moment variability (fast frequency area under the spectra) and gradual variability (slow frequency area under the spectra) were calculated using the methodology outlined in Johnson et al. (2020). Moment-to-moment variability is a measure of all variability of RT within a sequence of 9 digits, a SART cycle. Gradual variability is a measure of all variability longer than one cycle. Higher values on these latter two variables indicate higher response variability. Each SART measure was calculated for the first (trial 2 to 113) and second (trial 114 to 225) halves of the task, to measure possible time-on-task effects and decline in vigilance over the 4.5min task. The half-by-half analysis of the SART has been useful in similar nature-based studies that find differences in performance over the first and second halves of the task (Lee et al., 2015; Pasanen et al., 2018).

5.4.4.5 *Self-reported environmental characteristics*

After the outdoor experience, participants were asked to report on the features of the outdoor environment they visited. The items were created to reflect restorative features identified in previous studies (e.g., Lindal & Hartig, 2015; Mesimäki et al., 2019; Nordh & Østby, 2013). We used this measure to ensure there was no significant variation between intervention groups on the type of environment visited. We confirmed this with a one-way ANOVA: $F(1, 211) = 1.13, p = .34, \eta^2 = .02$. The full measure and item means and standard deviations are found in Appendix A.3.

5.4.5 *Analysis*

All analyses were conducted using SPSS version 27. Prior to the main analyses we checked and confirmed that no groups differed on any of the pre-test measures, using one-way ANOVAs.

We compared the differences in means between the four intervention groups on psychological outcomes with ANCOVAs, while controlling for the pre-test, or trait-level scores. Assumptions of the statistical models were assessed before proceeding, including homogeneity of regression slopes, and

homogeneity of variance assessed by inspecting the distribution of standardized residuals and Levene's test. Cases appearing as outliers on residuals plots were removed and the models rerun as a sensitivity check. We transformed three variables (pre- and post-test) due to violating assumptions of homogeneity of variance: we used an inverse transformation for negative affect, and logarithmic transformations for both SART moment-to-moment variability and gradual variability. Omission errors were not included as a dependent variable in the analysis due to significant floor effects: 40% of participants made 0 omission errors in the pre-test attention task. Descriptive statistics of each dependent variable are presented in Table 5.2.

A series of mediation analyses were conducted using PROCESS in SPSS. The mediation models used categorical predictors (intervention group), and indicator coding with the unguided control group as the reference group. State mindfulness was the mediator variable, and various outcome variables were tested: connection with nature, positive affect, negative affect, and SART variables. Within each analysis, mediation was analysed on three separate levels of the predictor, indicating comparisons between engagement interventions and the reference group: the indirect effect was therefore interpreted as the impact each engagement intervention (mindful engagement, directed engagement, and mind wandering) had on the outcome variable as a result of its impact on state mindfulness, relative to the unguided control group (Figure 5.2; Hayes & Preacher, 2014). We used bias-corrected bootstrapping methods to estimate the 95% confidence intervals of all effects (based on 5000 samples).

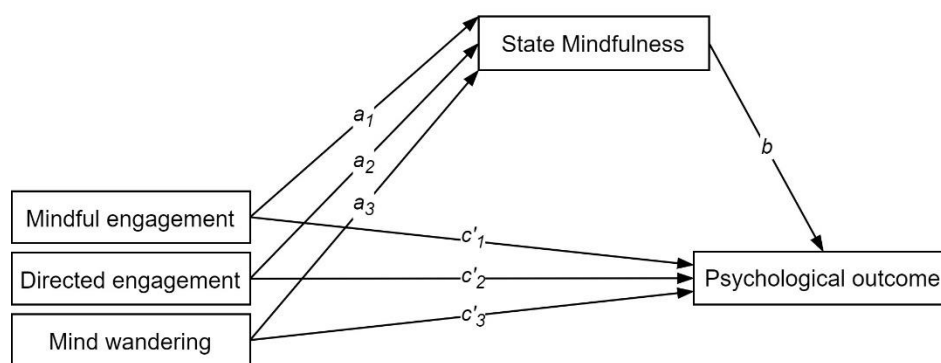


Figure 5.2. Conceptual representation of the analysed mediation pathways. Predictor variable is multi-categorical with >2 levels (four interventions groups): indirect effects are thus examined separately with the unguided control group as the reference category (a_1b , a_2b , a_3b).

Table 5.2. Descriptive Statistics: Means (*M*) and Standard Deviations (*SD*) of Pre- and Post-test Measures for each Experimental Group

Measure	Mindful engagement		Directed engagement		Mind wandering		Unguided control	
	Pre-test <i>M (SD)</i>	Post-test <i>M (SD)</i>	Pre-test <i>M (SD)</i>	Post-test <i>M (SD)</i>	Pre-test <i>M (SD)</i>	Post-test <i>M (SD)</i>	Pre-test <i>M (SD)</i>	Post-test <i>M (SD)</i>
Mindfulness*	36.5 (5.7)	86.3 (14.4)	33.7 (6.6)	81.0 (15.4)	34.5 (6.2)	81.6 (15.0)	33.7 (5.5)	76.1 (14.4)
Connection with nature	25.8 (4.8)	26.9 (5.6)	23.4 (5.0)	24.9 (4.7)	24.5 (4.5)	25.3 (4.7)	24.9 (4.6)	25.6 (4.9)
Positive affect	26.7 (6.6)	27.1 (8.4)	25.8 (7.0)	25.6 (8.2)	26.4 (7.2)	26.2 (7.9)	25.1 (6.7)	25.2 (7.8)
Negative affect	17.5 (7.2)	14.0 (4.7)	18.8 (7.8)	15.8 (5.6)	18.2 (6.8)	13.4 (3.9)	18.9 (8.5)	15.6 (7.8)
SART Mean RT (FH)	411 (86)	424 (89)	417 (108)	412 (104)	406 (92)	411 (110)	407 (87)	412 (103)
SART Mean RT (SH)	407 (91)	397 (94)	420 (123)	401 (104)	390 (104)	387 (92)	396 (109)	402 (107)
SART SDRT (FH)	95 (32)	94 (44)	88 (34)	98 (50)	88 (42)	88 (41)	89 (33)	77 (29)
SART SDRT (SH)	106 (42)	106 (47)	101 (50)	104 (56)	92 (49)	87 (39)	88 (35)	84 (37)
SART commission errors (FH)	5.8 (3.5)	5.0 (2.9)	6.0 (4.0)	6.3 (4.1)	6.1 (4.0)	5.8 (4.6)	6.0 (4.0)	4.7 (3.9)
SART commission errors (SH)	3.9 (2.2)	4.0 (2.3)	4.0 (2.3)	3.8 (2.4)	4.0 (2.5)	3.5 (2.6)	3.8 (2.2)	3.1 (2.6)
SART moment-to-moment variability (FH)	92 (72)	89 (75)	70 (44)	98 (94)	87 (117)	67 (54)	84 (58)	62 (52)
SART moment-to-moment variability (SH)	134 (103)	112 (98)	119 (134)	121 (128)	111 (153)	88 (67)	90 (78)	91 (84)
SART gradual variability (FH)	376 (345)	413 (529)	330 (449)	506 (545)	373 (675)	309 (287)	387 (530)	289 (503)
SART gradual variability (SH)	540 (492)	545 (453)	599 (706)	510 (574)	475 (606)	469 (779)	401 (331)	404 (495)

Note. * Pre- and post-test measures are different: trait mindfulness and state mindfulness. All variables are untransformed. FH = first half; SH = second half.

5.5 Results

5.5.1 Adherence to protocol

Participants were included in the final analyses if they completed the outdoor intervention in an acceptable time, between 20-45 minutes ($n = 215$). There was no statistical difference between groups for the amount of time spent during the intervention, $F(3, 311) = 0.13, p = .94$.

5.5.2 Attention fatigue

Paired samples t -tests indicated that participants' sustained attention became fatigued during the first SART. Omission errors, $t(194) = -4.26, p < .001$, SDRT, $t(194) = -3.03, p = .003$, moment-to-moment variability, $t(192) = -3.82, p < .001$, and gradual variability, $t(192) = -4.91, p < .001$, increased from the first to the second half of the first SART. Mean response time remained consistent across the two halves of the first SART, $t(194) = 1.62, p = .10$, and commission errors reduced in the second half of the task, $t(194) = 9.04, p < .001$.

5.5.3 Engagement intervention group differences on psychological outcomes

5.5.3.1 State mindfulness

There was a significant difference between intervention groups for state mindfulness experienced in nature, as reported in the post-test survey, while controlling for trait-level mindfulness, $F(3, 198) = 2.90, p = .04$, partial $\eta^2 = .04$. Pairwise comparisons revealed that the mindful engagement group had a higher level of experienced state mindfulness than the unguided control group ($p < .01$), but no significant difference compared with other groups (Figure 5.3a).

5.5.3.2 Connection with nature

After the nature experience, there was no difference between intervention groups for state-level connection with nature, while controlling for trait-level connection with nature, $F(3, 202) = 0.46, p = .71$, partial $\eta^2 = .01$ (Figure 5.3b).

5.5.3.3 Positive affect

There was no difference between intervention groups for positive affect after the nature experience, while controlling for pre-test positive affect, $F(3, 206) = 0.34, p = .79$, partial $\eta^2 = .01$ (Figure 5.3c).

5.5.3.4 Negative affect

After the nature experience, there was a significant difference between intervention groups for negative affect, while controlling for pre-test negative affect, $F(3, 204) = 2.99, p = .03$, partial $\eta^2 = .04$. Pairwise comparisons revealed that the directed engagement group had significantly higher

negative affect than the mind wandering group ($p < .01$), but there were no significant differences between other groups (Figure 5.3d).

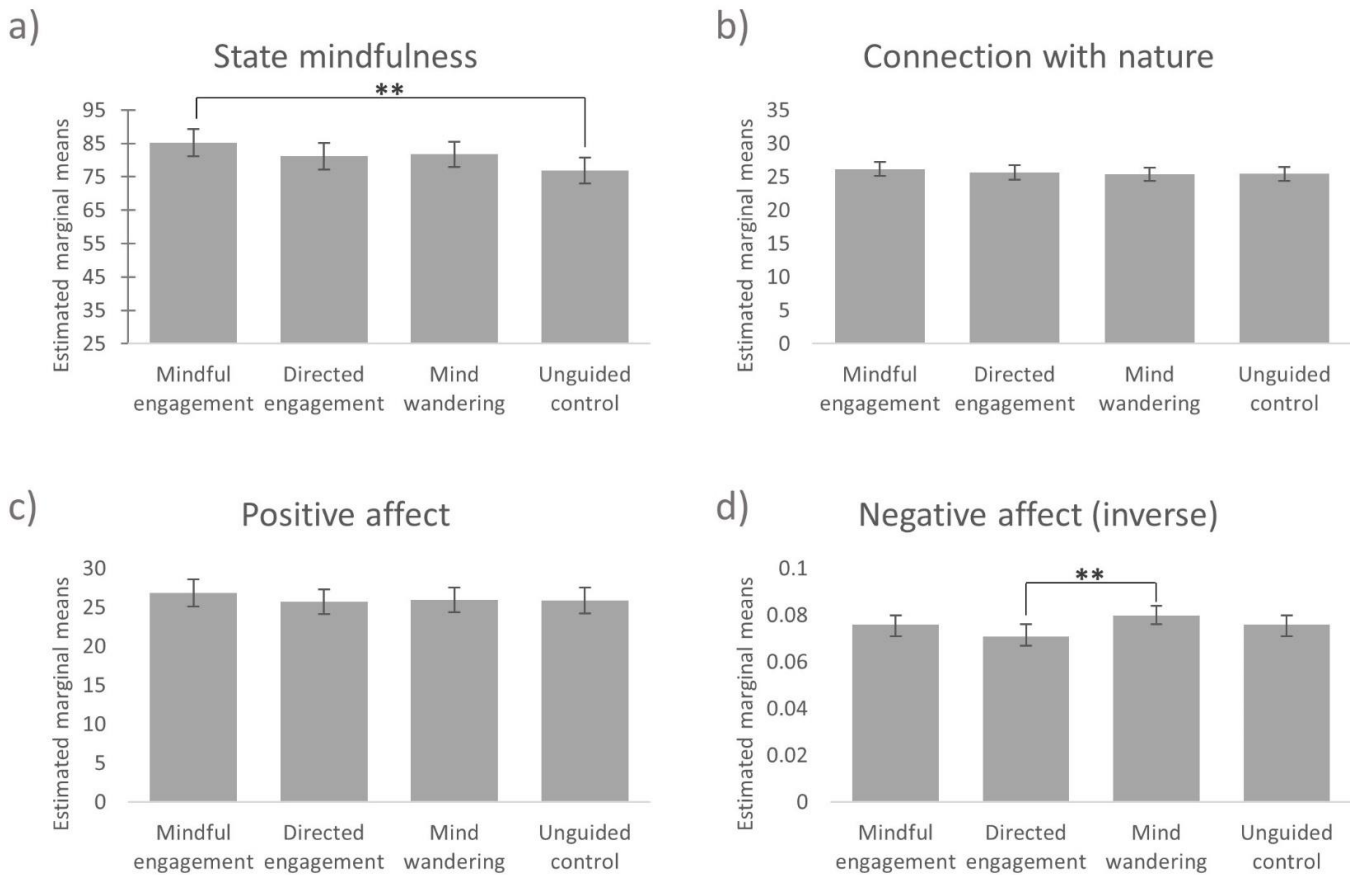


Figure 5.3. Estimated marginal means in different intervention groups for the self-reported post-test measures, controlling for pre-test baseline scores. ** Indicates significant differences between groups, $p < .01$. Higher score on negative affect (inverse score) represents lower negative affect.

5.5.3.5 SART Mean RT

There was no difference between intervention groups for the post-test, first half mean RT when controlling for the pre-test first half measure, $F(3, 174) = 1.58$, $p = .20$, partial $\eta^2 = 0.03$, nor for the second half mean RT, $F(3, 173) = 0.99$, $p = .40$, partial $\eta^2 = 0.02$ (Figure 5.4a).

5.5.3.6 SART SDRT

There was a significant effect on post-test first half SDRT on levels of intervention group when controlling for the pre-test first half measure, $F(3, 175) = 4.60$, $p < .01$, partial $\eta^2 = 0.07$. Pairwise comparisons revealed that the unguided control was significantly less variable in responding than the directed engagement group ($p < .001$), the mindful engagement group ($p = .01$) and the mind wandering group ($p = .01$). There was no significant effect on post-test second half SDRT on levels of

intervention group when controlling for the pre-test second half score, $F(3, 175) = 1.57, p = .20$, partial $\eta^2 = 0.03$ (Figure 5.4b).

5.5.3.7 SART commission errors

After the nature experience, there was a significant difference between intervention groups for first-half commission errors, while controlling for the pre-test first half scores, $F(3, 175) = 2.88, p = .04$, partial $\eta^2 = .05$. Pairwise comparisons revealed that the directed engagement group made more commission errors than the unguided control group ($p = .04$), and the mindful engagement group ($p = .02$). There was no difference between intervention groups for second-half commission errors, while controlling for the pre-test second half scores, $F(3, 175) = 1.89, p = .13$, partial $\eta^2 = .03$ (Figure 5.4c).

5.5.3.8 SART gradual variability

There was a significant difference between intervention groups for post-test first half gradual variability, while controlling for the pre-test first half scores, $F(3, 169) = 5.85, p < .01$, partial $\eta^2 = .09$. Pairwise comparisons revealed that the directed engagement group was significantly more variable in responding than the unguided control group ($p < .001$), the mindful engagement group ($p = .02$), and the mind wandering group ($p = .01$). There was no difference between intervention groups for second-half gradual variability, while controlling for the pre-test second-half scores, $F(3, 170) = 1.78, p = .15$, partial $\eta^2 = .03$, (Figure 5.4d).

5.5.3.9 SART moment-to-moment variability

After the nature experience, there was a significant difference between intervention groups for first half moment-to-moment variability, while controlling for the pre-test first half scores, $F(3, 169) = 4.09, p = .01$, partial $\eta^2 = .07$. Pairwise comparisons revealed that the directed engagement group was more variable in responding than the unguided control group ($p = .01$), and the mind wandering group ($p = .03$). The unguided control group had the lowest variability overall, and was also significantly lower than the mindful engagement group ($p = .04$). There was no difference between intervention groups for second half moment-to-moment variability, while controlling for the pre-test second half scores, $F(3, 170) = 0.75, p = .53$, partial $\eta^2 = .01$ (Figure 5.4e).

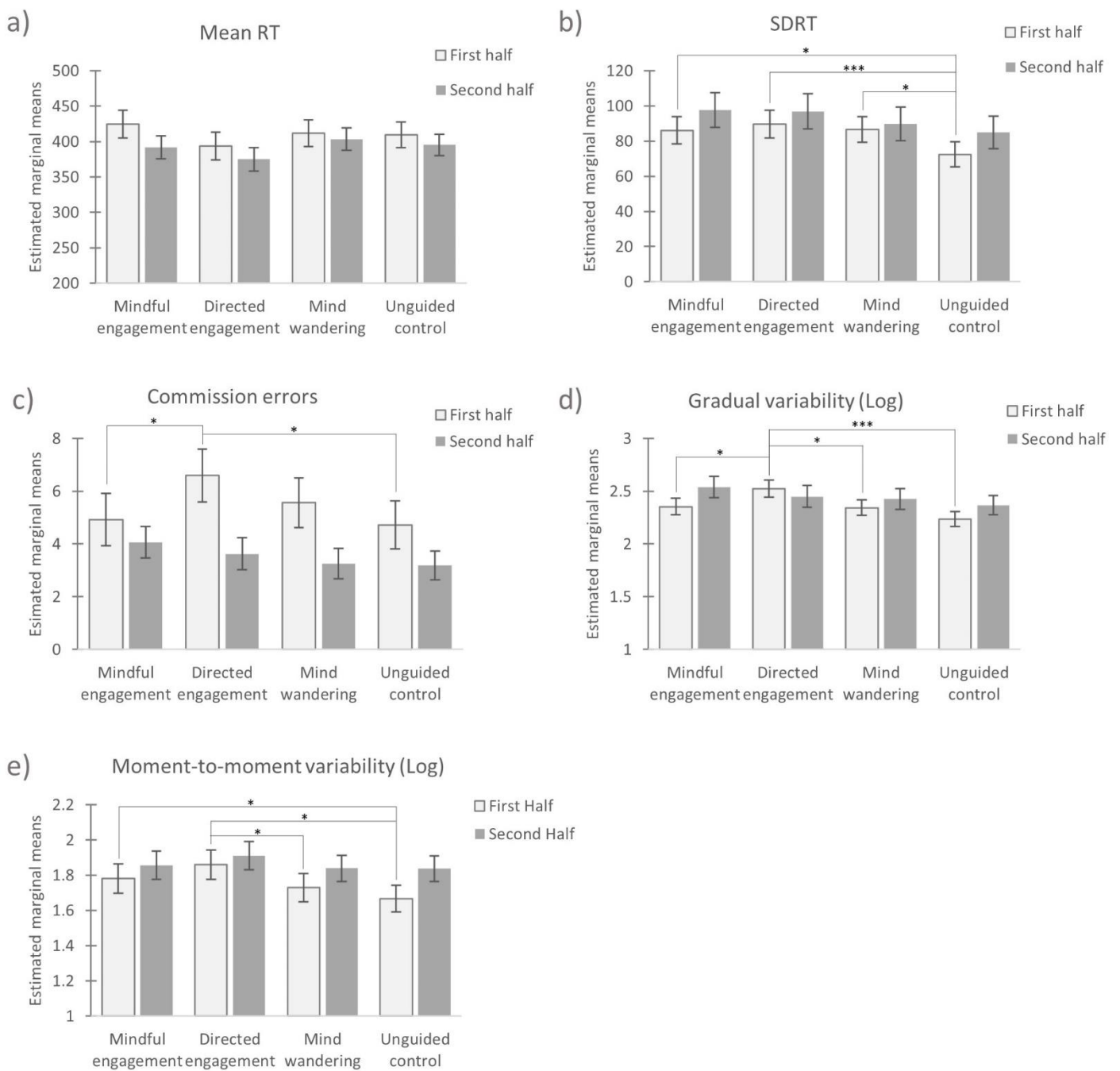


Figure 5.4. Estimated marginal means in different intervention groups for the post-test attention scores, controlling for pre-test baseline scores. Error bars show 95% confidence intervals.

* Indicates significant differences between groups, $p < .05$; *** $p < .001$

5.5.4 Indirect effects of engagement interventions on psychological outcomes through state mindfulness

5.5.4.1 *Connection with nature*

Relative to the unguided control group, all three engagement interventions indirectly influenced connection with nature through a higher level of experienced state mindfulness, where all bootstrapped confidence intervals for the indirect effects were above zero: mindful engagement indirect effect = 0.81, 95% CI = 0.32, 1.44, directed engagement indirect effect = 0.53, 95% CI = 0.05, 1.12, mind wandering indirect effect = 0.52, 95% CI = 0.05, 1.07. Relative to the unguided control group, there was no evidence that the engagement interventions led to increases in connection with nature independently of their effect on state mindfulness (direct effects, Figure 5.5a).

5.5.4.2 *Positive affect and negative affect*

Relative to the unguided control group, the mindful engagement intervention indirectly influenced both positive affect and negative affect through the higher level of experienced state mindfulness, where the bootstrapped confidence interval was above zero: indirect effect on positive affect = 1.44, 95% CI = 0.56, 2.50, indirect effect on negative affect = -0.38, 95% CI = -0.86, -0.04. The directed engagement and mind wandering interventions did not indirectly influence positive affect or negative affect relative to the unguided control group. Relative to the unguided control group, there was no evidence that the engagement interventions led to increases in positive affect (direct effects, Figure 5.5b) or negative affect (direct effects, Figure 5.5c) independently of their effect on state mindfulness.

5.5.4.3 *SART Mean RT and commission errors*

Relative to the unguided control group, the mindful engagement intervention indirectly influenced mean RT and number of commission errors in the first half of the attention task through the higher level of experienced state mindfulness: indirect effect on mean RT = 7.85, $SE = 3.69$, 95% CI = 1.62, 16.09 (Figure 5.5e), indirect effect on number of commission errors = -0.46, 95% CI = -0.98, -0.11 (Figure 5.5d). There were no direct effects of the engagement interventions on mean RT. There was a direct effect of the directed engagement intervention on commission errors in the first half, where the directed engagement intervention led to higher number of commission errors relative to the unguided control group, and independent of its effect on state mindfulness. There was no evidence of an indirect effect or direct effect on mean RT or commission errors in the second half of the attention task (Appendix A.4).

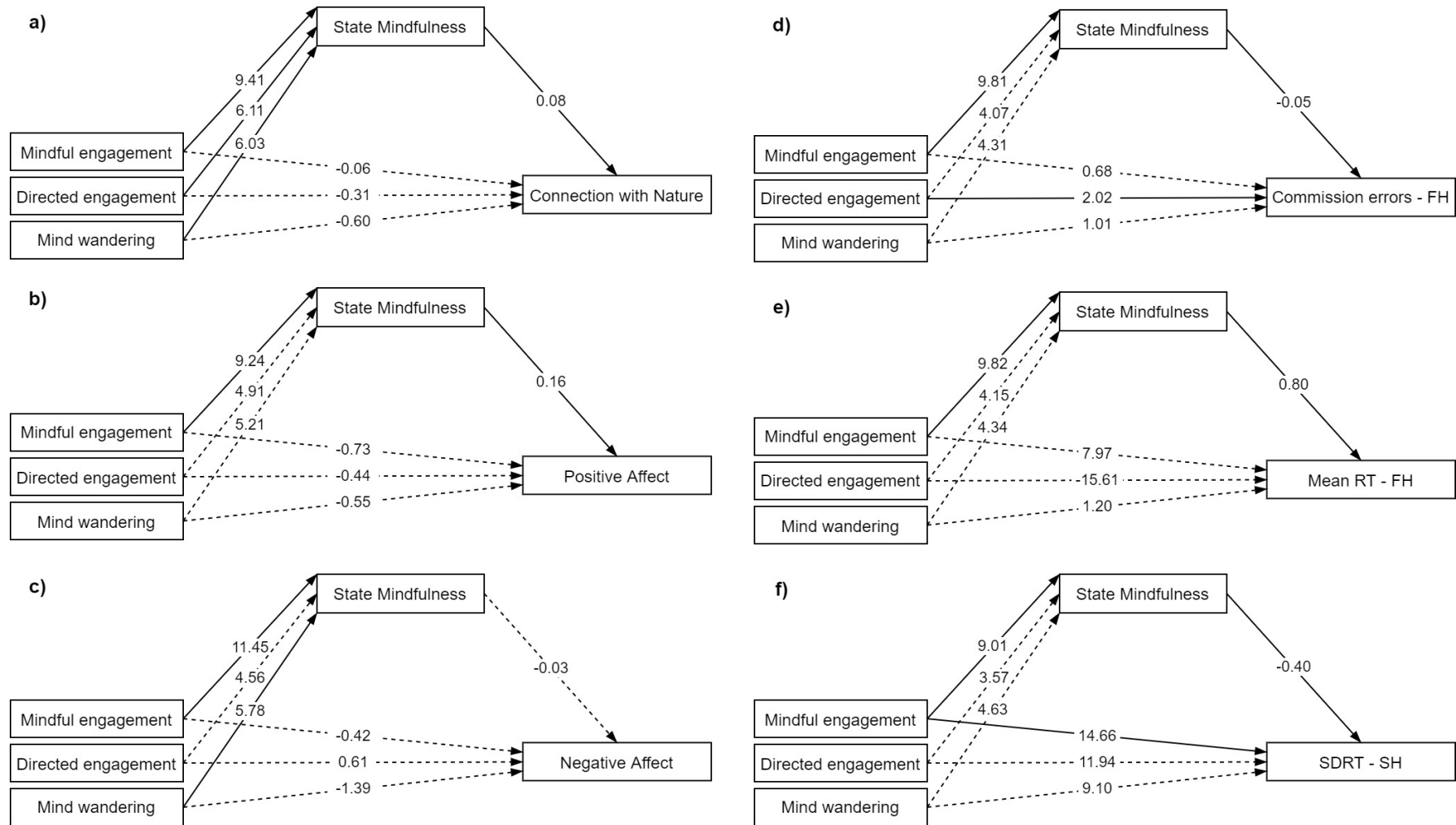


Figure 5.5. Mediation models representing the effect of the intervention groups (mindful engagement, directed engagement, and mind wandering) on connection with nature (a), positive affect (b), negative affect (c), commission errors first half (d), mean reaction time second half (e), and standard deviation reaction time (f). Models include the direct effect and the mediating effect of state mindfulness experienced in nature, as reported in the post-test survey. Significant pathways are solid lines. All models used indicator coding with the unguided control group as the reference group. FH = First Half; SH = Second Half.

5.5.4.4 SART SDRT

There was no evidence of an indirect effect on SDRT in the first half of the attention task (Appendix A.4). In the second half of the task, the mindful engagement intervention indirectly influenced SDRT relative to the unguided control group, through the higher level of experienced state mindfulness: mindful engagement indirect effect -3.59, $SE = 2.06$, 95% CI = -8.17, -0.28 (Figure 5.5f).

5.5.4.5 SART moment-to-moment and gradual variability

There was no evidence of the engagement interventions indirectly influencing gradual variability or moment-to-moment variability on the attention task in the first or second half (Appendix A.4).

5.6 Discussion

The present study compared the efficacy of three brief engagement interventions in nature on psychological outcomes, revealing that different types of engagement in nature may be suited to distinct outcomes. Our findings indicated that the mindfulness intervention led to higher levels of state mindfulness than the unguided control group, though not a statistically higher level than the directed engagement and mind wandering groups (partially supporting H1a). Although it is possible that the mindful engagement group gained a better understanding of mindfulness through the intervention tasks, and therefore responded differently on the state mindfulness questionnaire (Van Dam et al., 2012), the lack of difference between the other groups suggests that the contrast with the unguided control group was meaningful. It was expected that the mindful engagement group would have significantly higher levels of state mindfulness than the directed engagement and mind wandering groups, consistent with previous research that compares mindfulness with other engagement interventions (Aspy & Proeve, 2017; Rahl et al., 2017) including mind wandering (Arch & Craske, 2006; Kiken & Shook, 2011). Other studies that use brief (15-20min) mindfulness interventions in nature have similarly observed no significant effects on state mindfulness (Nisbet et al., 2019; Unsworth et al., 2016).

There were significant differences between the intervention groups on the following outcomes: negative affect, and four measures on the first half of the post-test attention task – commission errors, SDRT, moment-to-moment variability, and gradual variability. The differences between groups were not in the directions hypothesised (H1 and H2). The directed engagement group experienced significantly higher negative affect than the mind wandering group. Although the directed engagement group were asked to spend the final five minutes noticing beauty in nature, which can lead to positive wellbeing outcomes (Capaldi et al., 2017), they were also asked to be reflective and judge their environment, which may have led to negative emotional responses (Pasanen et al., 2018).

The finding that the mind wandering group had the lowest levels of negative affect was not expected, but perhaps unsurprising, given the mixed literature relating to the possible benefits of mind wandering in the right context (Schooler et al., 2014). Franklin et al. (2013) found that although instances of mind wandering are typically associated with lower mood, the opposite is true when thought content is interesting and useful. We propose that being in nature and on a work break may provide an interesting context for mind wandering, and explain our finding that this group had the best mood outcomes. This argument is supported by a recent study that examined the contents of written thoughts during outdoor experiences, and found that these experiences are commonly associated with positive introspection (Schertz et al., 2018).

Performance on the post-test attention task demonstrated that the unguided control group had the highest level of attention restoration during the nature experience, and that the directed engagement group had the lowest level of attention restoration. For the first half of the post-test attention task, the unguided control group performed significantly better on each of the measures (lower commission errors, SDRT, moment-to-moment and gradual variability) than the directed engagement group, and performed better than all groups on SDRT. The directed engagement group had lower performance than all groups on the first half of the attention task for gradual variability, and lower performance on commission errors than the mindful engagement group. By the second half of the task, all groups were performing similarly. We offer three possible explanations for these findings. First, it is plausible that the exercises were somewhat cognitively effortful for participants, resulting in poorer attention performance for the directed engagement group and the highest attention restoration for the unguided group. Lymeus et al. (2017) demonstrate that mindful engagement exercises incur some initial attentional effort, and this may also be the case for our engagement exercises. Second, the unguided control group did not have to use their phone during the outdoor experience: previous research shows that engaging with technology during an outdoor break is detrimental to attention restoration (Jiang et al., 2019). Third, as noted above, the directed engagement group's intervention exercises may have directly contributed to a less restorative experience for this group. These findings overall raise the question of how the unguided control group engaged during their experience. Although we did not instruct or assess their activity in the environment, the context of a work break may have allowed this group to engage in activities that suited their needs and, as the results suggest, avoid tasks that tax attention.

A surprising finding was that there was no difference between intervention groups on connection with nature after the nature experience. Similar studies have found that higher engagement during short nature experiences leads to a stronger sense of nature connection, with large effects (Lumber et al., 2017; Nisbet et al., 2019). We note that Lumber et al.'s engagement intervention was specifically designed to strengthen nature connection based on theoretically grounded pathways to this outcome. While the mindful engagement and directed engagement interventions in the current

study involved some engagement with the external, natural environment, the interventions also involved other concepts such as observing body and thoughts. Interventions that are designed to target specific outcomes from engagement in nature may be most beneficial (for example, Lumber et al.'s nature connection exercises (2017), or Pasanen et al.'s restoration-enhancement exercises (2018)).

There is partial support for our hypothesis that mindfulness during the experience would function as a mediator of the effect of the engagement intervention on psychological outcomes. For all three intervention groups compared with the unguided control group, the engagement intervention resulted in a higher level of connection with nature as a result of the positive effect of the intervention on experienced state mindfulness. For positive affect, negative affect, mean RT, SDRT, and commission errors, indirect effects through state mindfulness were observed only for the mindful engagement group. These findings are consistent with past research that links state mindfulness in nature with connection with nature (Nisbet et al., 2019) and affect (Stewart & Haaga, 2018). Other studies have shown that simply being in nature increases state mindfulness (Brymer et al., 2021; Hamann & Ivztan, 2016). Stewart and Haaga (2018) demonstrated that state mindfulness may mediate the effect of exposure to virtual nature on positive affect and psychological wellbeing. Our findings are consistent with these studies, though we extend this work by proposing an indirect pathway between specific engagement techniques and these outcomes as a result of state mindfulness experienced in nature.

Several limitations of the study should be noted. We designed the intervention to be entirely online, which posed both strengths and weaknesses to the overall study. A strength of this design was that the intervention could be delivered to individuals under a range of circumstances, including restrictions associated with the COVID-19 pandemic. Weaknesses, however, included a high rate of attrition, being unable to monitor compliance with intervention instructions, and the use of smartphones during the outdoor break – which may have been disruptive to restoration (Jiang et al., 2019). Further to this, participants could spend their break how they preferred, as they were not given instructions other than the engagement exercises; although this design feature improves ecological validity, there was likely much variation in the experience of different participants that was not monitored. Future research may explore similar interventions that deliver instructions in-person and/or use a measure that assesses individual behaviour and activities during the experience. The nature of the online intervention also meant that participants could choose any outdoor environment near their home, so some environments may not have had many natural features at all. This limitation may have impacted the mindful and directed engagement groups who were asked to notice and find beauty in nature; however, even in the most constrained outdoor environments, viewing the sky, clouds and weather can function as a positive source of restoration and nature contact (T.-Y. Lin et al., 2022; Richardson et al., 2015).

5.7 Conclusion

Our study directly compared mindful and other forms of engagement in nature. It contributed to a better understanding of the role of engagement in nature experiences, showing that such interventions need to be carefully designed and applied. First, interventions designed to heighten *mindful* engagement in nature may benefit from alternative designs or applications (for example, using guided meditations, Lymeus et al., 2018), as our mindful engagement group did not experience a higher level of state mindfulness than the other two experimental groups. Second, simply engaging more with an experience does not necessarily lead to benefit: the directed engagement group had the least restorative experience in this study. Instructions must therefore be designed with specific intention. If one is looking to restore attention, for example, our results indicate that an unguided experience may be most useful. On the other hand, mind wandering in nature may improve mood greater than other forms of engagement. To our knowledge this is the first study that has applied mind wandering as an experimental intervention in nature, and further research is needed to understand whether and how mind wandering may benefit different types of nature experiences.

5.8 References

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6 Chapter 6.

Examining the facets of mindful engagement and mind wandering in nature

6.1 Overview

This chapter focuses on the experience of cognitive engagement in nature – specifically state mindfulness and state mind wandering in nature – and the influence of these engagement forms on psychological outcomes of the nature experience. Having previously established the direct effect of engagement *interventions* in nature on psychological outcomes (Chapter 5, published as Macaulay et al., 2022c), this chapter examines the forms of engagement that underpin intervention effects. Here engagement is positioned as a component of the nature experience that forms through associations with environmental and personal contexts (rather than strictly through an intervention effect). We can then examine intervention instruction as an effect that sits within, and interacts with, the environmental and personal contexts that are likely to shape the experience of engagement in nature. This approach will allow a more focused understanding of the function of cognitive engagement in nature and the various factors that shape engagement.

This chapter draws on additional data from the experimental study conducted in Chapter 5, where 215 participants were involved in an outdoor engagement intervention and completed pre- and post-experience surveys on a range of psychological measures. This chapter is being prepared for submission to the *Journal of Environmental Psychology*, building on the published findings in Chapter 5.

6.2 Abstract

Mindfulness and mind wandering may both enhance the psychological outcomes of nature experiences. Both mindfulness and mind wandering are conceptualised to comprise multiple facets, which are specific components of these mental states that may differentially predict psychological outcomes. However, associations between these different facets and psychological outcomes of nature experiences 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 different environmental and personal circumstances on these engagement facets in nature. We conducted an experiment in which participants were instructed on how to engage with nature during a 20min outdoor experience. Participants were allocated into one of four groups, each given different engagement instructions: mindful engagement, directed engagement, mind wandering, and an unguided control group. Each group completed online surveys before and after the outdoor experience, measuring connection with nature, positive and negative affect, state mindfulness and mind wandering in nature, and perceived restorativeness of the experience. They also completed the Sustained Attention to Response Task (SART) and reported on the characteristics of the environment they visited.

Through an exploratory factor analysis, we found that the measure of state mindfulness assessed three facets – decentering, noticing and accepting the internal experience, and body awareness, and the measure of mind wandering assessed two facets – mindlessness, and pleasant mind wandering. Regression analyses revealed associations between these facets and outcomes of the nature experience: 1) decentering was associated with better outcomes for connection with nature and mood; 2) mindlessness was positively associated, while pleasant mind wandering was negatively associated with negative affect; and 3) contrary to expectations, noticing and accepting the internal experience was associated with poorer outcomes for negative affect and measures on the SART. Further analyses examined contextual factors that influenced engagement during the nature experience. Perceived restorativeness was a strong predictor of each mindfulness and mind wandering facet, while the environmental characteristics factor was only a weak predictor. Personal contextual factors of trait mindfulness and nature connection led to higher engagement with nature, while negative affect before the nature experience was associated with higher awareness of thoughts and emotions, and mindlessness. 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.

6.3 Introduction

In this paper we focus on mindfulness and mind wandering as engagement forms that can emerge in and alter the experience of nature. Both have the potential to enhance psychological outcomes of nature experiences, including nature connection, mood, and attention restoration (Lymeus et al., 2018; Nisbet et al., 2019; Williams et al., 2018; Macaulay et al., 2022c). Past studies have demonstrated the value in deconstructing the facets of both mindfulness (e.g., Coffey et al., 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 et al., 2017; Sadowski et al., 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 et al., 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 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 higher outcomes of psychological restoration and nature connection. This contribution is important for both theoretical development and informing the design of nature-based engagement interventions. Theoretically, this paper will provide insight into the pathways between engagement and restoration and nature connection. Practically, given that mindfulness and mind wandering can be applied and practiced in a variety of ways in nature, this will allow for more targeted engagement interventions that focus on the facets known to strengthen outcomes of restoration and nature connection. 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 contextual circumstances – environmental and personal – that influence the experience of mindfulness and mind wandering in nature, to test the conditions in which their key facets lead to psychological outcomes. Within these analyses, we consider how interventions that are designed to enhance engagement in nature work alongside these other factors in the nature experience. By examining concurrent mechanisms (i.e., contextual circumstances, engagement facets, and intervention effect), we provide a more nuanced understanding of intervention effects on psychological outcomes of nature.

In this paper we refer to specific terms related to engagement. We provide the following definitions in Table 6.1 for clarity.

Table 6.1. 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 (within a nature experience)	Mindful engagement; mind wandering; focused attention
Engagement facet	The distinct components or elements that comprise an engagement form	Present moment-awareness; nonjudgment (mindfulness)
Engagement practice	The technique or behaviour employed to cultivate an engagement form	Paying attention with curiosity and openness (mindful practice); or, intentionally letting thoughts drift in and out (deliberate mind wandering).

6.3.1 Mindfulness and mind wandering in nature experiences

Both mindfulness and mind wandering encompass a variety of cognitive processes and practices. 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, empirical literature that measures mindfulness and mind wandering alongside each other often use unidimensional operationalisations of the 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 of the impacts and mechanisms of these forms of engagement (Seli et al., 2015). We must avoid adopting this limited approach into literature 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 mindfulness and mind wandering in nature experiences. In the following we review how mindfulness and mind wandering - and their underpinning facets - are applied in nature experiences.

Mindfulness has been applied in nature in a variety of ways. 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). 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 et al., 2008; Lutz et al., 2015; Vago & Zeidan, 2016). The empirical literature examining mindfulness in nature reflects this diversity of practices. One study tested whether a six-week mindfulness course could be beneficially taken into an outdoor environment, and used a range of exercises including focused attention and body scans (Choe et al., 2020). Lymeus and colleagues (2018) similarly tested the benefits of mindfulness in a restorative natural environment, although in their study mindfulness was primarily based on open monitoring practice, where one observes all internal and external phenomena with curiosity and openness. Studies that examine whether psychological outcomes of nature exposure are enhanced with the addition of mindfulness tend to apply a form of mindfulness that focuses on the sensory experience (Shin et al., 2013) and external environment (Nisbet et al., 2019). These experimental studies have shown that mindfulness during a nature experience can improve connection with nature (Nisbet et al., 2019), anxiety, and happiness (Shin et al., 2013).

There are theoretical explanations for how the facets of mindfulness may strengthen psychological outcomes of nature experiences, though empirical evidence for these is limited. In nature, mindfulness may support psychological outcomes via several mechanisms: a detachment from the subjective experience (decentering) that leads to greater immersion in and connection with nature (Hanley et al., 2017); heightened awareness and engagement with the sensory experience (Barbaro & Pickett, 2016; Nisbet et al., 2019); and acceptance and nonjudgment towards the experience of nature (Wang et al., 2016). We have previously summarised this literature into three key mechanisms that may underpin the benefits of mindfulness in nature: decentering, perceptual sensitivity, and non-reactivity (Macaulay et al., 2022a). These and other facets of mindfulness are operationalised with various self-report instruments, some of which have been used in nature experience studies. Nisbet et al. (2019) found that a short mindfulness intervention in nature heightened the sense of decentering, but not level of curiosity with one's experience, as measured with the Toronto Mindfulness Scale (Lau et al., 2006). Stewart and Haaga (2018) found that nature exposure led to higher mindfulness as measured with the MAAS, which measures attention and distraction, but not higher mindfulness on the State Mindfulness Scale (Tanay & Bernstein, 2013), which measures awareness of mental events and bodily sensations. Their study also indicated that mindfulness (as measured with the MAAS) mediated the positive effect of nature exposure on psychological wellbeing and positive affect, suggesting a link between the attentional dimensions of mindfulness and affective benefits of nature. Taken together, these studies provide some initial evidence for links between nature exposure and decentering and mindful attention, however, no studies have examined yet how these aspects of mindfulness contribute to outcomes of the nature experience.

There is some theoretical and empirical evidence for the benefit of mind wandering in nature. 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).

In nature experiences, mind wandering in nature can lead to calming and restorative benefits (Macaulay et al., 2022b), and there is some evidence for the potential of nature experiences to generate positive introspection (Cervinka et al., 2020). Theoretical accounts of mind wandering in nature suggest that fascinating, undemanding qualities in nature enable introspection and mind wandering, which may lead to better creative thinking (Atchley et al., 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 the mind wandering experience will likely affect the consequences of mind wandering in nature (Seli et al., 2015; Smallwood & Andrews-Hanna, 2013). Across several papers, Seli and colleagues (2015; 2016; 2017) demonstrated that intentional and unintentional mind wandering are distinct forms of mind wandering. Spontaneous, unintentional mind wandering is associated with a lack of control and inattentiveness, while deliberate, intentional mind wandering is associated with goal-directed thought and relief from boredom (Carriere et al., 2013; Seli, Risko, & Smilek, 2016). Mind wandering that is productive, future-oriented and/or sufficiently interesting is associated with positive psychological outcomes such as 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, an intentional form of mind wandering may lead to positive psychological outcomes, where an individual is facing low cognitive demands, is supported by aesthetically pleasing and fascinating natural qualities, and has the capacity to engage in goal-directed or otherwise engaging thought (Seli, Risko, Smilek, et al., 2016; Williams et al., 2018). Unintentional, spontaneous mind wandering may occur in nature if an attempt to focus on a current task is hindered by attention being drawn away due to some salient external or internal stimulus (Carriere et al., 2013). Taken together, we suggest that both deliberate and spontaneous mind wandering may occur in nature and impact outcomes in contrasting ways.

6.3.2 Diverse contexts influence engagement in nature experiences

Environmental factors are likely to impact how mindfulness and mind wandering occur in nature experiences: that is, whether an environment generally supports these forms of engaging, and the influence of the environment on their underlying facets. A restorative environment with fascinating qualities is proposed to support learning 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 restorative environments. In more constrained environments, such as busy urban green spaces, or uninteresting and non-fascinating 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 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 uninteresting 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 environmental effects on the facets of mindfulness and mind wandering.

Personal contextual factors such as individual levels of trait mindfulness or 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 et al., 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 et al., 2014) also changes the context within a nature experience. While existing literature examines this contextual change on psychological outcomes of the nature experience directly (e.g., Macaulay et al., 2022c; Pasanen, Johnson, et al., 2018), here we consider the effect of intervention instructions as occurring within the holistic context of the nature experience, and therefore examine potential interactions with environmental and personal characteristics. We have previously considered the effect that mindfulness could have on the experience and outcomes of nature in environments that are somewhat constrained (Macaulay et al., 2022a). For example, while in a restorative environment mindful engagement may heighten immersion in and contact with nature through a decentered subjective experience, in a constrained environment decentering may function to heighten psychological distance from subjective constraints and support restoration. These ideas remain exploratory and require testing, to understand how intervention instructions might change the influence of contexts on engagement.

6.3.3 Current study and research questions

Our first aim in this study was to examine the underpinning facets of mindfulness and mind wandering in nature, including what shapes them, and how they affect outcomes. Our second aim was to examine the role of intervention instructions on engagement within this base set of relationships.

The following research questions reflect the focus of these two aims, foregrounding an analysis of engagement facets in nature – the contexts that influence them and the outcomes they influence – and then analysing the effect of intervention instructions within these associations (Figure 6.1). To start, we identified the key facets of engagement in nature. We then asked whether the engagement intervention instructions influenced these facets differently. Our first research questions are thus:

- 1a.** What are the facets of mindfulness and mind wandering in nature experiences?
- 1b.** Do instructions to engage in different ways influence the facets of mindfulness and mind wandering in nature?

We then examined contextual influences on mindfulness and mind wandering in nature, to understand the parameters of these forms of engagement. Contexts we examined include environmental and personal characteristics. To test the role of intervention instructions within these associations, we analysed whether instructions influenced the relationship between context and engagement in nature. We asked:

- 2a.** How do environmental and personal contextual factors influence the facets of mindfulness and mind wandering in nature?
- 2b.** Do engagement intervention instructions moderate the association between environmental and personal characteristics and 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 the 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 Figure 6.1 below.

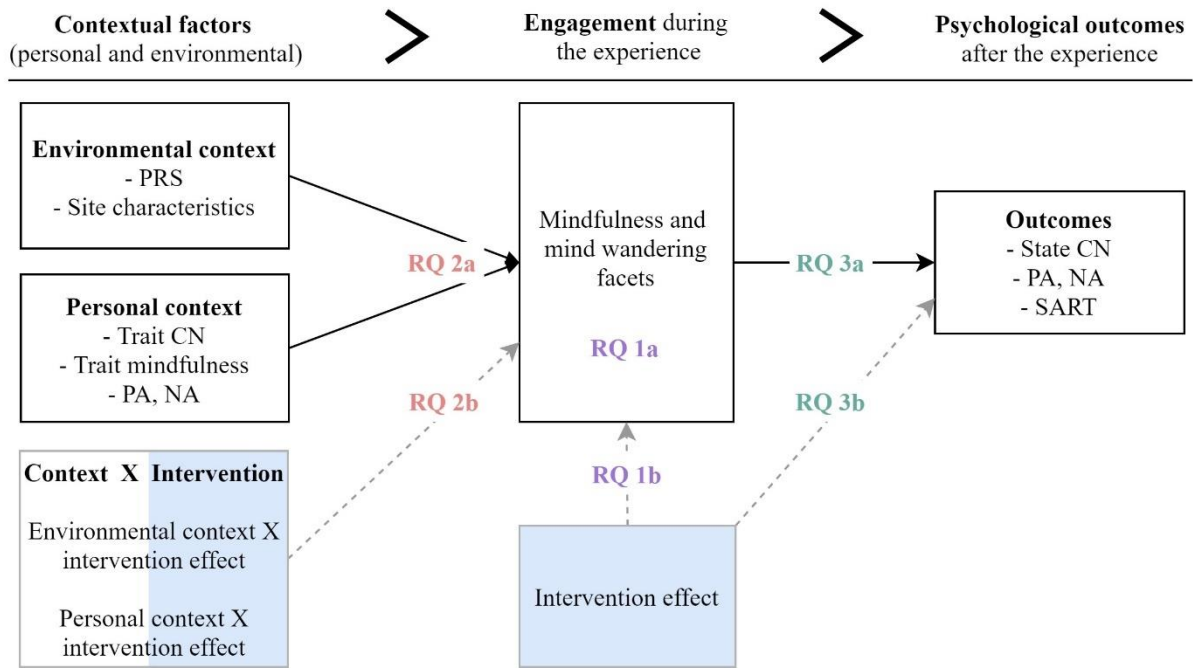


Figure 6.1. Conceptual representation of research questions (RQ). The bolded lines and boxes (RQs 1a, 2a, 3a) represent our first aim of testing the set of relationships that form the engagement experience and outcomes of engagement in nature; the grey lines and boxes (RQs 1b, 2b, 3b) represent our second aim of testing the role of intervention instructions within these relationships. Blue shading represents the effect of intervention instructions. PRS = Perceived restorativeness; CN = Connection with nature; PA = Positive affect; NA = Negative affect; SART = Sustained attention to response task.

6.4 Method

The current chapter uses the same data collection method and dataset as used in Chapter 5. Provided here is a brief overview of the method with key aspects highlighted that are relevant for the current chapter.

6.4.1 Participants and procedure

Participants ($n = 215$) were recruited through online advertising and newsletters and were mostly staff and students at the University of Melbourne. The majority of participants were female (74%) and the mean age was 24.3 years ($SD = 9.4$).

Participants were asked to spend 20-mins in an outdoor environment. 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 during the outdoor experience, perceived restorativeness of the outdoor experience, and reported characteristics of the environment they visited. After the pre-test survey, all

participants were instructed to visit 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 to the experience in ways distinct from mindful qualities ('directed engagement'; $n = 55$); a group instructed to let their minds wander during the outdoor experience ('mind wandering'; $n = 57$); and an unguided group who received no engagement instructions ('unguided control'; $n = 54$). Full instructions are provided in Appendix A.2.

6.4.2 Measures

The following measures and psychological outcomes were described in Chapter 5, and are used in the current study:

- *Trait and state connection with nature*: measured with the Connectedness to Nature Scale short-form (CNS; Mayer & Frantz, 2004; Pasca et al., 2017);
- *Trait mindfulness*: measured with the 14-item Freiburg Mindfulness Inventory (FMI-14; Walach et al., 2006);
- *State mindfulness during the nature experience*: measured with the State Mindfulness Scale (SMS; Tanay & Bernstein, 2013); subscales from the Multidimensional State Mindfulness Questionnaire (MSMQ; Blanke & Brose, 2017) that measure nonjudgmental acceptance and non-reactivity; and the decentering subscale from the Toronto Mindfulness Scale (TMS; Lau et al., 2006);
- *Positive affect (PA) and negative affect (NA)*: measured before and after the nature experience with the Positive and Negative Affect Schedule (Watson et al., 1988);
- *Environmental characteristics*: measured with 11 items that reflect the restorative features in the environment (Appendix A.3), and totalled into a single factor representing the quality of the environment for restoration;
- *Sustained attention*: measured using the Sustained Attention to Response Task (SART; Johnson et al., 2007; Robertson et al., 1997). In this chapter we use the mean and standard deviation response time and commission errors.

The following measures have not been described previously and are used in the current study.

6.4.2.1 State mind wandering during the nature experience

We used a measure of state-level mind wandering that asked participants about their mind wandering during the outdoor experience. We wanted to capture the multidimensional nature of mind wandering, so used items from the following scales: the Mind Wandering- Deliberate (MW-D) and the Mind Wandering- Spontaneous Scales (MW-S; Carriere et al., 2013) that measure deliberate, intentional mind wandering (for example, "*I allowed my thoughts to wander on purpose*"), and unintentional, spontaneous mind wandering (for example, "*It felt like I did not have control over when my mind would wander*"); and the 5-item state version of the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) that measures mindlessness or a lack of awareness (for example, "*I was finding myself preoccupied with the future or the past*"). Participants were asked to rate items based on how well they reflected their outdoor experience, from 1 (Not at all) to 5 (Extremely).

Scores were summed and higher scores indicate a greater level of mind wandering during the nature experience ($\alpha = .84$).

6.4.2.2 Perceived restorativeness

We used four items from the Perceived Restorativeness Scale (PRS; Hartig et al., 1997). The PRS was chosen as a measure of the environmental context; although perceived restorativeness measures how an individual relates to and perceives their environment, we reasoned that this scale would complement the environmental characteristics factor in measuring the multiple ways an environment can influence one's experience in nature. The PRS items measure fascination with the environment/experience (*The setting has fascinating qualities; My attention is drawn to many things here*) and a sense of being away from everyday demands (*It is an escape experience; Spending time here gives me a good break from my day-to-day routine*). Participants were asked to rate each item based on how well it reflected their outdoor experience from 1 (Not at all), to 7 (Completely).

6.4.3 Analysis

All analyses were conducted using SPSS version 27. Assumptions of the following statistical tests were assessed and satisfied, including homoscedasticity of the regression models, normal distribution of residuals, and multicollinearity. As in Chapter 5, negative affect was transformed using an inverse function.

1. Exploratory factor analysis of mindfulness and mind wandering scales (RQ1a).

Mindfulness and mind wandering variables were entered into separate factor analyses to identify the underlying dimensions of these distinct constructs¹. Exploratory factor analysis using principal axis factors and direct oblimin rotation was used as these tests are appropriate in identifying latent dimensions when factors may be correlated (Fabrigar & Wegener, 2012; Hair et al., 2014). Choosing the number of factors to retain was based on an assessment of the scree plot and eigenvalues, practical and statistically significant item loadings and cross-loadings, and conceptual consistency (Costello & Osborne, 2005; Hair et al., 2014).

2. Analyses of covariance (ANCOVAs) answering RQ1b: are there differences between the intervention instructions on mindfulness and mind wandering and their facets?

¹ Due to the possible conceptual overlap between state mindfulness and state mind wandering items, and the exploratory nature of our investigation of engagement forms in nature, an exploratory factor analysis (EFA) was first attempted that included both state mindfulness and state mind wandering items. The clearest solution was a five-factor solution that contained factors similar to those identified in the separate mindfulness and mind wandering models (three mindfulness factors and two mind wandering factors that have conceptual similarity to the final factors described in the results section). Although Bartlett's test of sphericity and the Keiser-Meyer-Olkin test (KMO = .88) demonstrated suitability for these items in the model, the factor structures contained many high cross-loadings and low item loadings. We chose to conduct the EFAs separately for mindfulness and mind wandering, considering that these are distinct forms of engagement that likely contain their own dimensions and subfactors.

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.

3. Regression analyses answering RQ2a: how do environmental contexts (reported environmental characteristics, and perceived restorativeness) and personal factors (mood, trait mindfulness, trait nature connection) predict engagement facets?

A series of regression analyses demonstrated the relative influence of perceived restorativeness and the environmental characteristics factor on the facets of state mindfulness and mind wandering in the nature experience. Perceived restorativeness and the environmental characteristics factor were entered into a regression analysis together to predict separate engagement facets.

A second series of regression analyses demonstrated the associations between personal factors (individual disposition before the nature experience) and the facets of state mindfulness and mind wandering during the nature experience. Trait mindfulness, trait connection with nature, and positive and negative affect before the nature experience were entered into regression analyses together to predict the different engagement facets.

4. Moderation analyses answering RQ2b: do intervention instructions (group allocation) moderate the associations between contextual factors and engagement?

Having analysed how contextual factors influence and shape engagement during the nature experience (step 3 above), a next step was to test whether the intervention instructions would moderate this effect of context on engagement. A series of regression analyses were conducted that tested interaction terms between intervention groups and each contextual factor (i.e., perceived restorativeness, the environmental characteristics factor, trait mindfulness, trait nature connection, positive and negative affect). For the intervention group, dummy variables were created where each intervention group (mindful engagement, directed engagement, and mind wandering) was compared with the unguided control group. The interaction terms thus signified whether the contextual factor (e.g., trait nature connection) influenced the engagement facet (e.g., decentering) to a different degree depending on group allocation (e.g., mindful engagement compared with the unguided control).

5. Regression analyses answering RQ3a, how does each facet of mindfulness and mind wandering predict psychological outcomes; and RQ3b, do intervention instructions influence these outcomes when accounting for mindfulness and mind wandering in the experience?

To test how mindfulness and mind wandering during the nature experience influenced psychological outcomes, we conducted separate multiple regression models where engagement facets and intervention groups 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 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., the mindfulness and mind wandering engagement facets).

We reasoned that if intervention groups (dummy variables as described above) did significantly influence outcomes in the overall model, then a follow-up analysis would be used to test the interaction between group and engagement. This follow-up analysis would allow us to identify whether the facets of mindfulness and/or mind wandering were associated with outcomes differently depending on group allocation. In only one regression model (predicting standard deviation of response time) intervention group had a significant influence on the outcome variable, so we conducted the follow-up interaction model (described below).

6.5 Results

6.5.1 Exploratory factor analysis of mindfulness and mind wandering questionnaires

State mindfulness

To understand the facets of mindfulness that were present in the nature experiences in this study (RQ1a), we conducted an exploratory factor analysis containing all 26 items measuring state mindfulness. Bartlett's test of sphericity ($\chi^2 = 1808.6$, $df = 210$, $p < .001$) and Keiser-Meyer-Olkin test (KMO = .902) demonstrated that the 26 items were suitable for exploratory factor analysis in the current sample. Both the eigenvalues and the scree plot suggested a three or four factor solution, and conceptually we expected four factors derived from the questionnaire subscales that we used. A four-factor solution produced an unclear factor structure, with one factor containing low item loadings and several cross-loadings. A three-factor solution produced a clearer factor structure and better interpretability. Five items in this solution did not fit well: these items had two of either cross-loadings on other items, low item loadings ($< .4$), and/or low communality ($< .3$). These items were taken out of the analysis one by one to try and improve the factor structure and loadings. Ultimately, a three-factor solution without these items improved the fit and interpretability of the factors.

The latent factors were interpreted as: decentering, noticing and acceptance of internal experience, and body awareness (Table 6.2). The items that loaded highly on *decentering* were expectedly from the TMS decentering subscale, plus three items from the MSMQ non-reactivity subscale, and one item from the SMS mind subscale. This factor represents distance and deidentification with the ongoing personal experience (Lau et al., 2006). The items that loaded highly on *noticing and acceptance of internal experience* were a mix from the MSMQ nonjudgment subscale and the SMS mind subscale. We interpreted this factor to involve both an awareness of internal (mental) phenomena, and a quality of acceptance and nonjudgment towards the internal experience.

The third factor, *body awareness*, was expectedly comprised of high loadings from items on the SMS body subscale.

Table 6.2. The exploratory factor structure of the state mindfulness measures

State mindfulness items	F1 Decentering	F2 Noticing and accepting of internal experience	F3 Body awareness	Communalities
I accepted my thoughts/feelings without dwelling on them	0.82			0.60
I was receptive to observing unpleasant thoughts and feelings without interfering with them.	0.69			0.53
I experienced myself as separate from my changing thoughts and feelings.	0.58			0.50
I noticed thoughts come and go	0.57			0.43
I was more concerned with being open to my experiences than controlling or changing them.	0.56			0.40
I was aware of my thoughts and feelings without overidentifying with them.	0.55			0.64
I approached each experience by trying to accept it, no matter whether it was pleasant or unpleasant.	0.54			0.48
I was more invested in just watching my experiences as they arose, than in figuring out what they could mean.	0.53			0.45
I did not immediately react to the thoughts/feelings that popped into my head.	0.53			0.42
I did not get engrossed in my thoughts/feelings.	0.44			0.23
I judged the things that were running through my head. (R)		0.65		0.42
I thought some of my thoughts/feelings were slightly off. (R)		0.65		0.46
Things went through my mind that I should not really be engaging myself with. (R)		0.62		0.41
I noticed pleasant and unpleasant thoughts		0.62		0.49
I noticed pleasant and unpleasant emotions		0.60		0.57
I thought I could have acted more appropriately at a certain time. (R)		0.53		0.29
I was aware of different emotions that arose in me		0.49		0.44
I clearly physically felt what was going on in my body			0.66	0.49
I noticed physical sensations come and go			0.64	0.57
I changed my body posture and paid attention to the physical process of moving			0.51	0.26
I felt in contact with my body			0.46	0.45
Cumulative % of variance	33.52	46.80	52.91	

Note. Direct oblimin rotation used. Item loadings < 0.40 have been removed. (R) = reverse scored.

State mind wandering

To understand the facets of mind wandering that were present in the nature experiences in this study (RQ1a), we conducted an exploratory factor analysis containing the 11 items measuring state mind wandering. Bartlett's test of sphericity ($\chi^2 = 504.7$, $df = 36$, $p < .001$) and Keiser-Meyer-Olkin test (KMO = .81) demonstrated that the 11 items were suitable for exploratory factor analysis in the current sample. The eigenvalues and scree plot inflexion suggested selecting two factors for rotation. A two-factor solution produced a relatively clear factor structure, however we assessed the item loadings, cross-loadings and communalities to determine if the factors were appropriate. Two items had significant cross-loadings. These items were taken out of the analysis one by one and tested again. The resulting two-factor solution produced two clear factors with statistically significant item loadings and conceptual interpretability (Table 6.3). The latent factors were interpreted as: mindlessness, and pleasant mind wandering. Items loading highly on the *mindlessness* factor included 3 items from the MAAS, and two items from the MW-Spontaneous subscale. Items loading highly on the *pleasant mind wandering* factor were three items from the MW-Deliberate subscale and one from the MW-Spontaneous subscale. We interpreted this factor as pleasant mind wandering because the items indicated an enjoyable mind wandering experience (even if not necessarily intentional).

Table 6.3. The exploratory factor structure of the state mind wandering measures

	F1 Mindlessness	F2 Pleasant mind wandering	Communalities
I was finding it difficult to stay focused on what was happening in the present.	0.84		0.64
I was finding myself preoccupied with the future or the past.	0.68		0.44
It felt like I did not have control when my mind would wander	0.55		0.39
I found myself mind wandering even when I was supposed to be doing something else	0.54		0.39
I was rushing through the experience without being really attentive to it	0.44		0.19
I found myself enjoying mind wandering		0.86	0.72
I allowed myself to get absorbed in pleasant fantasy		0.62	0.39
I allowed my thoughts to wander on purpose		0.53	0.27
I found my thoughts wandering spontaneously		0.51	0.47
Cumulative % of variance	37.7	54.66	

Note. Direct oblimin rotation used. Item loadings < 0.40 have been removed.

Once we had identified and interpreted the mindfulness and mind wandering subfactors, we explored their properties and correlations, along with the other key variables in this study (Table 6.4). All mindfulness and mind wandering (engagement) facets were positively correlated, except decentering and mindlessness (non-significant negative association).

Table 6.4. Descriptive statistics and correlations between key study variables

Factors	Alpha	<i>M</i>	<i>SD</i>	Mindfulness total scale	Noticing and acceptance	Body awareness	Mindlessness	Pleasant mind wandering
Mindfulness total scale	.91	81.08	15.12					
Mind wandering total scale	.84	32.48	7.52	.51**				
Decentering	.87	31.39	6.94		.35**	.57**	-0.03	.44**
Noticing and acceptance	.83	19.93	5.52			.48**	.52**	.50**
Body awareness	.74	13.30	2.89				.16*	.42**
Mindlessness	.76	13.77	3.97					.39**
Pleasant mind wandering	.74	13.08	3.29					

** Correlation is significant at the .01 level (2-tailed)

* Correlation is significant at the .05 level (2-tailed)

6.5.2 Intervention instructions influence engagement facets

A series of ANCOVAs revealed some intervention group differences between the underlying facets of mindfulness and mind wandering (RQ1b; Table 6.5). As expected, the mindful engagement group had the highest level of state mindfulness (total scale) overall, although this difference was only statistically significant compared to the unguided control group ($p = .004$). The unguided control group had the lowest scores of the mindfulness facet of *noticing and acceptance*. The omnibus test was significant and pairwise comparisons indicated that the unguided control group had significantly lower scores of noticing and acceptance than the mindful engagement group ($p = .006$), the directed engagement group ($p = .006$), and the mind wandering group ($p = .02$). The omnibus test for the state mind wandering facet of *mindlessness* was significant; pairwise comparisons indicated that the unguided control group had significantly lower scores of mindlessness than the mindful engagement group ($p = .009$), and the mind wandering group ($p = .01$).

Table 6.5. ANCOVAs testing the difference between intervention groups on mindfulness and mind wandering

Dependent variable <i>Covariate: trait level mindfulness</i>	Mindful engagement <i>EMM (SE)</i>	Directed engagement <i>EMM (SE)</i>	Mind wandering <i>EMM (SE)</i>	Unguided control <i>EMM (SE)</i>	Omnibus <i>F statistic</i>	Partial η^2
State mindfulness (total)	85.20 ^a (2.08)	81.17 (1.99)	81.76 (1.93)	76.87 ^b (1.94)	2.90*	.04
State mind wandering (total)	33.41 (1.09)	32.42 (1.03)	33.93 (1.00)	30.28 (1.03)	2.47	.04
Decentering	33.14 (0.92)	30.97 (0.87)	32.12 (0.85)	29.93 (0.87)	2.44	.04
Noticing and acceptance	20.95 ^a (0.79)	20.80 ^a (0.75)	20.29 ^a (0.73)	17.90 ^b (0.75)	3.56*	.05
Mindfulness of body	14.01 (0.40)	13.41 (0.37)	12.95 (0.36)	13.29 (0.38)	1.33	0.02
Mindlessness	14.54 ^a (0.57)	13.80 (0.53)	14.42 ^a (0.52)	12.48 ^b (0.54)	3.06*	0.04
Pleasant MW	13.12 (0.47)	13.15 (0.45)	13.81 (0.43)	12.30 (0.45)	1.95	0.03

* $p < .05$; ** $p < .01$

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

6.5.3 Restorativeness and environmental contextual factors influence engagement facets

To test the influence of environmental context on engagement during the experience (RQ2a), perceived restorativeness and the environmental characteristics factor were entered into multiple regression models to predict engagement facets. The regression models significantly predicted all engagement facets: decentering ($R^2 = .24$, $F(2, 206) = 31.64$, $p < .001$), noticing and acceptance ($R^2 = .13$, $F(2, 206) = 14.93$, $p < .01$), body awareness ($R^2 = .20$, $F(2, 208) = 25.60$, $p < .001$), mindlessness ($R^2 = .03$, $F(2, 208) = 3.28$, $p = .04$), and pleasant mind wandering ($R^2 = .21$, $F(2, 207) = 26.79$, $p < .01$). These models (the standardized coefficients of each predictor and their confidence intervals) are presented in Figure 6.2a below. Unstandardised coefficients and errors are reported in Appendix B (Table B.2).

Perceived restorativeness was consistently a stronger predictor of the engagement facets compared with environmental characteristics. Perceived restorativeness was positively associated with all engagement facets: decentering ($p < .001$), noticing and acceptance of internal experience ($p < .001$), body awareness ($p < .001$), mindlessness ($p = .04$), and pleasant mind wandering ($p < .001$).

The environmental characteristics factor was negatively associated with noticing and acceptance of internal experience ($p = .04$), and mindlessness during the nature experience ($p = .04$). This result indicates that more nature-rich, restorative environments were associated with a lower level of noticing and acceptance and lower level of mindlessness, when controlling for subjective perception of restorativeness of the site. Environmental characteristics was not associated with decentering ($p = .13$), body awareness ($p = .73$), or pleasant mind wandering ($p = .06$).

6.5.4 Personal contextual factors influence engagement facets

To test the influence of personal contexts on engagement during the experience (RQ2a), trait nature connection, trait mindfulness, pre-test positive affect and pre-test negative affect were entered into multiple regression models to predict engagement facets. The regression models significantly predicted all engagement facets: decentering ($R^2 = .20$, $F(4, 199) = 12.19$, $p < .001$), noticing and acceptance ($R^2 = .19$, $F(4, 20) = 20.35$, $p < .001$), body awareness ($R^2 = .20$, $F(4, 202) = 12.19$, $p < .001$), mindlessness ($R^2 = .20$, $F(4, 202) = 12.67$, $p < .001$), and pleasant mind wandering ($R^2 = .13$, $F(4, 200) = 7.67$, $p < .001$). Standardised regression coefficients and their confidence intervals are presented in Figure 6.2b below, and unstandardised coefficients are reported in Appendix B (Table B.3).

Trait nature connection was positively associated with noticing and acceptance of the internal experience ($p = .03$), and body awareness ($p = .001$), but had no significant influence on decentering ($p = .13$). Trait nature connection was positively associated with pleasant mind wandering in the experience ($p = .01$) but had no significant association with mindlessness ($p = .32$).

Trait mindfulness was positively associated with all facets of state mindfulness in the experience: decentering ($p < .001$), noticing and acceptance ($p < .001$), body awareness ($p = .02$). Trait mindfulness had no significant influence on state mind wandering in the experience: mindlessness ($p = .28$), and pleasant mind wandering ($p = .66$).

Positive affect was positively associated with decentering ($p = .04$) and body awareness ($p = .01$), but had no significant association with noticing and acceptance ($p = .06$). Positive affect was positively associated with pleasant mind wandering during the experience ($p = .02$), but was not associated with mindlessness ($p = .86$).

Inversed negative affect had a strong negative association with noticing and acceptance of the internal experience ($p < .001$). Accounting for the inversed transformation, this means that higher negative affect was associated with a higher level of noticing and acceptance. Negative affect was not significantly associated with decentering ($p = .25$) or body awareness ($p = .09$). Inversed negative affect was negatively associated with both pleasant mind wandering during the experience ($p = .003$), and mindlessness ($p < .001$). Accounting for the inversed transformation, this means that higher negative affect was associated with a higher level of mind wandering.

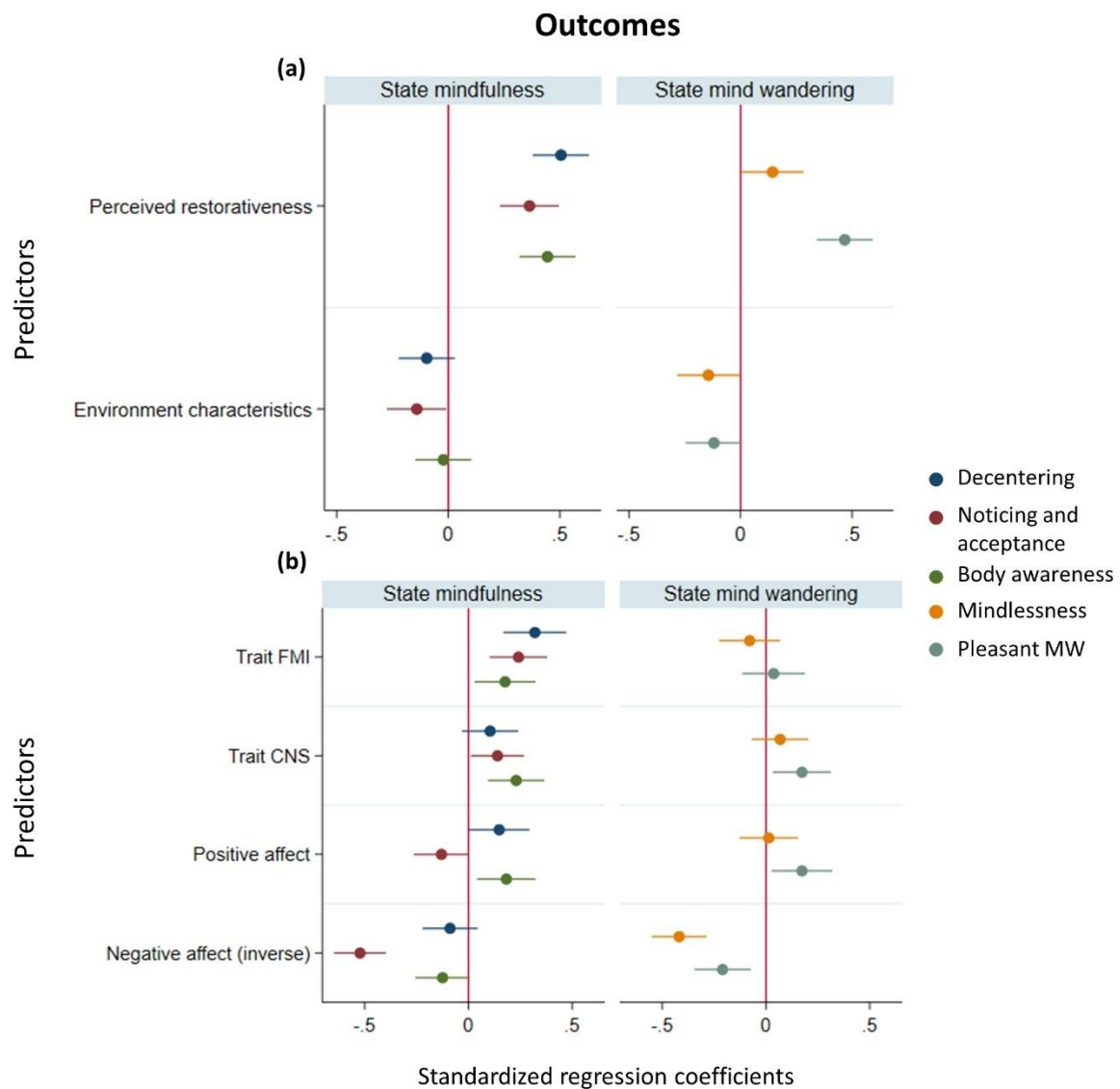


Figure 6.2. Environmental contextual factors (a) and personal factors (b) predict engagement facets in the nature experience in separate multiple regression models. Coloured circles are standardised regression coefficients and are shown with 95% confidence intervals (coloured lines). Statistically significant predictor variables do not cross zero (red 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 blue symbols represent the regression model where perceived restorativeness and the environmental characteristics factor predict the decentering facet.

6.5.5 Intervention instructions have little influence on the effect of contextual factors on engagement facets

A series of moderation analyses examined whether the environmental or personal factors influenced engagement (mindfulness and mind wandering) to differing degrees depending on

intervention group allocation (RQ2b). With one exception – noted below – there were no interaction effects observed in the moderation analyses, indicating that group allocation did not influence the degree to which the environmental (perceived restorativeness and the environmental characteristics factor) or personal factors (trait mindfulness, trait nature connection, positive and negative affect) were associated with engagement outcomes. Appendix B (Table B.4 – Table B.9) contains the results of these regression analyses.

The exception was that pre-test positive affect had a significantly stronger influence on decentering for the mindful engagement group, compared to the unguided control group (Table 6.6). The result indicates that for those in the mindful engagement group, a higher level of positive affect before the outdoor experience led to a significantly higher level of decentering during the experience, in contrast to the unguided control group (Figure 6.3).

Table 6.6. Multiple regression predicting Decentering, including interaction terms between Group and positive affect (shaded).

	<i>B</i>	<i>SE</i>	<i>p</i>
Positive affect (PA)	0.07	0.13	.59
Mindful group	3.96	1.29	.00
Directed group	1.38	1.24	.27
MW group	2.49	1.24	.05
Mindful group * PA	0.42	0.19	.03
Directed group * PA	0.24	0.18	.20
MW group * PA	0.31	0.18	.09
$R^2 = .17$			

Note: intervention groups are compared with the unguided control group as a reference group. Bold values represent significant *p* values (< .05).

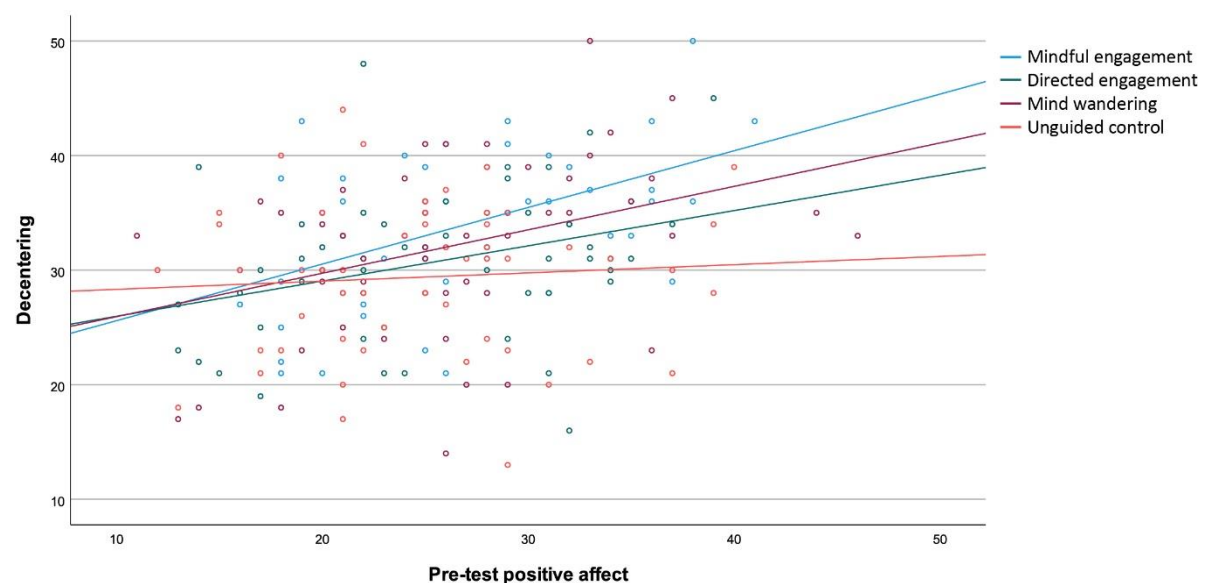


Figure 6.3. Pre-test positive affect is positively associated with decentering during the nature experience, to a significantly higher degree for the mindful engagement group compared with the unguided control group.

6.5.6 Mindfulness and mind wandering facets predict key psychological outcomes

To test the influence of mindfulness and mind wandering on the outcomes of the nature experience (RQ3a), and the role of the intervention effect within these associations (RQ3b), the five engagement facets and the intervention group dummy variables were all entered into multiple regression models to predict separate psychological outcomes. Within these models, the facets of mindfulness and mind wandering were associated with outcomes to differing degrees - Figure 6.4 displays the standardised regression coefficients for the predictor variables in each regression model, and unstandardised coefficients and errors are reported in Appendix B (Table B.1).

Decentering ($p = .04$) and pleasant mind wandering ($p < .01$) both positively associated with connection with nature, and the overall model was significant ($R^2 = .24$, $F(8, 197) = 7.90$, $p < .001$). Decentering ($p < .01$) and body awareness ($p = .02$) were both positively associated with positive affect, and the overall model was significant ($R^2 = .23$, $F(8, 197) = 7.20$, $p < .001$). Noticing and acceptance ($p < .001$) and mindlessness ($p = .02$) were negatively associated with inverse negative affect, and pleasant mind wandering ($p = .02$) was positively associated with inverse negative affect. The overall regression model for negative affect was significant, ($R^2 = .27$, $F(8, 196) = 9.07$, $p < .001$). Decentering was negatively associated with commission errors ($p = .03$), and, unexpectedly, noticing and acceptance ($p = .03$) was positively associated with commission errors. However, overall, the model did not significantly predict commission errors ($R^2 = .08$, $F(8, 173) = 1.95$, $p = .06$). Noticing and acceptance was positively associated with standard deviation RT ($p = .04$), and the model overall was significant, ($R^2 = .10$, $F(8, 173) = 2.33$, $p = .02$). The regression model did not significantly predict mean RT ($R^2 = .02$, $F(8, 173) = 0.44$, $p = .90$), and none of the engagement facets were significantly associated with mean RT.

In comparison to the unguided control group, none of the intervention groups were significantly associated with connection with nature, positive affect, negative affect, commission errors, 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 psychological outcomes. Of note, both mindful engagement ($p = .01$) and directed engagement ($p = .04$) intervention groups had positive associations with SD RT on the SART: SD RT was significantly higher in these intervention groups compared to those in 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 group and engagement facets. The model contained all possible interactions between intervention group and engagement facets. The multiple regression model did not significantly predict SD RT ($F(15, 158) = 1.10$, $p = .35$), and none of the predictor variables or interaction terms had significant associations with the outcome variable. This result suggests that engagement facets influenced SD RT similarly across all groups.

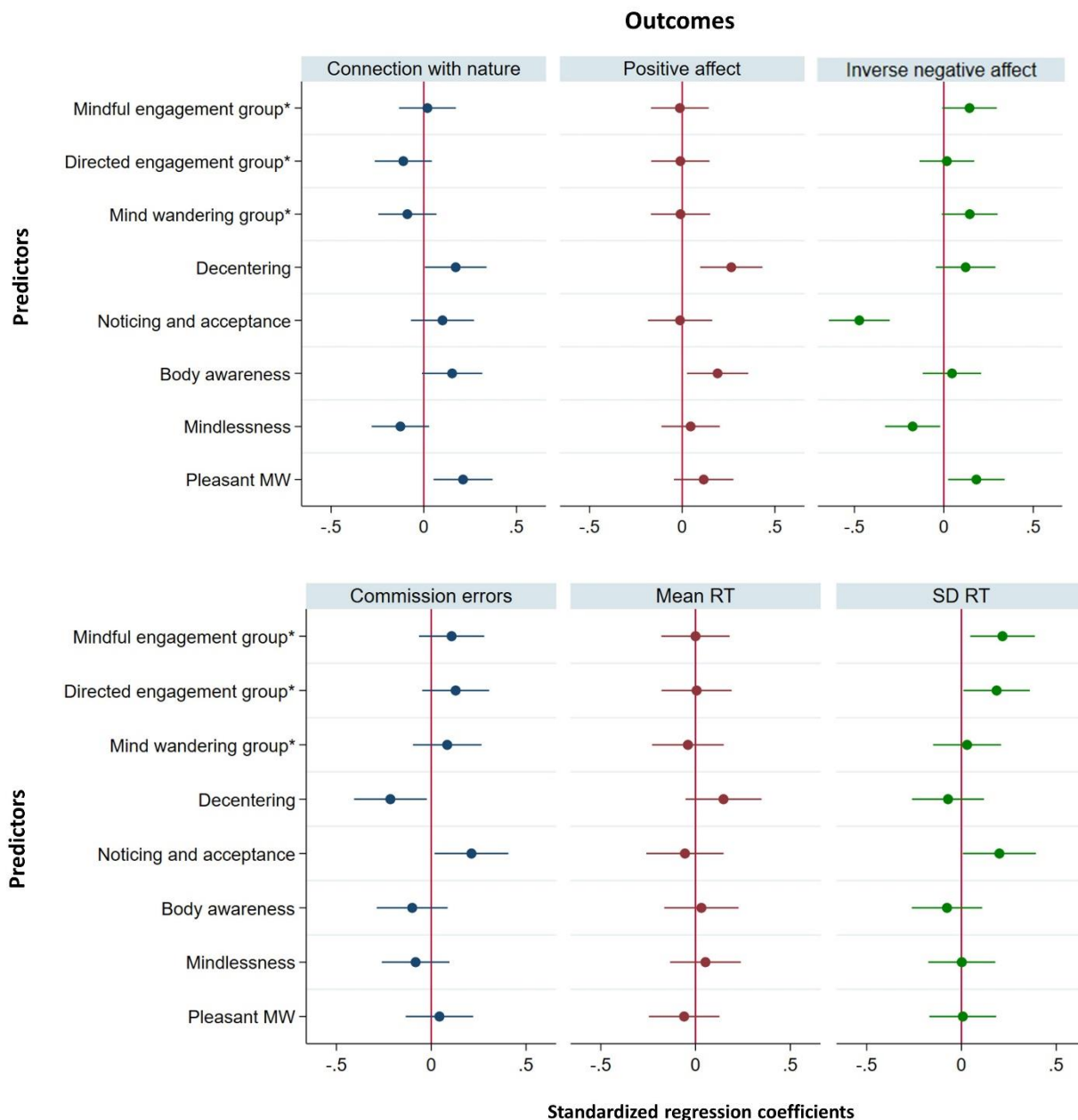


Figure 6.4. Regression models where intervention groups and engagement facets predict separate psychological outcomes. *The engagement groups are compared against the unguided control as the reference group. Coloured circles are standardised regression coefficients and are shown with 95% confidence intervals (coloured lines). Statistically significant predictor variables do not cross zero (red 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.

6.6 Discussion

This study provides novel insights into the mechanisms underpinning the effects of mindfulness and mind wandering in nature experiences, by 1) examining the underlying facets of these engagement forms that may contribute to psychological outcomes, 2) exploring the contextual parameters of mindfulness and mind wandering in nature to test whether they differ functionally in different environments and personal circumstances, and 3) testing the effect of these variables when individuals have been given specific instruction on how to engage. A key finding was that some facets of mindfulness and mind wandering sharply contrast in how they relate to psychological outcomes, which 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 and lower errors on the attention task, noticing and acceptance of the internal experience was associated with higher negative affect and more errors. We also showed that mindfulness and mind wandering in nature were influenced by how restorative an individual perceived the environment to be (and weakly related to the characteristics of the environment itself), and depend on individual factors like trait mindfulness, nature connection, and their mood. We provide an integrated summary of these findings in Table 6.7, which enables practical recommendations for implementing nature-based engagement interventions.

6.6.1 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 nature, by examining the specific facets of each that contribute to psychological outcomes of nature experiences (RQ1, RQ3a). The mindfulness facets, *decentering* and *heightened body awareness*, were associated with positive psychological outcomes. Decentering was associated with higher connection with nature, fewer errors on the attention task, and better mood after the nature experience, indicating an overall positive psychological 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 are less likely to over-identify 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. Heightened body awareness was also associated with higher positive affect. This result is in line with previous research that emphasises the role of physical, sensory stimulation in nature experiences for psychological restoration (Rickard & White, 2021).

An unexpected finding was that the mindfulness facet, *noticing and acceptance of internal experience*, had negative associations with psychological outcomes of the nature experience. Noticing

and acceptance was associated with higher negative affect, commission errors and SD RT after the nature experience, indicating that this engagement facet led to lower mood and poorer response inhibition on the sustained attention task. 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). We offer several explanations for this result. First, awareness of, or attention toward, the internal experience may have been effortful and thus led to lower performance on the attention task. Second, noticing thoughts and emotions may have led to negative mood for individuals who did not actively attempt to accept the internal experience. For individuals unfamiliar with mindfulness practice, attending to the present moment (observing or noticing internal experience) is not necessarily coupled with acceptance and nonjudgment; this can risk attention to negative mental states and result in poorer outcomes (Baer 2006; Coffey 2010).

The mind wandering facet, *mindlessness*, was associated with higher negative affect after the nature experience, while *pleasant mind wandering* led to lower negative affect. This contrast is not surprising given the qualities of these facets. Mindlessness is akin to spontaneous mind wandering, where an individual is distracted in the face of another task (Seli, Risko, & Smilek, 2016). Pleasant mind wandering, on the other hand, represents a deliberate or enjoyable form of mind wandering that is not attempted to be redirected. Deliberate mind wandering (Carriere et al., 2013) and mind wandering where the thought content is positive (Franklin et al., 2013) have shown to be associated with positive outcomes. These findings demonstrate the value in distinguishing between forms of mind wandering in nature experience, as the type of engagement may influence outcomes quite differently.

Unexpectedly, pleasant 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 pleasant 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 et al., 2009; Nisbet et al., 2011). Second, pleasant mind wandering may have led to stronger nature connection as a result of higher *contact* or 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 pleasant mind wandering and nature connection speculates on the thought content underpinning the mind wandering experience: drawing on recent findings by Lengieza et al. (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).

6.6.2 Environmental and personal contexts influence engagement in nature

Our second research question asked how environmental contexts influence engagement during the nature experience (RQ2a). We included two measures of environmental context: reported environmental characteristics to measure features of the physical environment, and perceived restorativeness, as a measure of how the participants evaluated and related to their environment. While perceived restorativeness of the experience was a strong predictor of all facets of engagement, we found that the environmental characteristics factor had a weak association with engagement during the experience, for both mindfulness and mind wandering. Small negative associations with mindlessness and noticing and acceptance indicated that a more nature rich environment reduced mindlessness, and reduced noticing and acceptance of thoughts and emotions, perhaps indicating a higher engagement with the external, sensory experience. This is consistent with theoretical underpinnings of restorative environments that engage (external) attention through soft fascination with the surrounding environment (Kaplan, 1995). More broadly, 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 et al., 2014; Marselle et al., 2014), and findings that psychological outcomes of nature depend on individual evaluations of nature, rather than environmental quality itself (Van den Berg et al., 2014). Together with findings in this study, we extend this work to suggest that individual evaluation of an environment (through perceived restorativeness) has a stronger influence on the experience of nature *and engagement in nature* than physical qualities of the environment. Including engagement as an aspect of the experience helps to build a more complete theoretical picture of the connections between environmental experiences and psychological outcomes.

The current study reveals that an individual's disposition or mood state can influence how they engage during a nature experience (RQ2a). Those who had a higher level of trait mindfulness engaged more mindfully – on all three mindful facets – during the nature experience. This result is unsurprising given the established links between trait and state mindfulness (Bravo et al., 2018), and demonstrates that those with a higher trait mindfulness will more readily attend to the present (internal and external) experience in nature. Trait nature connection was also associated with engagement during the experience: those who had a higher level of trait connection with nature were more aware of their physical sensations during the experience, were more aware of and accepting towards their internal experience, and engaged in more pleasant mind wandering. A higher negative affect before the nature experience was strongly associated with a higher degree of noticing and acceptance of the

internal experience, 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 et al., 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 et al., 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.

6.6.3 Intervention instruction effect

We examined whether engagement intervention instructions influenced the facets of state mindfulness and mind wandering (RQ1b), whether intervention group allocation moderated the effect that contextual factors had on these facets (RQ2b), and the effect of intervention instructions on psychological outcomes when controlling for facets of engagement in nature (RQ3b). The purpose of examining these relationships was to understand the influence of the intervention effect within the holistic transaction of the nature experience, where other variables like personal contexts and environmental factors were included.

First, the unguided control group experienced lower levels of noticing and acceptance of the internal experience, and mindlessness, compared with the other intervention groups (RQ1b). The unguided group were not instructed to pay attention to the internal experience at all, 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 in which participants walked outdoors without 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 and engagement in nature when accounting for other factors in the nature experience. Only one result demonstrated a significant moderation effect of intervention instructions on contextual factors (RQ2b): positive mood before the nature experience had a larger positive effect on decentering for the mindful engagement group, compared with the unguided control group. Thus, while personal and environmental contextual factors had significant influences on state mindfulness and mind wandering in nature, the engagement interventions had little effect on these relationships. Further, 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). These findings contribute to the literature on engagement interventions in nature by demonstrating the value of including measures of contextual variables and their specific influence on engagement during the nature experience. For instance, where other studies (e.g., Macaulay et al., 2022c; 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 and measures that allow analysis of how participants engage during the nature experience.

6.6.4 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 6.7). First, deidentifying with thoughts and emotions (decentering) and heightened awareness of the physical experience (body awareness) were overall associated with positive psychological states before and after the nature experience. These outcomes suggest that engagement interventions could be designed to target pathways to a decentered experience and heightened physical awareness, particularly for individuals who are already in a positive mood state. Second, noticing and acceptance of thoughts and emotions, and mindlessness during the nature experience were both associated with more negative psychological states before and 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, has demonstrated that focusing on thoughts and emotions during a nature experience has benefits for restorative outcomes (Pasanen, Neuvonen, et al., 2018); whether or not this 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. Associations with the environmental characteristics factor indicate that interventions that are applied in more restorative environments may reduce the focus on internal experience and mindlessness – likely through fascination with the external environment (Kaplan, 1995; Lymeus et al., 2018). Finally, those who had a lower mood before the nature experience engaged in deliberate, pleasant mind wandering, which was associated with better mood after the nature experience. This result positions pleasant 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).

Table 6.7. Summary of significant associations between engagement facets with contextual factors and psychological outcomes

Contextual factors (personal and environmental)	Engagement during the experience	Psychological outcomes after the experience
	Decentering	Higher positive affect Stronger connection with nature Better response inhibition and sustained attention
Higher positive affect Higher trait mindfulness Stronger connection with nature Higher negative affect Lower environmental characteristics	Noticing and acceptance	Higher negative affect Worse response inhibition and sustained attention
Higher positive affect Higher trait mindfulness Stronger connection with nature	Body awareness	Higher positive affect
Higher negative affect Lower environmental characteristics	Mindlessness	Higher negative affect
Positive affect Higher negative affect Stronger connection with nature	Pleasant 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 text indicates negative/unfavourable outcomes.

While Chapter 5 details limitations of the overall study design, there are limitations specific to the current paper that should be acknowledged and considered for future research. First, we selected measures of mindfulness and mind wandering from existing validated scales, and while this is an important feature of a strong study design, it limited our selection to scales that target specific facets of 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 combine to a measure 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 et al., 2006) would allow for examination of the broader sensory experience in nature. Second, our measure and analysis of environmental characteristics may not have captured all relevant aspects of the environments that

contributed to different types of experience and outcomes for participants. The measure was designed to reflect restorative features, based on theoretical and empirical research (e.g., Nordh et al., 2009), however, further work could examine whether these features are better examined with alternative items, or whether such a scale contains subfactors that differentially influence engagement and outcomes (for example, ‘anthropogenic’ vs natural features). Despite these limitations, the study provides novel insights into investigating the experience of engagement in certain environments, and encourages further development of methods and measures to capture these elements of nature experiences.

6.7 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 intentional and enjoyable 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.

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7 Chapter 7.

Discussion

7.1 Overview

This thesis makes a substantial contribution to our understanding of how individuals experience, engage with, and benefit from nature experiences. In this chapter, I draw on the initial conceptual framework I developed in Chapter 3 to synthesise the results of the three empirical chapters and answer the three overarching research questions that guided the thesis. In responding to these research questions, I evaluate the original conceptual framework, I draw broader implications for theoretical advancement, and I integrate these outcomes to provide practical recommendations for the design and implementation for nature-based engagement interventions. The research questions provide the structure of the chapter:

- **Research question 1:** In what ways do people cognitively engage within urban nature experiences?
 - I answer this question in Section 7.2, where I discuss the function of the mindfulness framework to understand, identify, and evaluate different forms of engagement in nature experiences.
- **Research question 2:** What are the mechanisms that link mindful and other forms of engagement with psychological restoration and connection with nature?
 - I answer this question in Section 7.3, where I review the evidence from the empirical chapters on the key mechanisms of engagement, and compare this evidence with proposed mechanisms described in Chapter 3.
- **Research question 3:** What contextual aspects of urban nature experiences influence, support, or constrain engagement?
 - I answer this question in Section 7.4, where I synthesise the environmental and personal contextual influences on engagement throughout the empirical chapters.

In Section 7.5, I draw together key findings discussed through this chapter to provide practical outcomes and future recommendations for research on nature-based engagement interventions.

7.2 Forms of engagement are identified that benefit the outcomes of nature experiences

A primary aim of this thesis was to identify the range of ways that individuals engage during urban nature experiences and how these engagement forms relate to psychological outcomes of nature. This thesis achieves this aim by first building a theoretical understanding of how qualities of engagement may associate with psychological outcomes (Chapter 3), and then empirically exploring (Chapter 4) and evaluating (Chapters 5 and 6) the influence of different engagement forms in nature. While most existing studies assessing the effects of engagement in nature do so in the context of testing nature-based engagement interventions, the findings in this thesis contribute an understanding of engagement in nature both in the absence of any engagement instructions (Chapter 4), and with intervention instructions designed to contrast specific engagement forms (Chapter 5). This allows for a more holistic view of how engagement in nature relates to psychological outcomes.

7.2.1 Building a mindfulness framework that integrates disparate concepts of engagement

In this thesis I use the construct of mindfulness to help integrate engagement concepts observed across the literature, and to form a framework upon which we can connect engagement with outcomes of nature experiences. Existing literature explores a range of engagement forms in nature, but there has been little attempt to integrate or understand these forms of engagement alongside each other (with exception: Pasanen et al., 2018), leaving them without thoughtful comparison and somewhat disconnected. Therefore, in Chapter 3 I developed a framework that depicts the convergences and divergences of different engagement forms on qualities and orientations that are defined within mindfulness (internal–external, and non-reactivity–reactivity; Figure 3.1, Chapter 3). The framework distinguishes mindfulness from other engagement forms that, for example, only direct attention to the present-moment external experience (e.g., Ballew & Omoto, 2018). Further, the framework allows for comparison of nature-based engagement forms, thus providing a necessary step toward understanding the components of engagement that may influence psychological outcomes.

In the empirical chapters of this thesis the mindful engagement framework guided identification and evaluation of engagement forms in nature, demonstrating the application – and limitations – of its use. In Chapter 4 I drew on the framework to identify five forms of engagement that differed based on orientation and quality: external sensory awareness, mindful engagement, mind wandering, acceptance towards the experience, and judgment towards the experience. In Chapters 5 and 6 I used the framework to form three intervention groups, enabling empirical evaluation of engagement techniques that differed on theoretical qualities of mindfulness. The engagement concepts identified in Chapter 4 demonstrate some complexity for which the framework cannot account. For instance, mind wandering might involve both judgment and nonjudgment. Similarly, acceptance and judgment could

be externally or internally focused. Thus, while the mindfulness framework helps to categorise the qualities of engagement forms, it is unable to characterise the entire experience of engagement in nature. What it does contribute is an organising method that offers researchers a way to identify the underpinning qualities of how individuals engage and interact with nature. Further, it progresses the growing literature on nature-based mindfulness studies by drawing attention to both the orientation and qualities of awareness that (a holistic) mindful practice can cultivate in nature.

7.2.2 Identifying forms of engagement in nature that connect to psychological restoration and nature connection

Further to identifying and understanding these engagement forms in nature, Chapters 4, 5, and 6 reveal connections between different engagement forms and psychological outcomes of nature experiences. This thesis focuses on psychological restoration and connection with nature as two known outcomes of nature experiences that have been previously linked with mindfulness (Djernis et al., 2019; Nisbet et al., 2019) and other engagement practices in nature (Pasanen, et al., 2018; Passmore & Holder, 2017). In this section I will synthesise the findings across these chapters regarding the forms of engagement that associate with restoration and connection with nature. The novel effects of mind wandering in nature, however, will be discussed separately in Section 7.2.3.

For psychological restoration, there was little evidence that mindfulness led to restorative outcomes, and relatively consistent evidence that judgment towards one's experience was associated with poorer outcomes. In Chapter 4, engaging mindfully was reported to lead to a sense of calm, though this effect was not seen in Chapter 5 – possibly due to limitations of the intervention discussed in the following paragraph. Negative judgment was unsurprisingly associated with lower restoration in Chapter 4. In Chapter 5, participants in the directed engagement group – who were instructed to attend to their experience in ways involving judgment or elaborative thought – experienced the lowest levels of attention restoration, and the highest levels of post-experience negative affect. These findings can be explained alongside previous studies that used similar engagement techniques. Duvall (2011) found that engagement tasks involving imagination and some judgment (e.g., making inferences, imagining using magic to change the environment) can lead to better self-reported attentional functioning; however, when compared with engagement tasks that are designed to specifically enhance restorative qualities of a nature experience, the same engagement tasks are less beneficial for attention restoration (Pasanen et al., 2018). Outcomes from Chapters 4 and 5 in this thesis therefore provide additional evidence that engagement tasks in nature do not uniformly lead to benefits: tasks that require some judgment or elaborative thought may require – and therefore tax – attentional resources.

For connection with nature, the evidence through the thesis partly supports existing research that higher mindful engagement is associated with stronger feelings of connection with nature. A

recent meta-analysis reviewing the antecedents to nature connection (Lengieza & Swim, 2021) finds evidence that mindfulness in nature can increase a sense of connectedness (Nisbet et al., 2019; Unsworth et al., 2016). The outcomes in Chapter 4 provide a qualitative account of this relationship and suggest a plausible mechanism: mindfulness in nature can increase connection with nature through heightened sensory contact with nature. In Chapter 5, however, there was no evidence that instructions to engage mindfully led to better outcomes for connection with nature. There are two general explanations for the seeming contrast here. First, the beneficial effect found in Chapter 4 could reflect a higher trait mindfulness among those participants who intentionally engaged mindfully, which has been linked with higher connection with nature (Schutte & Malouff, 2018). Second, the intervention method in Chapter 5 may have been ineffective in increasing perceived contact with nature. Contrasts with other nature-based mindfulness studies point to potential limitations in our design: these other studies are in-person and guided, rather than remotely delivered, and exclusively focus on external or physical sensations, rather than combined with internal awareness of thoughts and emotions (Nisbet et al., 2019; Shin et al., 2013). Together, these findings offer key implications for nature-based mindfulness research. First, trait mindfulness may partially explain the relationship between (state-level) mindfulness in nature and higher nature connection, which should be considered in experimental and observational research alike (Lengieza & Swim, 2021). Further, as will be discussed throughout this chapter, mindfulness interventions in nature may be more beneficial if they primarily cultivate external, sensory awareness to the environment.

7.2.3 Establishing mind wandering as a beneficial nature-based engagement activity

An outcome of this thesis was positioning mind wandering as a nature-based engagement form that can be deliberately and beneficially applied to improve outcomes of nature. The role and associated findings of mind wandering in this thesis offer several contributions to the literature. First, this work uses a novel approach of treating mind wandering as a form of engagement in nature that could be fostered through intervention instruction. Second, I identify and quantify the benefits of mind wandering in nature including calmness, better mood, and distance from work. And third, the mechanisms and dimensions of mind wandering in nature are identified to provide a nuanced account of the role of mind wandering in influencing outcomes of nature experiences.

Mind wandering in this thesis takes on a novel role as a supportive form of awareness that can be cultivated through instruction to benefit a nature experience. A dominant narrative surrounding mind wandering is that it is pervasive and disruptive (e.g., Killingsworth & Gilbert, 2010); for instance, mind wandering has been associated with higher levels of depression (Nayda & Takarangi, 2021) and lower performance on cognitive tasks (Mooneyham & Schooler, 2013). However, benefits of mind wandering have also been widely discussed. In cognitive psychology, a long-standing line of research acknowledges and explores the adaptive value of mind wandering (or ‘daydreaming’;

McMillan et al., 2013), and finds that under the right contexts, mind wandering can lead to benefits such as better mood (Franklin et al., 2013; Smallwood & Andrews-Hanna, 2013). In environmental psychology, theoretical research proposes mind wandering to support psychological restoration and creativity benefits of being in nature (Williams et al., 2018). Further, introspective reflection was positioned as a predominant form of engagement in restorative nature experiences in early literature (Kaplan & Kaplan, 1989). Despite these trends, no research to date has examined the potential for mind wandering to be implemented as a nature-based engagement activity. Motivated by mindfulness studies that operationalise mind wandering as an (instructed) control condition (Arch & Craske, 2006; Kiken & Shook, 2011), this thesis advances these literatures by implementing mind wandering experimentally in nature experiences. Thus, while mind wandering is far from a unique engagement form to consider in nature experiences, here it has a novel application in the form of intervention – and new empirical links to psychological outcomes of nature experiences.

The second contribution this work makes is specifying the outcomes of mind wandering in nature. First, mind wandering had no effect on attention restoration, which is in contrast with theoretical work by Williams et al. (2018) that proposes a synergistic relationship between mind wandering in nature and the pathways to attention restoration. Mind wandering was, however, associated with negative affect: participants in the mind wandering group (Chapter 5) experienced the lowest negative affect after their nature experience; mindlessness was associated with higher negative affect; and pleasant mind wandering was associated with lower negative affect (Chapter 6). There are several studies that investigate the nuances of the relationship between mind wandering and mood, finding that the content of mind wandering may explain the relationship (rather than mind wandering itself; Franklin et al., 2013; Poerio et al., 2013). The findings in this thesis lend support to this idea, where the content and context of mind wandering in nature may moderate the effect it has on mood outcomes. Another key finding was that pleasant mind wandering was associated with stronger nature connection. This may have occurred via an indirect pathway, where pleasant mind wandering led to a more restorative experience and subsequently strengthened nature connection (Wyles et al., 2019). Alternatively, this finding could be due to reflective episodes of mind wandering that orient towards and subsequently strengthen one's relationship with nature (Lengieza et al., 2021). Again, understanding the content of mind wandering is likely required to be able to interpret these links. Together these findings provide the first evidence for associations between mind wandering in nature and affect and nature connection. Future work should investigate the thought content of mind wandering in nature, to extend these findings into a deeper understanding of the mental states that lead to stronger human-nature connections.

The third contribution this work makes is differentiating between forms of mind wandering in nature by testing their unique influence on outcomes of the experience. In Chapter 4, participants commonly reported the benefits of not needing to control their thoughts, and the freedom of being

able to ‘let thoughts go’ in the absence of any tasks. These experiences of mind wandering in nature closely align with deliberate mind wandering as conceptualised by Seli et al. (2016), where individuals intentionally allow their thoughts to wander in the absence of a difficult task. In Chapter 6, a unique factor structure of mind wandering in nature distinguishes between mindlessness, characterised by distractedness and a lack of control over mind wandering, and pleasant mind wandering, characterised by a mind wandering experience that was enjoyable even if sometimes unintentional. These two forms of mind wandering were differentially associated with affect. In Chapter 6, pleasant mind wandering led to lower negative affect, while the opposite relationship was identified for mindlessness. Re-examining the experiences of individuals in Chapter 4 alongside these nature-based mind wandering factors, it seems the participants were likely engaging in pleasant mind wandering – a result, perhaps, of both the absence of other tasks, and the natural environments that afford positive introspection (Cervinka et al., 2020; Kaplan & Kaplan, 1989; Williams et al., 2018). These findings provide novel insights into mind wandering in nature: primarily, that nature experiences may promote a pleasant and positive form of mind wandering that benefits mood.

7.3 Mechanisms of mindful engagement in nature

A key aim of this thesis was to not only identify the types of engagement forms that benefit nature experiences, but to examine the mechanisms that underpin these effects. In the conceptual development of this thesis, I presented a model that hypothesises the mechanisms of mindfulness that likely underpin its effect on attention restoration and nature connection in nature experiences (Chapter 3, Figure 3.2). To evaluate this model, in Chapter 6 I measured the facets of engagement that predict key outcomes. Realising this aim provides two general contributions. First, examining these mechanisms advances theoretical understanding by building a more comprehensive and nuanced account of the ways in which nature leads to psychological benefit, such as identifying the beneficial pathways of sensory engagement, decentering, and pleasant mind wandering in the nature experience. This theoretical advancement encourages and provides a basis for future research that investigates engagement mechanisms beyond those examined in this thesis. Second, the examination of mechanisms provides practical outcomes for implementing engagement practices in nature, where the beneficial aspects of engagement can be identified and cultivated, and the potentially negative aspects can be avoided. Here I discuss the main findings from these chapters with reference to the hypothesised and evaluated models of mindfulness and mind wandering mechanisms (Figure 7.1).

7.3.1 Reviewing the evidence: evaluating the hypothesised mechanisms of engagement

Consistent with the hypothesised model (Chapter 3) and proposals in existing literature, decentering in nature was an aspect of mindfulness that was positively associated with psychological outcomes. Decentering was linked with positive affect, nature connection and attention restoration

(Chapter 6). Hanley et al. (2017) proposed decentering to be a significant factor underpinning the mindfulness and nature connection relationship, due to deidentification of the self leading to stronger identification with nature. Nisbet et al. (2019) found that a nature experience led to a higher level of decentering, although did not examine whether decentering related to psychological outcomes of nature. These findings therefore provide the first empirical evidence for decentering within the nature experience to predict key outcomes of restoration and nature connection.

Physical and body awareness in nature was found to predict higher positive affect after the nature experience (Chapter 6). In contrast to the hypothesised conceptual model (Chapter 3) that depicts a sensory awareness heightened through stimulation of all senses in nature (Barbaro & Pickett, 2016; Howell et al., 2011; Nisbet et al., 2019), the evaluated mechanism focuses on a heightened awareness of physical sensations in the body (for example, *'I felt in contact with my body'*), rather than the full range of senses such as sight and sound. State mindfulness measures were chosen that were suitable for measuring mindfulness in the nature experience, including the State Mindfulness Scale that measures mindfulness of the body. While this dimension of mindfulness adds some empirical support for heightened sensory awareness in nature, future investigations should use measures that account for broader sensory experiences in nature: for example, a state-version of the observing subscale of the Five Facet Mindfulness Questionnaire (Baer et al., 2006), which includes measures such as *'I pay attention to sensations, such as the wind in my hair or sun on my face'*.

Noticing and acceptance of the internal experience was a facet that was identified in Chapter 6 and contrasted in some ways with the hypothesised model both conceptually and in its relationship with psychological outcomes. In the hypothesised model (Chapter 3), non-reactivity was positioned as a key mechanism that allows one to observe the internal experience without elaboration, and potentially regulate reactions to any negative experiences. In Chapter 6, the facet was interpreted to involve noticing or observing thoughts and emotions, showing similarities with non-reactivity, and an element of nonjudgment or acceptance towards these thoughts and emotions. The conceptual distinction between non-reactivity and nonjudgment/acceptance is that the former involves not elaborating on thoughts and emotions (letting them come and go), and the latter involves not evaluating thoughts and emotions (Baer et al., 2008). Noticing and acceptance was associated with higher negative affect after the nature experience, worse performance on the attention task, and had no association with nature connection. These outcomes are somewhat inconsistent with past research that has linked non-reactivity with trait nature connection (Barbaro & Pickett, 2016; Hanley et al., 2017; Sadowski et al., 2020). However, the current study assesses these relationships in the context of state-level mindfulness and nature connection. Thus, these findings may point to practical challenges of cultivating state-level, mindful acceptance during a nature experience among individuals without prior mindfulness training – the implication of this will be discussed further below (Section 7.5).

The novel mind wandering pathways to psychological outcomes (discussed in Section 7.2.3), are also included in Figure 7.1 below. Although explored and analysed separately to mindfulness facets in Chapter 6, they are worth including in this model of engagement for two reasons. First, mind wandering in nature was very commonly reported in the nature experiences of Chapter 4, so it is valuable to foreground this form of engagement when considering the aspects of engagement that impact nature outcomes. Second, mind wandering and mindfulness have shared qualities and dimensions (Konjedi & Maleeh, 2021; Lutz et al., 2008) that can be considered in light of the different facets identified in Chapter 6. For example, mindlessness was correlated with noticing and acceptance of the internal experience, and suggests a level of meta-awareness of the distracted, mind wandering experience (Seli et al., 2017). Additional work is needed, however, to clarify the relationship between mind wandering and mindfulness in nature experiences. Here, Figure 7.1 forms a basis for future empirical analyses to plan, hypothesise, and explore this relationship further.

7.3.2 Theoretical contributions of understanding mechanisms of engagement in nature

This thesis, for the first time, provides empirical evidence for the components of mindfulness and mind wandering that influence psychological benefits of nature experiences, leading to a more complete understanding of the effects of engagement in nature. No research has empirically examined how mind wandering functions in nature, and though some literature has explored the facets of mindfulness that relate to nature connection and wellbeing outcomes (Coffey et al., 2010; Sadowski et al., 2020), these effects have not been explored in the context of state-level mindfulness in nature. The specific outcomes that are identified and contribute to this advancement are: decentering and pleasant mind wandering in nature contribute to higher connection with nature; decentering, body awareness, and pleasant mind wandering lead to benefits for mood; and noticing and acceptance of the internal experience, and mindlessness in nature lead to worse mood and attention performance. These outcomes advance theoretical development of engagement in nature.

There are negative aspects of both mindfulness and mind wandering in nature, which has implications for the field in two ways. First, literature on engagement in nature must recognise the diversity and limitations of different engagement forms in nature, acknowledging that there may be adverse effects of some types of engagement in nature. The finding that noticing and acceptance of the internal experience was associated with higher negative affect and worse attention performance was unexpected, and may point to contextual parameters on the capacity to cultivate this form of awareness in nature. Second, these findings push the literature to further consider components of nature experiences that interrupt assumed pathways between environmental experiences and positive psychological outcomes. The fields of restorative and connective nature experiences largely focus on benefits of nature experience, and higher engagement as an enhancer of these effects (e.g., Pasanen et

al., 2018) – the findings discussed here provide evidence that encourages future work to examine types of cognitive experiences in nature that have negative influences on psychological outcomes.

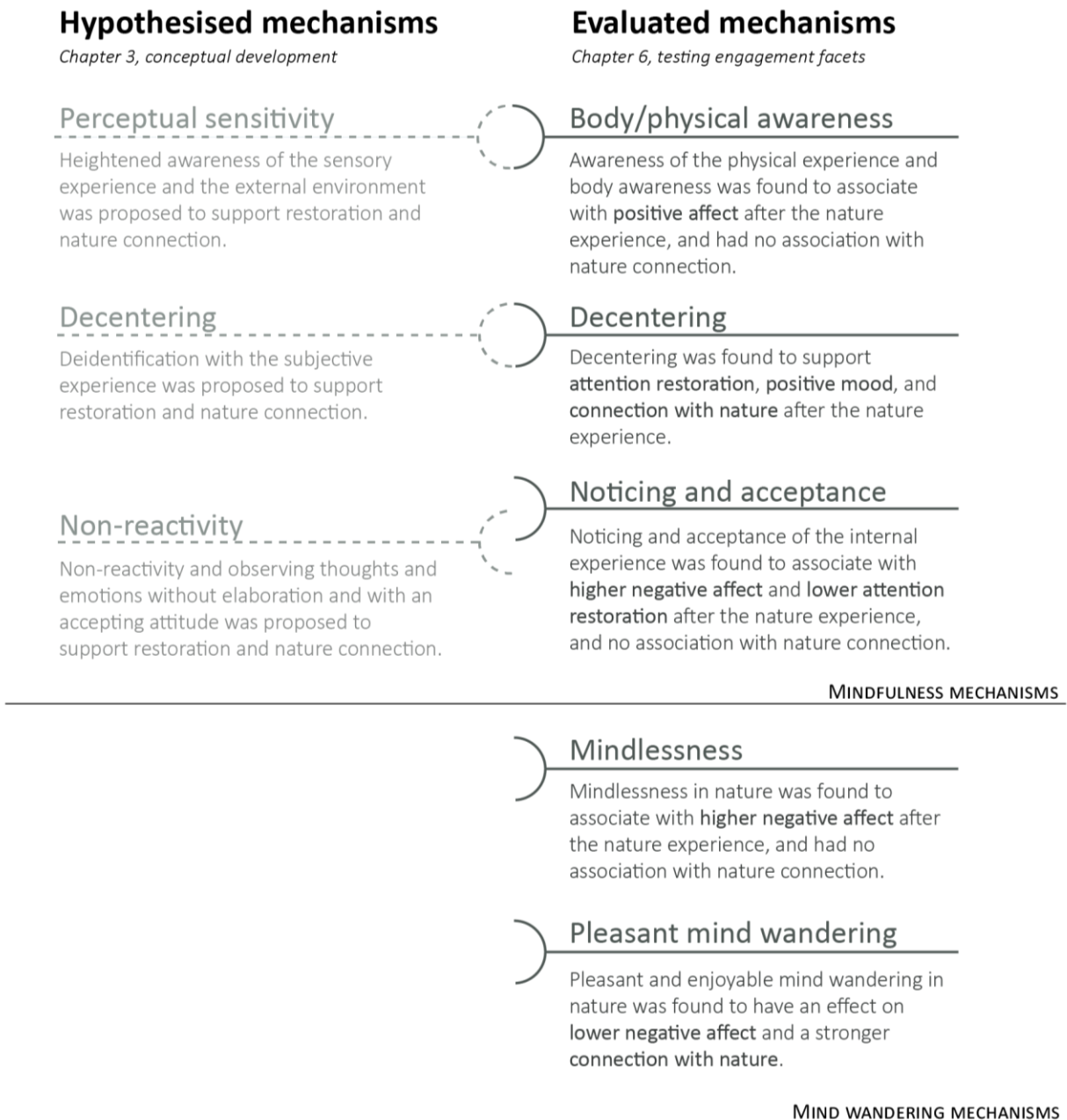


Figure 7.1. The initially hypothesised (light grey text) and later evaluated (dark grey text) mechanisms linking engagement with psychological restoration and nature connection.

The circles illustrate matching mechanisms, and the semi-circles illustrate nonmatching mechanisms, between the model presented in Chapter 3 and the tested pathways in Chapter 6: for instance, non-reactivity has overlapping qualities with the noticing and acceptance facet that was identified in Chapter 6; decentering was proposed and evaluated across the chapters; mindlessness and pleasant mind wandering were not proposed as key engagement facets in Chapter 3.

7.4 Engagement in nature is influenced by contextual factors

The third research question in this thesis was, *what contextual features of urban nature experiences influence, support, or constrain engagement?* In Chapter 3, I argue that many instances of engagement in nature likely occur under some form of constraint: the environment, for example, may be noisy and disturb one's ability to listen to bird sounds, or one's thoughts might be consumed by a work matter and disrupt capacity for quiet reflection in nature. More broadly, there are a myriad of factors that shape the experience of engagement in nature – through constraining or supportive pathways – and examining these will advance our theoretical understanding of nature-based engagement. Practically, exploring these factors will allow for an understanding of the limitations of certain practices in nature, and enable more effective design of spaces and nature experiences. In Chapter 4, I identified key personal and environmental contextual factors that co-occurred in experiences of engagement in nature (Figure 4.4). In Chapter 6, these effects were explored more directly, through linear models that predicted facets of mindfulness and mind wandering. Here I draw together these findings to respond to this research question, first discussing the environmental, and then personal influences on cognitive engagement in nature.

7.4.1 Engagement is weakly affected by the physical characteristics, but strongly relates to perceived restorativeness of the natural environment

In Chapter 4, I identified the environmental contexts that were reported by participants to shape their engagement in nature. Salient sensory features of the environment influenced engagement in various ways – through encouraging sensory awareness (e.g., bird sounds or colourful vegetation), or disrupting attention toward the environment (e.g., loud construction noise). Natural stimuli such as these have been found to influence cognitive and affective appraisals of restorative experiences (Ratcliffe et al., 2013) and anthropogenic noises negatively affect restorative appraisal (Nordh et al., 2009). The outcomes of Chapter 4 support and develop these works by providing exploratory evidence for the variety of influences on *engagement* in nature, including environmental features such as noise or vegetation level, but also how an individual perceives and reacts to that environment. After this exploratory work, in Chapter 6 these factors could then be measured and analysed as distinct predictors on engagement in nature.

In Chapter 6, the environmental characteristics that participants reported had a small effect on the facets of mindfulness and mind wandering in nature. Reported environmental characteristics, however, did have a small negative effect on mindlessness and noticing and acceptance of the internal experience. These findings suggest that a lower quality, less nature-rich environment leads to a more internally oriented experience. Further work is needed to clarify the functional role of internally oriented attention in natural environments: in their work on attention restoration, the Kaplans (Kaplan

& Kaplan, 1989) proposed that internal reflection on unresolved personal problems provides a deeper level of psychological restoration – a level that occurs after attention has been restored. They argue that an aesthetic environment is needed for this phase of restoration, where pleasure derived from an aesthetic experience can buffer against the potential difficulties that come with life reflection. While an environment with aesthetic stimuli might offer opportunity to face internal reflections in a state of cognitive restoration, the findings in this thesis suggest that internally oriented attention in an unsupportive and lower quality environment manifests as mindless distractedness, possibly because this occurs in a state of resource depletion. These findings provide an extension to earlier accounts of restoration by the Kaplans but require further empirical work to examine the costs and benefits of internal reflection across different environment types.

Perceived restorativeness was strongly and positively associated with all facets of mindfulness and mind wandering – although for mindlessness this effect was small (Chapter 6). These findings indicate that the more an individual felt their experience had fascinating properties and gave a sense of being away from everyday concerns (Hartig et al., 1997), the more they reported a mindful awareness and awareness of mind wandering. Thus, an individual's perception of the environment for restorative purposes had a much stronger influence on engagement during the experience than the environmental characteristics they reported. Past studies have found related effects: Korpela et al. (2014) demonstrated that wellbeing outcomes of nature experiences are mediated by the perceived restorativeness of the experience; Van den Berg et al. (2014) demonstrated that individuals' perception of naturalness in an environment influences restorative outcomes, and environmental characteristics do not. The findings across these studies demonstrate the value in studying the nature experience with a transactional lens, where aspects of environment and individual perception converge to form the nature experience qualities to be studied.

7.4.2 Engagement is influenced by individual's mood, trait mindfulness, and nature connection

Prior experience with mindfulness and higher trait mindfulness led to higher levels of state mindfulness during the nature experience. In Chapter 4, individuals who engaged mindfully with nature were those who had some familiarity or prior experience with the practice. In Chapter 6, trait mindfulness was positively associated with all three facets of state mindfulness in nature. Experience with mindfulness and trait mindfulness are related (e.g., Bravo et al., 2018) but the results here draw distinct implications. First, the finding that experience with mindfulness practice led to capacity and willingness to engage mindfully in nature affirms cautions against mindfulness interventions for novices in nature (Lymeus, 2022). That is, these findings suggest that while mindfulness experience may permit the practice of mindful engagement with nature, for those without such experience, mindful engagement with nature may be unsupported or effortful (Lutz et al., 2008; Lymeus et al.,

2017). Second, the finding that trait mindfulness was associated with state mindfulness in nature has broader implications for the analysis of mindfulness in nature. Recent research has found that state mindfulness is an emergent quality in nature experiences, independent of mindfulness practice (Brymer et al., 2021; Stewart & Haaga, 2018). The findings here suggest that this emergence likely differs among people with different levels of trait mindfulness, and thus future studies should consider how nature experiences may (or may not) support state mindfulness in nature for those with lower levels of trait mindfulness.

Stress and negative mood affected level of mind wandering and internal awareness in the nature experience. In Chapter 6, prior negative affect was associated with increases in both mindlessness and pleasant mind wandering, and a higher level of noticing and acceptance of the internal experience. Interestingly, mindlessness was then associated with higher negative affect after the nature experience, but pleasant mind wandering was associated with lower negative affect after the experience. Further, in Chapter 4, mind wandering was reported to provide some relief or distance from stressors or demanding thoughts. If we consider these findings together, it appears that for some individuals, lower mood prior to the nature experience led to a distracted, mindless experience that did not improve mood, while others with low mood engaged in pleasant mind wandering which improved mood. Pleasant mind wandering could therefore be positioned as an adaptive engagement form that regulates negative affect. This builds on work that examines environmental strategies for emotion regulation: the environment itself may support emotion regulation (Korpela et al., 2018), and I extend this to propose that form of engagement in nature may strengthen (or weaken) regulation pathways. The divergent responses of mindlessness and pleasant mind wandering may have been determined by one's level of prior negative mood, or influenced by the environmental context (e.g., an aesthetic, supportive environment may prompt pleasant mind wandering). Future work is needed to unpack these relationships further, by examining the interactions between personal and environmental contexts that support engagement and concurrent emotion regulation pathways in nature experiences.

Examining contextual aspects of the nature experience alongside engagement in nature builds a holistic account of how individuals engage with and benefit from nature. Existing literature and theoretical models of restorative and connective nature experiences acknowledge the role of environmental and personal contexts on the effects on psychological outcomes of nature experiences (e.g., Gobster et al., 2007; Marselle et al., 2021). The model built and examined in this thesis (Chapter 4, Figure 4.1) applies and contributes a new lens to these effects, where individual engagement is a key aspect of the nature experience that is influenced by environmental and personal contexts, and has an effect on psychological outcomes. In the following section, I synthesise these findings to present practical recommendations of applying nature-based engagement interventions across environmental and individual contexts.

7.5 Implementing engagement interventions in nature: Practical outcomes and future directions

Now that I have addressed the three research questions to provide an understanding of how mindful and other engagement forms function in nature experiences, I turn to the practical outcomes that draw together the interrelated findings. This thesis has shown that while some engagement interventions lead to psychological benefits, others do not. There is a clear need to consider the different factors that limit their potential – for instance, which forms of engagement does the intervention target? For whom is the intervention designed? What are the environmental features and qualities of the place? And, what is the mode of instruction delivery? While the recommendations in this section are specific to brief nature-based engagement interventions (i.e., single session), they build on literature that examines nature-based interventions (Shanahan et al., 2019) and mindfulness interventions in nature (Lymeus, 2022). Shanahan et al. (2019) reviewed different forms of nature-based interventions designed to promote wellbeing, and identified the need to consider a range of factors when implementing such actions, including accessibility, capacity of individuals, perceptions of nature and the natural setting, and community and individual needs. Lymeus (2022) provided a commentary on the published paper in Chapter 3 (Macaulay et al., 2022a), and identified similar recommendations and cautions, where nature-based mindfulness interventions must recognise the limits of individual accessibility, capacities, and motivations. The sections below connect with this literature, containing insights from this thesis for implementation of nature-based engagement interventions and outlining future research directions to build on this work (summarised in Figure 7.2).

7.5.1 Designing intervention content: What and for whom?

What types of engagement are best suited to promoting nature-based outcomes?

Engagement interventions in nature should avoid instructions that incur attentional effort. A key finding in Chapter 5 was that the unguided control group had the best post-experience attention performance overall, leading to the conclusion that the three engagement interventions were each somewhat effortful. Lymeus et al. (2017) demonstrate the attentional effort involved in learning mindfulness, due to the self-regulatory effort of managing competing demands on attention. In mindfulness, these demands are discussed in terms of the effort of practicing focused attention (e.g., Lutz et al., 2008). In this thesis, the effort involved may largely be due to having to read and pay attention to intervention instructions: the mind wandering group, who were only asked to let their minds wander, still had less stability in responses on the attention task than the unguided group. Some engagement forms appeared to require greater effort, and these effects were seen in both poorer attention and mood outcomes.

Internal awareness, judgment, and elaborative thought were forms of engagement that led to poorer outcomes, while sensory engagement and decentering led to improved outcomes. The directed engagement group in Chapter 5, whose instructions prompted judgment and elaborative thought had lower levels of restoration and mood outcomes; in Chapter 4, judgment was associated with lower restorative outcomes; and in Chapter 6, internal awareness, through noticing and acceptance, and mindlessness, was associated with negative affect and worse attention restoration. Sensory engagement (Chapter 4) and body awareness and decentering (Chapter 6) were associated with better outcomes for mood, nature connection, and attention restoration. These findings have implications for mindful engagement interventions, and engagement in nature generally. For mindfulness, these results indicate that in the case of brief nature-based interventions (cf. longer training programs, e.g., Lymeus et al., 2018) practices that focus on decentering and sensory or physical awareness in nature are most beneficial for psychological benefits. More broadly, these findings indicate that external, sensory-based engagement forms in nature are most beneficial, which reflects a common approach in nature-based engagement studies (Ballew & Omoto, 2018; Lin et al., 2014) and theoretical underpinnings of ART (Kaplan, 1995) and nature connection (Lumber et al., 2017). These distinct facets of mindfulness and other engagement forms can be targeted through different practices: for instance, researchers have found distinct benefits of practices such as mindful breathing and body scans (Kropp & Sedlmeier, 2019; Sauer-Zavala et al., 2013). Building on the work in this thesis, future research could target sub-forms of engagement practices that support restoration and nature connection.

How does engagement form interact with individual needs and capacities?

The benefit of an engagement intervention may rely on individual need for restoration. In Chapter 4, individuals who felt a need for restoration and to get distance from stressful daily life generally reported higher engagement with the external, sensory environment. Past research has found that need for restoration heightens individual preference for more natural (rather than urban) environments (Hartig & Staats, 2006; Staats et al., 2016), and affects motivations for activity type in nature (Degenhardt & Buchecker, 2012). The findings in this thesis build on this literature to provide an additional lens to nature experiences in the face of varying demands, demonstrating that individuals also pay attention in different ways depending on restoration needs. While the current evidence suggests sensory or external engagement is more effective for individuals facing higher cognitive demands, studies that manipulate restoration (e.g., Staats et al., 2016) offer a useful direction for future research, to affirm whether sensory (or other forms of) engagement is preferred under high or low attention fatigue or mood level.

Individual capacity to engage in certain ways also affects whether an engagement intervention will be beneficial. In Chapter 4, individuals who engaged mindfully already had experience with similar practices; in Chapter 6, trait mindfulness had a large influence on mindful engagement during

the nature experience. These findings, at the least, point to the necessity of accounting for individual experience with mindfulness when designing a nature-based mindfulness intervention. More broadly, these findings may also point to the need for more open approaches that consider individual motivations and preferences for engagement with nature. Lymeus (2022) illustrates further considerations of embedding the practice of mindfulness into nature experiences, where it is argued that training individuals in mindfulness practice is not an accessible solution to achieve more restorative nature experiences in urban landscapes. To avoid the limitation of individual-level trait mindfulness, nature experiences could be designed that position the environment as a potential source of mindfulness, rather than individual engagement or intent (Lymeus, 2022). Further research is needed to examine the types of experiences and environments that promote state mindfulness, to form recommendations that accommodate individual capacities to mindfully engage with nature.

7.5.2 Applying intervention content: Where and how?

Findings from Chapters 4 and 6 suggest that individual-level engagement interventions could benefit from integration with restorative design principles. Although environmental characteristics had a small effect on engagement in the analysis of Chapter 6, perceived restorativeness – as measured with indicators of how fascinating the environment was and whether it gave a sense of being away from everyday demands – had a large positive effect on engagement during the experience. In Chapter 4, individual perceptions of the environment and whether an individual felt they could gain psychological distance from work, also influenced the various engagement forms. Engagement interventions could be designed to strengthen specific restorative elements in environments, for example by encouraging individuals to let their awareness be captured by fascinating stimuli, or achieve psychological distance through letting go of everyday hassles (e.g., Korpela et al., 2017).

The technology used to deliver the engagement interventions designed in these studies may have undermined the benefits derived from the nature experience. The intervention instructions were delivered on participants' smartphones to read during their outdoor experience. However, the unguided control group did not have to attend to instructions on their smartphone during the experience, and this group had the best post-experience attention restoration (Chapter 5). Although it is reasonable to interpret that the intervention exercises taxed attention, the mind wandering instructions did not ask participants to pay attention to anything in particular, so the technology factor likely had some impact on attention. Other studies have demonstrated the disruptive effect of technology on a work break: having a laptop present during a break interferes with attention restoration (Jiang et al., 2019), and smartphone use on a break is associated with higher reported fatigue (Dora et al., 2021). Taken together, it is worth exploring alternative deliveries of interventions that do not involve smartphone use (e.g., non-digital signs; Ibes et al., 2018; Korpela et al., 2017).

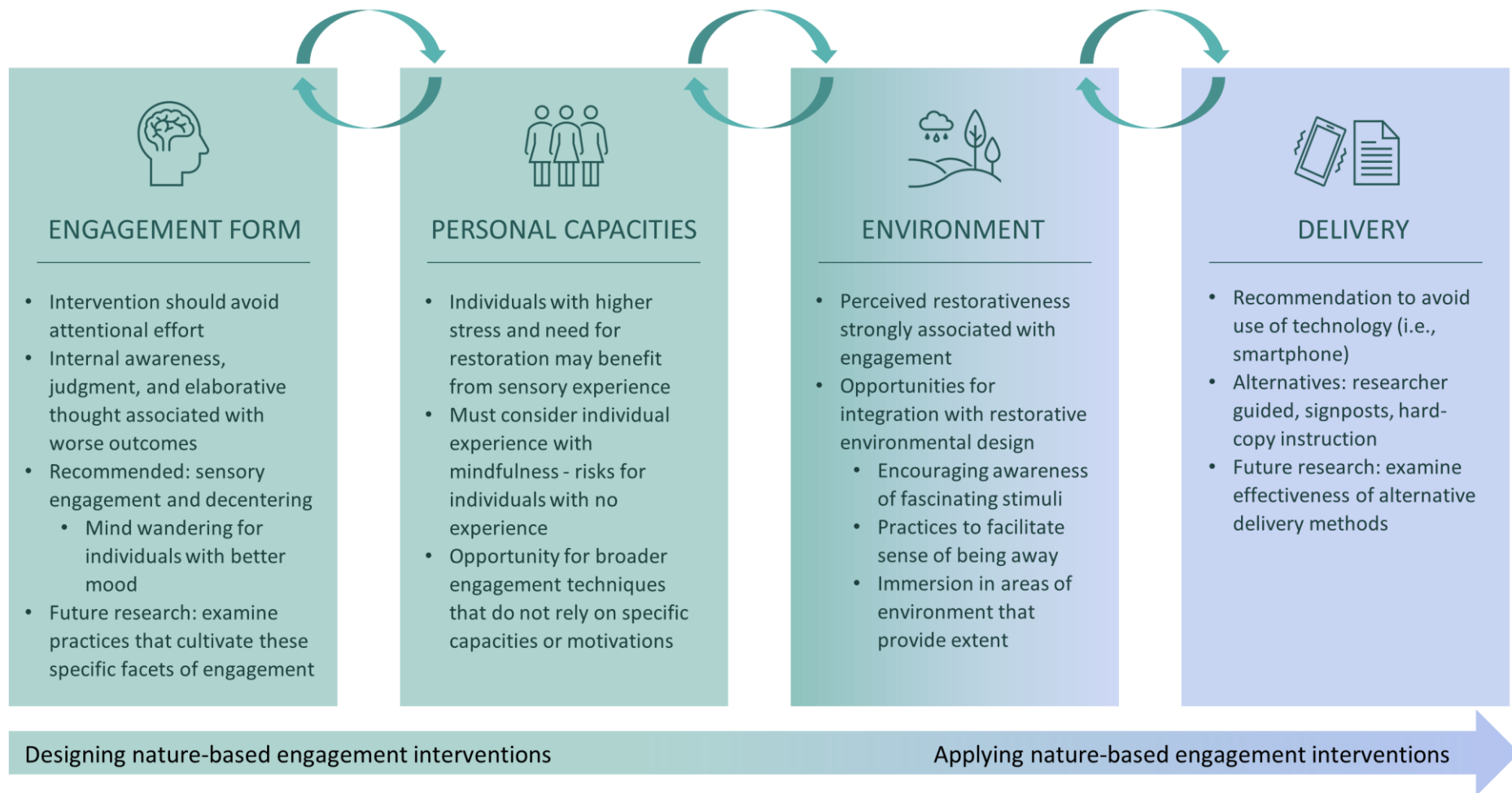


Figure 7.2. Summary of outcomes, including recommendations for designing and applying nature-based engagement interventions. The left-hand green columns are recommendations for the design of interventions, and the right-hand blue columns are recommendations for the application/delivery of them. Note that the Environment column is relevant to both design and delivery of interventions. The circular arrows at the top of the diagram represent the interactions between these summary outcomes: for instance, to understand the engagement forms to be selected, one should consider the personal capacities and environment in which it will be applied.

7.6 Limitations

This thesis used two study designs and limitations of both studies are addressed here, with recommendations for future work. Specific limitations of the studies are discussed in the respective chapters, so here I present some broader aspects across the thesis that limit understanding of engagement in nature. The COVID-19 pandemic created restrictions on access to outdoor spaces, so half of the interviewees in the first study, and all participants in the intervention study visited green spaces at or near their homes. While these methods allowed for analysis of a wide range of contexts on participant experience, the restrictions on the study design meant participants could not visit preselected green space sites that contained varying features, as initially intended – such a research effort would allow for comparison of engagement experience across controlled environmental characteristics. Further, this type of research would allow for a deeper understanding of the environments that support a mindful engagement with nature, irrespective of instruction or practice (Lymeus, 2022).

Both studies also examined just one nature experience, which limits our understanding of how individuals may engage with nature over time. While the aim of the current research was to understand engagement within a single nature transaction, there are likely important phenomena within repeated transactions with nature that inform our understanding of engagement and connections with nature. Further research could draw on a ‘building capacities’ framework (Marselle et al., 2021) with qualitative or longitudinal study designs, to explore whether engagement patterns that are revisited and developed through ongoing nature experiences contribute to a better capacity to connect and restore resources in nature.

Finally, while the mindfulness framework (Chapter 3) offers a way to categorise and understand the qualities of engagement forms in nature, it has its own limitations. The quality of nonjudgment/judgment does not figure into all engagement forms (for instance, a mind wandering episode may fluctuate between these qualities), and not all engagement forms are strictly external or internal. There are also other qualities (e.g., meta-awareness; Lutz et al., 2015; Seli et al., 2017) that may be fruitful to examine when comparing engagement forms in nature. The framework does offer a precedent for examining engagement forms using a typology method to understand them; to build on this development, future research could explore alternative engagement dimensions that help to categorise and understand engagement forms in nature.

7.7 Conclusion

The experience of nature has been long known to produce psychological benefits such as restoring of cognitive resources and building a sense of nature connection. However, opportunities to

experience nature and receive such benefits are dwindling (Soga & Gaston, 2016). In this context, activities or practices that more fully engage individuals with the natural world are receiving greater attention. In this thesis, it was my aim to strengthen the structure and evidence base of a growing literature on enhancing individual engagement in nature experiences. Starting from an understanding of mindfulness, I examined the role of individual engagement with nature by first exploring how people engage with nature in urban green spaces, and then investigating the effect of different engagement interventions on outcomes of psychological restoration and nature connection.

Findings across the thesis highlight the nuance and complexity of engagement forms in nature and how they relate to psychological outcomes, leading to substantial implications for nature-based engagement research and practice. Most significantly, the findings point to the potential risks of prescriptive engagement experiences, and instead open the door to research and practices that encourage understanding of individual needs and capacities, and engagement forms that require less effort. Specifically, outcomes suggest that for individuals without experience, mindful engagement with nature may be difficult to apply wholly – but a present-moment sensory engagement could be more accessible and suit a broader population. Mind wandering in nature emerged through the thesis as a common and beneficial engagement form, providing the first empirical evidence for its potential within the application of nature-based interventions. This thesis contributes a theoretically grounded framework and evidence base for the understanding of engagement with nature, pushing the field to go beyond basic assumptions of the benefits of higher engagement in nature and address the key components that improve outcomes. From this, I provide a unique contribution to the ongoing effort of understanding and fostering opportunities for restorative and connective nature experiences in urban environments.

7.8 References.

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Appendix A – supplementary material to Chapter 5

A.1 Preregistration form

The following two pages contain the preregistration form as submitted to AsPredicted. The PDF version can be found here: <https://aspredicted.org/q32mj.pdf>

The preregistration form was submitted before data collection, and thus contains some small discrepancies in terminology to what is used in the thesis chapters:

- The intervention to enhance “non-mindful engagement” is equivalent to the Directed Engagement group as reported in Chapters 5 and 6
- The “comparison engagement group” is also equivalent to the Directed Engagement group
- “Site constraints” are equivalent to Environmental characteristics as reported in Chapters 5 and 6.

Mindful Engagement in Urban Green Spaces (#49495)

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1) Have any data been collected for this study already?

No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?

- 1a. An intervention to enhance mindful engagement in urban nature improves the outcomes of 1) attention restoration, 2) connection with nature, and 3) affect, to a greater degree than other forms of cognitive engagement.
- 1b. An intervention to enhance non-mindful engagement improves the outcomes of 1) attention restoration, 2) connection with nature, and 3) affect greater than a mind-wandering intervention and a control group.
2. The effect of interventions involving engagement in an urban nature experience is mediated by one's state mindfulness during the experience.
- 3a. Site constraints will negatively impact state mindfulness during the experience.
- 3b. The engagement intervention will reduce (moderate) the negative impact of site constraints on state mindfulness.

3) Describe the key dependent variable(s) specifying how they will be measured.

Outcome variables:

Attention performance will be measured pre- and post-treatment with the Sustained Attention to Response Task (SART).

Participants' response times (mean and standard deviation of response time), commission errors (responses to No-Go digit '3'), and omission errors (failure to respond to Go stimuli, all digits except '3') are the dependent measures.

Connection with nature will be measured with the Connectedness to Nature Scale (CNS) - a self-report, 7-item Likert scale. Additionally, the Inclusion of Nature in the Self scale will be used to measure state-level connection with nature.

State affect will be measured with the Positive Affect Negative Affect (PANAS) scale. It is a 20-item Likert scale questionnaire, where participants rate their momentary positive and negative feelings, such as "interested" or "irritable". Ratings on each of the subscales (Positive affect and Negative affect) are averaged to create scale scores.

Mediator variable:

State mindfulness will be measured with a self-report, 23-item Likert scale, where participants respond to questions such as "I noticed pleasant and unpleasant emotions". Ratings will be averaged to calculate a scale score.

Moderator variable:

Site constraints will be measured by with two Likert scale measures. The first is a measure of perceived site restorativeness, including 4 items. Ratings will be averaged to calculate a scale score, and higher scores will indicate low constraint. The second measure is a 10-item scale to measure physical characteristics of the site. Ratings will be averaged to calculate a scale score, and higher scores will indicate low constraint.

4) How many and which conditions will participants be assigned to?

The survey platform, Qualtrics, is set up to randomly assigned participants to one of four conditions:

Mindful engagement; comparison engagement; mind wandering; self-guided control.

Participants in the first three conditions receive a written intervention during an outdoor experience, and the fourth (self-guided control) condition receives no intervention during their outdoor experience.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

Hypothesis 1a and 1b (examining the intervention effect on attention performance, nature connection and mood) will be examined with separate ANCOVAS. The independent variable will be group (four intervention conditions); the dependent variables will be the post-test

outcome variables, and the covariates in the ANCOVA will be the pre-test scores.

The secondary hypothesis (that the effect of the intervention is mediated by state mindfulness) will be examined with separate mediation analyses, where the intervention condition is the independent variable, dependent variables are post-test outcome variable scores (attention performance, connection with nature, and state affect) and the mediator variable is state mindfulness. The pre-test outcome variable scores will be treated as covariates.

Hypothesis 3 will be examined with a moderation analysis, where the site constraint is the independent variable, state mindfulness is the outcome variable and the intervention condition is the moderator variable.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

If any participant scores > 30 response errors to go-trials, their response will be removed, as this will indicate they have not conducted the task correctly. Nature connection and affect scores: We will compute the average scale scores across all intervention groups and inspect the data for outliers. If the data appear to be from respondents answering incorrectly (e.g. inspecting positively scored and negatively scored items), responses will be removed. If the data appear to be accurate responses but >3.29 SD above/below the mean, the score will be winsorised.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.

We will continue to collect data until 250 people have participated, or until 31st April 2021, whichever comes first.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?) We will conduct other exploratory analyses, including how sub-factors within the state mindfulness and mind wandering scales contribute to the psychological outcomes.

A.2 Intervention instructions

Table A.1. Intervention instructions

	Mindful engagement	Directed engagement	Mind wandering	Unguided control group
Introduction 1min	Over the next 20 minutes, you will be asked to engage with your experience mindfully. Mindfulness involves paying attention to the present moment, and having an accepting, curious, and nonjudgmental awareness of your ongoing experience. During this experience, try to observe where your attention goes - this could be to things in your environment, or to your thoughts and emotions. Wherever your attention goes, try to clearly observe the stimulus, curiously and in detail.	Over the next 20 minutes, you will be asked to engage in particular ways with your experience in this environment. Outdoor spaces can provide us with a range of experiences and opportunities. Throughout your experience, you will be prompted to engage with aspects of your environment and the experience more generally. Depending on your type of environment, you may wish to move around or remain seated somewhere.	Over the next 20 minutes, you will be asked to engage in a particular way with your experience in this environment. During this time we'll prompt you to practice a process which allows you to perceive things in a way that lets your mind wander freely. Please have a read of these different prompts and continue with your break.	For the next 20 minutes, you will spend a work break in an outdoor environment. This could be at your home, or in a nearby space that is suitable for a break. You have been assigned to a group that will not receive instructions on your phone during the experience. Instead, we'd like you to set a timer on your phone for 20 minutes, so that you know when to head back inside after your break.
Prompt 1 1-5mins	<i>Grounding, breath</i> With eyes open or closed, begin this experience by paying close attention to the sensation of breathing. You might notice the physical sensation of rising and falling with the breath, or the quiet sound of breathing. If you notice you drift into thought, see if you can gently bring your attention back to your breathing. Practice this over the next 5 minutes with your eyes open or closed.	<i>Physical relaxation, stretching</i> Begin this experience by physically relaxing in the environment over the next 5 minutes. Take a seat or move slowly about the space and focus on relaxing your body. Notice where you have discomfort or tension and think about what physical movements or stretches would be prepare you for returning to an afternoon of work.	Let your mind wander freely during the next 5 minutes. There is no need to try to focus on any particular aspect of your experience today.	What to do during your break? Remain in the outdoor environment you have chosen for the duration of your break, but during this time please feel free to engage in whichever activities you might usually like to do.
Prompt 2 5-10mins	<i>Notice sensory surroundings</i> For the next 5 minutes, allow your attention to be drawn to sights, sounds, and smells, in this space.	<i>Imagery</i> Spend the next 5 minutes looking around your space and reflecting on how this environment relates to other things in your life.	Let your thoughts drift off as you continue with your break. You might be thinking about things that have happened, or	

	Be curious. Allow your whole awareness to receive the range of sensations here. If you find yourself lost in thought, see if you can use your surrounding environment to pull your attention back to the present moment.	Do parts of this environment relate to social activities, other places or people, work matters, or something else? If not, see if you can imagine making links between this place and other aspects of your life.	things that will happen, or simply immersing yourself in imagination.	
Prompt 3 10-15mins	<i>Internal experience, no judgment</i> Spend the next 5 minutes observing what you are thinking and feeling without judgment. Try to clearly witness thoughts and feelings come and go, without judging their quality, just as you might observe sounds come and go. See if you can observe thoughts, emotions, and sensations as ‘events’ or appearances in your mind, rather than aspects of you and how things ‘really’ are.	<i>Judgment, elaborative thought</i> Have a think about what you would change about this environment to make it better suited to your break. It might be a physical change to your environment, or something abstract or intangible. Look around you over the next 5 minutes and consider what could make this experience better.	Let yourself drift in and out of daydreams as you continue to spend time here on your break.	
Prompt 4 15-20mins	<i>Noticing nature</i> For the next 5 minutes, allow your attention to be drawn to sights, sounds, and smells, in this space. Notice the nature around you with curiosity, and observe your role within it with acceptance. Rather than trying to change or control this experience, simply notice your ongoing reactions to, and experience within, the environment around you.	<i>Noticing and connecting with nature</i> Spend the next 5 minutes paying attention to the natural features in your environment. What beauty can you see in the nature around you? Why do you find it beautiful? Notice the details of the natural environment – find something tiny to examine and think about its relation to the larger natural world.	Lose yourself in your thoughts and imagination in the last 5 minutes, before you head back inside. No need to try and focus on anything in particular.	

A.3 Environmental characteristics questionnaire and descriptive statistics

Environmental characteristics questionnaire, and Means (M) and Standard Deviations (SD) for the total sample					
Items	Score (level of restorativeness from low to high)			M	SD
	1	2	3		
1. Was there much 'urban' noise there today? E.g., cars, building, machinery, etc.	Yes, urban noise was loud, disruptive	Could hear urban noise, but not loudly or it was not disruptive	No, not loud, or there was no influence of urban noise on being there	2.02	.63
2. Is there much grass coverage?	Little to no grass	Some space with grass coverage	Mostly grass coverage	2.08	.75
3. Are there many trees that you can see?	Very few trees/bushes	Some trees and/or bushes	Many trees and/or bushes	2.28	.66
4. Are there many other plants? E.g., flowering plants, succulents, shrubs.	Very few other plants	Some other plants	Many other plants	2.26	.70
5. Is there a water feature present? E.g., pond, fountain, creek.	No water present	Some water presence/feature	Water main feature of the space	1.39	.62
6. What are the buildings like nearby?	Buildings surround the place, impacting the experience of being in the space. Architectural design not pleasing aesthetically	Some buildings present but the experience in the space is not impacted much. Architectural design moderately pleasing	Little to no impact or presence of buildings (far away, or small). Present buildings are aesthetically pleasing in design	1.87	.64
7. Is there seating available?	Little to no seating	Some seating but not convenient/comfortable	Accessible seating in comfortable areas (e.g., shaded spot)	2.25	.83
8. Is the place shaded from the sun?	No shade at all	Some scattered shade	Shade in areas with seating	2.20	.66
9. Is there space to get some sun?	No sunlight, it's a dark space	Sunlight in some areas, but not very accessible	Sunlight in open areas	2.71	.54
10. Does the space feel large enough to explore?	Small space, no scope for exploration	Moderately sized, some scope for exploration	Larger space, with plenty of space for exploration	1.90	.64
Total scale (items averaged)				2.09	.32

A.4 Mediation analysis table (no significant indirect effects)

Mediation analysis for variables that had no significant indirect effects															
Effect	Path	Commission errors SH		Gradual variability FH		Gradual variability SH		M-to-M variability FH		M-to-M variability SH		Mean RT SH		SDRT FH	
		Est (SE)	<i>p</i> or 95% CI	Est (SE)	<i>p</i> or 95% CI	Est (SE)	<i>p</i> or 95% CI	Est (SE)	<i>p</i> or 95% CI	Est (SE)	<i>p</i> or 95% CI	Est (SE)	<i>p</i> or 95% CI	Est (SE)	<i>p</i> or 95% CI
	b	-0.01 (0.01)	.33	-0.001 (0.002)	.77	-0.006 (0.001)	.75	0.001 (0.00)	.52	0.001 (0.001)	.53	0.45 (0.28)	.11	-0.24 (0.16)	.14
Mindful engagement	a	9.85 (3.08)	.002	9.90 (3.12)	.002	9.76 (3.15)	.002	10.01 (3.12)	.002	9.48 (3.19)	.003	9.96 (3.10)	.002	9.47 (3.04)	.002
	c'	1.00 (0.43)	.02	0.13 (0.07)	.09	0.16 (0.08)	.04	0.10 (0.06)	.09	0.02 (0.06)	.75	-8.94 (11.39)	.43	18.56 (6.43)	.004
	a*b	-0.10 (0.10)	[-.31, .09]	-0.01 (0.02)	[-.04, .03]	-0.01 (0.02)	[-.05, .03]	0.01 (0.01)	[-.02, .04]	-0.01 (0.01)	[-.04, .02]	4.49 (3.17)	[-0.96, 11.35]	-2.23 (1.61)	[-5.60, 0.65]
Directed engagement	a	4.28 (3.18)	.18	4.08 (3.19)	.20	3.91 (3.23)	.23	4.18 (3.12)	.19	3.91 (3.25)	.23	4.50 (3.21)	.16	4.22 (3.14)	.09
	c'	0.44 (0.43)	.30	0.30 (0.07)	< .001	0.09 (0.08)	.25	0.17 (0.06)	.004	0.08 (0.06)	.14	-18.66 (11.54)	.11	21.19 (6.51)	.001
	a*b	-0.04 (0.06)	[-.18, .05]	-0.002 (0.01)	[-.02, .02]	-0.002 (0.01)	[-.02, .02]	0.004 (0.01)	[-.01, .03]	-0.003 (0.01)	[-.02, .01]	2.03 (2.28)	[-0.74, 7.80]	-0.99 (1.06)	[-3.59, 0.67]
Mind wandering	a	4.54 (3.06)	.14	4.29 (3.11)	.17	4.88 (3.08)	.12	4.24 (3.12)	.17	4.61 (3.09)	.12	4.82 (3.09)	.12	5.23 (3.03)	.02
	c'	0.21 (0.41)	.62	0.12 (0.07)	.09	0.07 (0.07)	.36	0.06 (0.06)	.29	0.03 (0.05)	.62	3.68 (3.68)	.74	16.79 (6.29)	.01
	a*b	-0.05 (0.06)	[-.17, .05]	-0.002 (0.01)	[-.02, .02]	-0.003 (0.01)	[-.03, .02]	0.004 (0.01)	[-.01, .03]	-0.004 (0.01)	[-.02, .01]	2.17 (2.05)	[-0.89, 6.88]	-1.23 (1.14)	[-3.89, 0.60]

Notes: Interventions groups (mindful engagement, directed engagement, and mind wandering) are contrasted against the unguided control group as the reference group.

M-to-M = Moment-to-moment; SH = Second Half SART; FH = First Half SART; RT = Reaction Time; SDRT = Standard Deviation Reaction Time. Bold *p* values indicate significant direct effects.

Appendix B – supplementary material to Chapter 6

Results tables

Table B.1 Regression models: mindfulness and mind wandering predicting psychological outcomes of the nature experience

	Connection with nature		Positive affect		Negative affect (inverse)		Commission errors		Mean RT (log)		Standard deviation RT (log)	
	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β
Group Unguided control (reference)	-	-	-	-	-	-	-	-	-	-	-	-
Group Mindful	0.24 (0.93)	.02	-0.25 (1.51)	-.01	-0.01 (0.00)	.14	1.52 (1.23)	.11	0.00 (0.02)	.00	0.08 (0.03)	.22*
Group Directed	-1.26 (0.89)	-.11	-0.18 (1.47)	-.01	0.00 (0.00)	.02	1.75 (1.22)	.13	0.00 (0.02)	.01	0.07 (0.03)	.18*
Group Mind wandering	-1.00 (0.90)	-.09	-0.17 (1.47)	-.01	-0.01 (0.00)	.14	1.13 (1.23)	.08	-0.01 (0.02)	-.04	0.01 (0.03)	.03
Decentering	0.13 (0.06)	.17*	0.31 (0.10)	.27**	0.00 (0.00)	.12	-0.19 (0.08)	-.22*	0.00 (0.00)	.15	0.00 (0.00)	-.07
Noticing and acceptance	0.09 (0.08)	.10	-0.02 (0.13)	-.01	0.00 (0.00)	-.47***	0.23 (0.11)	.22*	0.00 (0.00)	-.05	0.01 (0.00)	.20*
Body awareness	0.27 (0.14)	.15	0.53 (0.23)	.19*	0.00 (0.00)	.04	-0.21 (0.20)	-.10	0.00 (0.00)	.03	0.00 (0.01)	-.08
Mindlessness	-0.16 (0.10)	-.13	0.09 (0.16)	.05	0.00 (0.00)	-.19*	-0.12 (0.14)	-.09	0.00 (0.00)	.05	0.00 (0.00)	.00
Pleasant MW	0.32 (0.12)	.21**	0.28 (0.20)	.12	0.00 (0.00)	.18*	0.08 (0.16)	.05	0.00 (0.00)	-.06	0.00 (0.00)	.01
	<i>N</i> = 208		<i>N</i> = 206		<i>N</i> = 205		<i>N</i> = 182		<i>N</i> = 182		<i>N</i> = 182	
	<i>R</i> ² = .24		<i>R</i> ² = .23		<i>R</i> ² = .27		<i>R</i> ² = .08		<i>R</i> ² = .02		<i>R</i> ² = .10	

Note. Bold values indicate significant regression coefficients. * $p < .05$, ** $p < .01$, *** $p < .001$
Higher values on negative affect (reciprocal score) represents lower negative affect.

Table B.2 Regression models: environmental characteristics and perceived restorativeness predicting engagement during the nature experience

	<i>Decentering</i> (<i>N</i> = 209)			<i>Noticing and acceptance</i> (<i>N</i> = 209)			<i>Body awareness</i> (<i>N</i> = 211)			<i>Mindlessness</i> (<i>N</i> = 211)			<i>Pleasant MW</i> (<i>N</i> = 210)		
	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β
Environmental characteristics	-0.21 (-0.49, 0.06)	0.14	-.10	-0.25 (-0.48, -0.01)	0.12	-.14*	-0.02 (-0.13, 0.09)	0.06	-.02	-0.18 (-0.35, -0.005)	0.09	-.14*	-0.12 (-0.30, -0.01)	0.07	-.12
Perceived restorativeness	0.75 (0.56, 0.94)	0.10	.50***	0.43 (0.28, 0.59)	0.08	.37**	0.28 (0.20, 0.35)	0.04	.45***	0.12 (0.003, 0.24)	0.06	.14*	0.33 (0.24, 0.42)	0.05	.47***
<i>R</i> ²	.24			.13			.20			.03			.21		

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

Table B.3 Regression models: personal characteristics predicting engagement during the nature experience

	<i>Decentering</i> (<i>N</i> = 204)			<i>Noticing and acceptance</i> (<i>N</i> = 205)			<i>Body awareness</i> (<i>N</i> = 207)			<i>Mindlessness</i> (<i>N</i> = 207)			<i>Pleasant MW</i> (<i>N</i> = 205)		
	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β	<i>B (CI)</i>	<i>SE B</i>	β
Trait nature connection	0.15 (-0.04, 0.35)	0.10		0.17 (0.01, 0.32)	0.08	.14*	0.14 (0.06, 0.22)	0.04	.23**	0.06 (-0.06, 0.17)	0.06		0.12 (0.02, 0.22)	0.05	.17*
Trait mindfulness	0.36 (0.19, 0.53)	0.09	.31***	0.22 (0.09, 0.34)	0.06	.24**	0.08 (0.01, 0.15)	0.04	.17*	-0.05 (-0.15, 0.04)	0.05		0.02 (-0.06, 0.10)	0.04	0.03
Pre-test PA	0.15 (0.01, 0.30)	0.09	.15*	-0.10 (-0.21, 0.00)	0.06		0.08 (0.02, 0.14)	0.03	.19*	0.01 (-0.07, 0.09)	0.04		0.08 (0.01, 0.15)	0.04	.17*
Pre-test NA (inverse)	-24.30 (-65.41, 16.81)	0.09		-129.89 (-160.96, -98.81)	15.76	-.52***	-14.56 (-31.58, 2.47)	8.64		-75.85 (-99.21, -52.49)	11.85	0.4***	-30.16 (-50.18, -10.14)	10.15	-.21**
<i>R</i> ²	0.20			0.29			0.19			0.20			0.13		

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

Does Group membership moderate the effect that perceived restorativeness has on engagement subfactors?

Table B.4. Models predicting engagement subfactors, containing interaction terms between **perceived restorativeness** and Group membership

	Decentering			Notice/acceptance			Body awareness			Mindlessness			Pleasant MW		
	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>
PRS	0.59	0.16	.00	0.44	0.14	.00	0.27	0.07	.00	0.22	0.10	.04	0.38	0.08	.00
Mindful group	2.13	5.80	.71	2.73	4.99	.59	-0.09	2.53	.97	3.28	3.77	.38	0.13	2.81	.96
Directed group	0.22	4.77	.96	3.86	4.05	.34	0.34	2.05	.87	6.35	3.05	.04	3.50	2.28	.13
MW group	-3.39	4.98	.50	4.85	4.22	.25	0.92	2.14	.67	5.25	3.18	.10	3.79	2.39	.12
Mindful group * PRS	0.07	0.27	.79	-0.01	0.24	.98	0.03	0.12	.79	-0.08	0.18	.63	0.01	0.13	.96
Directed group * PRS	0.07	0.23	.78	-0.05	0.20	.82	-0.01	0.10	.96	-0.25	0.15	.10	-0.13	0.11	.24
MW group * PRS	0.32	0.25	.19	-0.12	0.21	.55	-0.06	0.11	.60	-0.17	0.16	.28	-0.11	0.12	.34
	R ² = .27			R ² = .16			R ² = .20			R ² = .06			R ² = .23		

Note: Each engagement group is compared with the unguided control group. Shaded rows indicate the interaction terms.

Does Group membership moderate the effect that environmental characteristics (site) have on engagement subfactors?

Table B.5. Models predicting engagement subfactors, containing interaction terms between **environmental characteristics** and Group membership

	Decentering			Notice/acceptance			Body awareness			Mindlessness			Pleasant MW		
	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>
Site	0.22	0.36	.54	0.21	0.29	.47	0.25	0.15	.10	-0.03	0.21	.91	0.06	0.18	.74
Mindful group	3.21	10.15	.75	8.06	8.16	.32	6.56	4.22	.12	3.49	5.87	.55	5.52	4.91	.26
Directed group	6.34	9.74	.52	6.79	7.79	.38	2.74	4.03	.50	1.92	5.59	.73	0.35	4.68	.94
MW group	5.49	9.85	.58	11.56	7.92	.15	4.14	4.06	.31	6.05	5.64	.28	1.44	4.72	.76
Mindful group * Site	0.07	0.48	.88	-0.23	0.39	.56	-0.26	0.20	.19	-0.09	0.28	.76	-0.23	0.23	.33
Directed group * Site	-0.23	0.46	.61	-0.18	0.36	.62	-0.12	0.19	.54	-0.02	0.26	.93	0.03	0.22	.90
MW group * Site	-0.13	0.46	.78	-0.44	0.37	.23	-0.20	0.19	.29	-0.20	0.26	.44	0.01	0.22	.98
	R ² = .06			R ² = .06			R ² = .04			R ² = .05			R ² = .04		

Note: Each engagement group is compared with the unguided control group. Shaded rows indicate the interaction terms.

Does Group membership moderate the effect that trait mindfulness has on engagement subfactors?

Table B.6. Models predicting engagement subfactors, containing interaction terms between **trait mindfulness** and Group membership

	Decentering			Notice/acceptance			Body awareness			Mindlessness			Pleasant MW		
	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>
FMI	0.38	0.16	.02	-0.08	0.14	.54	0.14	0.07	.05	-0.10	0.10	.32	0.00	0.08	.99
Mindful group	3.18	1.31	.02	3.42	1.12	.00	0.83	0.56	.14	2.21	0.80	.01	1.03	0.67	.13
Directed group	1.06	1.24	.39	3.15	1.06	.00	0.10	0.53	.85	1.38	0.76	.07	0.97	0.64	.13
MW group	2.26	1.23	.07	2.57	1.04	.01	-0.34	0.53	.52	1.94	0.75	.01	1.56	0.63	.01
Mindful group * FMI	0.10	0.23	.66	0.11	0.19	.58	-0.06	0.10	.56	-0.08	0.14	.59	-0.01	0.12	.91
Directed group * FMI	0.00	0.21	.99	0.28	0.18	.11	-0.03	0.09	.74	0.07	0.13	.58	0.14	0.11	.19
MW group * FMI	0.12	0.21	.56	0.35	0.18	.06	0.07	0.09	.44	-0.02	0.13	.88	0.09	0.11	.41
	R ² = .19			R ² = .09			R ² = .12			R ² = .06			R ² = .06		

Note: Each engagement group is compared with the unguided control group. Shaded rows indicate the interaction terms.

Does Group membership moderate the effect that trait nature connection has on engagement subfactors?

Table B.7. Models predicting engagement subfactors, containing interaction terms between **trait nature connection** and Group membership

	Decentering			Notice/acceptance			Body awareness			Mindlessness			Pleasant MW		
	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>
CNS	0.28	0.20	.15	0.24	0.16	.13	0.17	0.08	.04	-0.05	0.12	.69	0.21	0.09	.03
Mindful group	4.05	1.33	.00	3.24	1.07	.00	0.73	0.55	.19	1.63	0.79	.04	0.83	0.64	.20
Directed group	1.56	1.31	.24	3.39	1.06	.00	0.50	0.54	.36	1.65	0.78	.04	1.31	0.63	.04
MW group	2.78	1.27	.03	2.47	1.02	.02	-0.17	0.52	.74	1.84	0.75	.01	1.62	0.61	.01
Mindful group * CNS	0.11	0.28	.68	-0.17	0.23	.45	0.07	0.12	.58	0.14	0.17	.41	-0.12	0.13	.38
Directed group * CNS	-0.02	0.27	.95	0.26	0.22	.24	0.10	0.11	.36	0.23	0.16	.15	0.07	0.13	.58
MW group * CNS	0.09	0.28	.74	-0.09	0.22	.67	-0.03	0.12	.80	-0.03	0.17	.87	-0.13	0.13	.32
	R ² = .11			R ² = .11			R ² = .13			R ² = .05			R ² = .10		

Note: Each engagement group is compared with the unguided control group. Shaded rows indicate the interaction terms.

Does Group membership moderate the effect that positive affect has on engagement subfactors?

Table B.8. Models predicting engagement subfactors, containing interaction terms between **positive affect** and Group membership

	Decentering			Notice/acceptance			Body awareness			Mindlessness			Pleasant MW			
	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	
PA	0.07	0.13		.59	0.09	0.11	.42	0.10	0.06	.08	0.10	0.08	.20	0.11	0.06	.10
Mindful group	3.96	1.29		.00	3.00	1.10	.01	0.76	0.55	.17	1.75	0.79	.03	0.86	0.63	.17
Directed group	1.38	1.24		.27	2.81	1.06	.01	0.08	0.53	.87	1.36	0.76	.08	0.81	0.61	.19
MW group	2.49	1.24		.05	2.31	1.05	.03	-0.37	0.52	.48	1.78	0.75	.02	1.43	0.60	.02
Mindful group * PA	0.42	0.19	.03	0.06	0.17	.72	0.06	0.08	.46	-0.14	0.12	.25	-0.02	0.09	.81	
Directed group * PA	0.24	0.18	.20	-0.03	0.15	.83	0.06	0.08	.41	-0.09	0.11	.43	0.06	0.09	.48	
MW group * PA	0.31	0.18	.09	-0.13	0.15	.40	0.03	0.08	.70	-0.11	0.11	.31	0.02	0.09	.85	
	R ² = .17			R ² = .06			R ² = .13			R ² = .05			R ² = .10			

Note: Each engagement group is compared with the unguided control group. Shaded rows indicate the interaction terms. Bolded value indicates significance at $p < .05$.

Does Group membership moderate the effect that negative affect (inverse) has on engagement subfactors?

Table B.9. Models predicting engagement subfactors, containing interaction terms between **negative affect** and Group membership

	Decentering			Notice/acceptance			Body awareness			Mindlessness			Pleasant MW		
	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>
NA	-16.93	39.31	.67	-116.08	28.08	.00	-16.02	16.73	.34	-66.33	20.32	.00	-36.90	18.59	.05
Mindful group	4.40	1.36	.00	3.65	0.97	.00	1.02	0.58	.08	1.94	0.70	.01	1.00	0.64	.12
Directed group	1.14	1.33	.39	2.76	0.95	.00	0.15	0.56	.79	1.29	0.68	.06	0.83	0.63	.19
MW group	2.57	1.32	.05	2.45	0.94	.01	-0.20	0.56	.71	1.80	0.67	.01	1.56	0.62	.01
Mindful group * NA	-14.80	59.17	.80	22.08	42.26	.60	4.83	25.18	.85	6.28	30.58	.84	-6.43	27.98	.82
Directed group * NA	-43.14	56.57	.45	-31.76	40.73	.44	0.00	24.07	.99	-24.41	29.23	.40	-5.63	26.78	.83
MW group * NA	66.69	60.97	.28	25.77	42.94	.55	-3.84	25.58	.88	-35.85	31.06	.25	23.67	28.66	.41
	R ² = .07			R ² = .27			R ² = .04			R ² = .24			R ² = .09		

Note: Each engagement group is compared with the unguided control group. Shaded rows indicate the interaction terms.