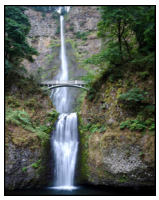
Journal of Environmental Psychology 59 (2018) 36–45

Contents lists available at ScienceDirect

Journal of Environmental Psychology

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



Conceptualising creativity benefits of nature experience: Attention restoration and mind wandering as complementary processes

Kathryn J.H. Williams[a,*], Kate E. Lee[a], Terry Hartig[b], Leisa D. Sargent[c], Nicholas S.G. Williams[a], Katherine A. Johnson[d]

[a] School of Ecosystem and Forest Sciences, University of Melbourne, Australia
[b] Institute for Housing and Urban Research, Uppsala University, Sweden
[c] UNSW Business School, UNSW, Australia
[d] Melbourne School of Psychological Sciences, University of Melbourne, Australia

ARTICLE INFO

Handling Editor: Jeff Joireman

ABSTRACT

Accumulating evidence indicates that time spent in natural environments promotes creativity, but few researchers have considered how this occurs. We evaluate two candidate mechanisms, attention restoration and mind wandering. We compare the accounts in terms of attentional focus, brain network activation, cognitive effects, and the temporal progression of these processes across the stages of creativity. Based on this analysis, we propose that (1) gentle shifts between externally oriented soft fascination and internally oriented mind wandering can occur during nature experience; (2) this provides the basis for mutually reinforcing pathways that enhance attention control following nature experience; and (3) mind wandering might support additional benefits for creativity, including flexibility and new associations of ideas. We propose research to test the proposed pathways, including the conditions under which environments influence creativity, the ebb and flow of attention orientation during environmental experience, and the links between attentional focus, brain network activation and creativity.

1. Introduction

How does the experience of nature influence creativity? Anecdotal evidence over millennia and across cultures suggests a particular link between nature and creativity. This is exemplified by the work of writers like William Wordsworth and painters like Georgia O'Keefe who drew on nature as both a source of ideas and as a setting that enabled creativity. Many readers will recognise the related experience of taking a work day lunch break in a park and finding that the solution to a problem suddenly becomes clear, or of returning to work with new energy and ideas. Despite this conjecture, only a relatively small body of research formally tests whether nature experience boosts creativity, and much of this work lacks a theoretical explanation for *how* such benefits occur. Attention restoration theory (ART; Kaplan & Kaplan, 1989) is commonly referenced to explain the creativity benefits of nature experience in terms of a renewed ability to direct and control attention (e.g. Atchley, Strayer, & Atchley, 2012; McCoy & Evans, 2002). Researchers recognise, however, that ART does not sufficiently explain how nature experience might enable the flexible forms of cognition associated with creativity (van Rompay & Jol, 2016). This has led to speculation that other processes - such as mind wandering - may be involved (Atchley et al., 2012). Mind wandering, sometimes referred to as daydreaming, is internally focused thought that is unrelated to the task at hand (Baird et al., 2012; Smallwood & Schooler, 2015).

On the face of it, these two mechanisms are not readily compatible. For example, when applied to the nature-creativity relationship, ART suggests that creativity benefits occur primarily through restoration of a directed attention capability via an *externally oriented,* effortless form of attention called soft fascination (Kaplan & Kaplan, 1989; Kaplan, 1995). There is some evidence that these cognitive benefits are due to improved functioning of attention and executive control networks of the brain (e.g., Berman, Jonides, & Kaplan, 2008). In contrast, mind wandering researchers suggest that creativity benefits occur through associative processes - spontaneous formation of associations between previously unconnected ideas - with creativity promoted through *internally oriented* cognition (Schooler et al., 2011). In other contexts, mind wandering has been linked to the functioning of the default network, a complex of brain regions empirically linked to creativity (Beaty, Benedek, Kaufman, & Silvia, 2015).

To resolve this seeming tension, we consider nature experience in

* Corresponding author. School of Ecosystem and Forest Sciences, Baldwin Spencer Building, University of Melbourne, Parkville, 3010, Australia.
E-mail address: kjhw@unimelb.edu.au (K.J.H. Williams).

https://doi.org/10.1016/j.jenvp.2018.08.005
Received 20 December 2017; Received in revised form 7 August 2018; Accepted 14 August 2018
Available online 17 August 2018

light of two areas of creativity research (outlined in more detail in Section 2). First, we consider nature experience as a form of incubation, a period of time when conscious work on a problem stops but through which problem solving is nevertheless facilitated (Sio & Ormerod, 2015). Second, we draw on work emphasising the role of complementary (or dual) pathways for different dimensions of creativity, specifying roles for both executive and associative cognitive processes (Beaty, Silvia, Nusbaum, Jauk, & Benedek, 2014). Considered together, this allows us to more clearly articulate the different cognitive pathways through which attention restoration and mind wandering might promote creativity, and provide a temporal framework for reconciling how both attention restoration and mind wandering might contribute to creativity during and following a period of incubation in a natural environment.

Neither attention restoration theory nor the concept of mind wandering were specifically developed to explain how nature experience might benefit creativity. Therefore, we first use the above frameworks to separately describe how attention restoration theory and mind wandering might be extended to explain the nature-creativity relationship. In doing so we specify the attentional focus, brain networks and cognitive effects associated with attention restoration and mind wandering (Section 3). We then explicitly consider synergies and contrasts between the accounts, along with the temporal progression of these processes during a nature experience and across stages of the creative process. This allows us to consider attention restoration and mind wandering as complementary and mutually reinforcing processes that influence different dimensions of creativity (Section 4). Based on this analysis, we provide concrete guidance for future research that directly tests our proposed pathways (Section 5). This research would enhance understanding of how environments shape creativity, but also contribute to our understanding of attention restoration and mind wandering more broadly.

2. Creativity and the creative process

Creativity refers to a process of generating new and useful ideas (Amabile, Barsade, Mueller, & Staw, 2005; Plambech & Konijnendijk, 2015), and is generally understood as having multiple dimensions, including flexibility (the breadth and number of distinct semantic categories in play), fluency (the number of unique ideas generated), originality (the uncommonness of ideas, reflecting ability to approach a problem in a new way), and the ability to unify disparate (or remotely associated) ideas (Baas, De Dreu, & Nijstad, 2008; Barr, Pennycook, Stolz, & Fugelsang, 2015). A well-established framework views creativity as a process with multiple stages: preparation, incubation, idea generation, and evaluation (Amabile et al., 2005). Preparation involves directing one's attention to a topic, gathering information, and exploring aspects of the topic that are of interest. Incubation commonly occurs following initial preparation for the task: conscious work on a problem stops, but conscious or unconscious cognitive processes enable new ideas to emerge without apparent additional effort (Sio & Ormerod, 2015). Idea generation is a period when conscious work is again undertaken to resolve the creative problem and potential solutions emerge. During the evaluation phase, focused attention is given to the merit of ideas generated. In this section we introduce two key areas of theory relevant to considering how nature experience might figure in creativity: mechanisms of incubation, and cognitive theories of creativity. For ease of reference, key terms used in this section are summarised in Table 1.

2.1. Mechanisms of incubation

Hundreds of studies have tested whether problem solving (creative or otherwise) is enhanced by a period of incubation after the task has commenced. Meta-analyses demonstrate a positive incubation effect for general problem solving as well as for specific creative tasks (Sio & Ormerod, 2009; Strick et al., 2011). Multiple theories have been proposed to explain how incubation supports problem solving (Gilhooly, 2016; Gilhooly, Georgiou, & Devery, 2013), including conscious and unconscious work hypotheses (Sio & Ormerod, 2009). Conscious work hypotheses suggest that the incubation phase improves normal conscious work on a problem. For example, the recovery from fatigue theory proposes that the incubation period promotes problem solving by reducing mental fatigue, enabling improved conscious work *after* an incubation period (Gilhooly, 2016). In contrast, unconscious work hypotheses suggest incubation enhances problem solving through unconscious processes *during* an incubation period. A range of unconscious processes have been proposed, such as spreading activation and opportunistic assimilation (Sio & Ormerod, 2015). Spreading activation involves activation spreading widely and freely across loosely related ideas (or semantic categories), and is thought to allow previously ignored memory items to be considered. Opportunistic assimilation involves incorporating chance-encountered information available during the incubation period (for example, cues in the environment), and is thought to provide benefits by allowing consideration of ideas that would be otherwise ignored. In this paper, we draw on incubation research to consider both the mechanisms and the temporal frames in which nature experience influences creativity.

2.2. Cognitive theories of creativity

The distinction between conscious and unconscious work explanations of incubation echoes other concerns within theories of creativity. Beaty et al. (2014) outline two major theories of creativity: controlled-attention and associative theory. Controlled-attention theory positions creative thought as a top-down process in which executive functions maintain a strategic search for novel solutions, enable controlled shifts between closely and distantly related ideas, and suppress ideas that are less original (Nusbaum & Silvia, 2011). Controlled-attention theory aligns with conscious work hypotheses of incubation, since both rely on executive control of conscious work. In contrast, the associative theory of creativity posits that creativity is improved by any state or condition that increases the likelihood that the necessary ideas can become associated (Mednick, 1962). For example, less hierarchical knowledge structures and greater cognitive flexibility are more likely to allow novel combinations of ideas (Beaty et al., 2014). The associative theory of creativity assumes ‘bottom up’ processes based on association rather than ‘top down’ goal-directed strategies based on attention control. Individuals' associative abilities can be measured through a semantic distance task where participants produce words associated with a target term such as “good” or “hot”. Production of more semantically distant pairs (for example “boiling” is more distantly related to “popular” and more closely related to “hot”) indicates stronger associative capacity. Recent research has shown variation in individuals' associative abilities, along with evidence that this ability makes a unique contribution to creative performance (Beaty et al., 2014). Associative theory aligns with unconscious work hypotheses, specifically the proposition that unconscious work occurs through spontaneous and spreading activation of memories (Sio & Ormerod, 2009). In exploring this topic, we consider how attention restoration and mind wandering relate to controlled-attention and associative theories of creativity.

Importantly, recent work suggests that mechanisms described by both controlled-attention and associative theories may be needed to account for creative performance. Beaty et al. (2015) tested the contributions of both executive and associative processes in the production of novel ideas and found evidence of unique contributions of both. Barr et al. (2015) predicted that individual differences in willingness (and ability) to use analytical strategies to solve problems – characteristic of more top-down attention control processes – would be associated with some indicators of creativity but not others. Over a series of studies, they showed that people with high performance on analytical capacity also performed better on creativity measures involving connecting

Table 1
Glossary of terms relating to creativity and cognition.

Associative theory of creativity	A theory of creativity that focuses on individual capacity to link ideas that are distantly related.
Conscious work hypotheses	Theories of *incubation* (defined below) that suggest incubation allows more effective problem solving by enhancing normal conscious work processes.
Controlled-attention theory of creativity	A theory of creativity that focuses on individual difference in the ability to control attention and cognition.
Default network	A network of brain regions (including the posterior cingulate cortex, the medial prefrontal cortex, the inferior parietal lobule, and the medial temporal lobe) associated with self-referential thought, mind wandering, and creativity.
Dorsal attention network	A network of brain regions (including the intraparietal sulcus and the human homologue of the frontal eye field) associated with endogenous or voluntary control of attention.
Incubation	A stage of the creativity process in which focused work on a problem ceases, but through which new ideas are facilitated.
Opportunistic assimilation	A specific *unconscious work hypothesis* that suggests cues within the task environment are opportunistically included in potential solutions.
Recovery from fatigue	A specific *conscious work hypothesis* that suggests incubation boosts problem solving by allowing rest during incubation and so improved conscious effort following incubation.
Spreading activation	A specific *unconscious work hypothesis* that suggests activation spreads widely across related ideas, broadening the problem space and allowing previously ignored ideas to be considered.
Ventral attention network	A network of brain regions (including a ventral, frontal cluster and the temporoparietal junction) associated with exogenous or involuntary control of attention.
Unconscious work hypotheses	Theories of incubation that suggest incubation enables unconscious work to occur during the incubation period.

Key sources: Amabile et al., 2005; Beaty et al., 2014; Christoff, Irving, Fox, Spreng, & Andrews-Hanna, 2016; Sio & Ormerod, 2015. Buckner, Andrews-Hanna, & Schacter, 2008; Shulman et al., 2009.

remotely related ideas and originality of generated items, but not fluency or flexibility. Along with other authors, these researchers conclude that dual pathways are involved in creativity (e.g. Allen & Thomas, 2011; Sowden, Pringle, & Gabora, 2015). In a similar vein, we consider whether attention restoration and mind wandering describe mechanisms that plausibly co-occur through nature experience, contributing to different dimensions of creativity.

3. Nature experience and creativity

Recent studies testing the nature-creativity relationship are promising, consistently demonstrating enhanced creativity following exposure to natural environments or natural features in built environments. Two studies demonstrate benefits of periods walking in natural environments: Atchley et al. (2012) found that participants who had completed a four-day hike performed better on creativity measures than those who had not, while Ferraro III (2015) found improved performance after six-day wilderness classes. Other studies show that creativity benefits emerged in the presence of potted plants or viewing images of natural environments in a laboratory (Shibata & Suzuki, 2004; Studente, Seppala, & Sedowska, 2016; van Rompay & Jol, 2016). Researchers have also assessed the relationships between multiple physical characteristics of workplaces and perceived creative potential and creativity using observational surveys (Ceylan, Dul, & Aytac, 2008; Dul, Ceylan, & Jaspers, 2011; McCoy & Evans, 2002). These studies showed that natural elements in the form of office plants, a view through a window, or wood and stone surfaces are consistently positively associated with creativity. Finally, qualitative research demonstrates that creative professionals strongly consider nature to positively influence their creative performance, encouraging flexible thinking, inspiring many new ideas, and renewing energy (Plambech & Konijnendijk, 2015).

While this accumulated evidence is promising, relatively little consideration has been given to the psychological mechanisms through which nature experience supports creativity, or the specific characteristics of natural environments that promote this benefit. The majority of research articles draw on ART to explain the benefits of nature experience for creativity (Ferraro III, 2015; McCoy & Evans, 2002; Plambech & Konijnendijk, 2015; van Rompay & Jol, 2016), but this pathway is rarely described in detail. Moving beyond ART, Atchley et al. (2012) note that multiple pathways may be involved (including attention restoration), and they tentatively suggest that nature experience may influence creativity by allowing mind wandering that supports divergent thinking. Specific tests of these pathways have not been undertaken, however existing research testing the influence of nature experience on creativity (e.g. Atchley et al., 2012; Ferraro III, 2015; McCoy & Evans, 2002; Plambech & Konijnendijk, 2015; Shibata & Suzuki, 2004; Studente, Seppala, & Sedowska, 2016; van Rompay & Jol, 2016) does highlight characteristics of the relationship that have significance for understanding the mechanisms by which creativity occurs.

First, the studies found effects of nature experience on creativity using tasks that assess diverse dimensions of creativity, suggesting that multiple pathways are likely involved (Barr et al., 2015). The Remote Associates Task used by Atchley et al. (2012) and Ferraro III (2015) was originally designed to test divergent thinking or a capacity to flexibly search diverse semantic categories for potential solutions (Mednick, 1962). Recent research has demonstrated it also requires considerable higher order analytical processing to strategically search for the correct answer across unrelated categories of ideas (Barr et al., 2015). Shibata and Suzuki (2004) used a word association task that measured the number of words produced in ten minutes, likely quantifying creative fluency. The Torrance Test of Creative Thinking (Torrance, 1966) used by Ceylan et al. (2008), Dul et al. (2011) and McCoy and Evans (2002) measures multiple creative dimensions such as fluency, flexibility, and originality. The same is true for the Test for Creative Thinking – Drawing Production (Jellen & Urban, 1986) used by van Rompay and Jol (2016). What is important to note from these research findings is that links between nature experience and creativity have been demonstrated using multiple measures, including measures linked to both controlled attention (e.g. Remote Associates Task) and to associative processes (e.g. measures of flexibility) (Beaty et al., 2014). This means that nature experience is unlikely to be influencing creativity only through improved attention control or only through boosts to flexibility.

Second, the research raises the possibility that different mechanisms may be involved in different ways across the creative process. Plambech and Konijnendijk (2015) assessed the role of nature across the creative process based on interviews with Danish professionals working in creative industries such as arts and design. They found that some professionals went to nature to gather ideas and inspiration, noting that the shapes, smells, and sounds of nature frequently informed their preparation. The role of nature experience in creativity was most evident however during incubation. Participants often described spending time in nature to renew energy for creative performance, and many reported that this allowed them to become calm and bring to mind ideas. Participants also described how the fast pace and focused attention required for idea generation and evaluation were incompatible with being in nature, meaning that nature experience played a less explicit part in these stages of creative performance. Participants noted that after returning to work following a nature experience they felt better able to

synthesise and organise ideas. This suggests that considering attention restoration and mind wandering within a temporal framework of incubation and the creative process may usefully inform understanding of these mechanisms. In the following sections, we separately consider how understanding of attention restoration and mind wandering might be extended to explain creativity benefits of nature experience.

3.1. 1. Attention restoration and creativity

ART was developed to account for the association between time spent in an environment and restoration from directed attention fatigue. It is most commonly applied in research on nature experience. The theory describes components of environmental experience that support restoration, which are typically more characteristic of experiences in natural settings (Kaplan & Kaplan, 1989; Kaplan, 1995). One component is soft fascination. This is considered a form of attention defined in terms of effort, intensity, and affective valence: interesting and aesthetically pleasurable environments effortlessly and gently attract attention (cf. hard fascination in which attention is strongly captured, Kaplan & Kaplan, 1989). Soft fascination is supported and sustained in environments that additionally provide a sense of being away from everyday concerns and mental routines and devoid of stimuli that might trigger demanding thoughts, that have substantial scope and coherence (together feeding a sense of extent), and that are compatible with intended activities of the individual (Kaplan, 1995). While these components of restorative experience incorporate elements of affect, concern for attentional aspects typically dominates empirical work guided by ART (with affect given greater consideration in stress reduction theory; Ulrich et al., 1991). By attracting and holding attention effortlessly and gently while also enabling psychological distance, natural environments provide opportunities to rest effortful directed attention (Kaplan & Kaplan, 1989). Directed attention is conceived of as a limited mental resource that is required to ignore distractions, concentrate, and evaluate ideas. It is susceptible to fatigue because it requires effort (Kaplan & Kaplan, 1989). Researchers suggest that nature experience can promote creativity by providing a rest from effortful preparation of a creative task, and so restores the capacity to direct attention required for purposeful cognitive activity during two later stages of creative performance, idea generation and evaluation (Plambech & Konijnendijk, 2015; van Rompay & Jol, 2016).

While ART is largely used within environmental psychology, it is broadly consistent with a seminal model of attention processes central to cognitive psychology. Posner and colleagues have developed a comprehensive theory that describes key brain networks engaged in attention control (Petersen & Posner, 2012; Posner & Petersen, 1990). They refer to the alerting, orienting, and executive control networks, which are responsible for maintaining alertness, selecting information for processing, and maintaining task performance respectively (Petersen & Posner, 2012). The orienting network can be further distinguished into endogenous and exogenous networks. Endogenous orienting of attention is a voluntary and goal-driven form of attention, such as focusing on a work task and ignoring nearby conversations, and is managed by the dorsal attention network (DAN). Exogenous orienting of attention is an automatic capturing of attention by external stimuli, such as a phone ringing, and is managed by the ventral attention network (VAN) (Corbetta & Shulman, 2002). ART can be expressed using Posner's attention network model. Fascinating natural environments gently capture attention though exogenous orienting associated with low level activation of the VAN. This allows the networks that control directed attention (i.e. executive, alerting, endogenous orienting networks) a chance to rest and replenish (cf. Berman et al., 2008 who found a beneficial effect of nature experience only for the executive network). This kind of beneficial effect is referred to as attention restoration.

If nature experience is viewed as an incubation process, attention restoration explanations of the nature-creativity link are consistent with the 'recovery from fatigue' conscious work hypothesis described earlier (Gilhooly, 2016), in which the incubation period is viewed as a time of rest that improves normal problem solving following the break. From this perspective, soft fascination during the nature experience incubates creativity by restoring directed attention. This improves attention control, leading to improved conscious creative performance following the incubation period. The nature experience incubation period enables these benefits primarily through rest of the dorsal attention and executive networks and other areas of the brain that are involved in inhibiting distracting thoughts and stimuli, working memory performance, planning, and maintaining a task set. Attention restoration accounts are also self-evidently consistent with controlled-attention theories of creativity. We might therefore anticipate that restoration of attention control through nature experience will boost those aspects of creativity most closely related to these executive functions, such as originality and performance on tests that require strategically bringing together disparate ideas, such as the Remote Associates Task (Barr et al., 2015).

Building on ART to account for the nature-creativity link implies that environments that promote creativity will be the same environments that promote psychological restoration more broadly: softly fascinating environments that effortlessly but gently draw attention and are aesthetically pleasurable. Environments that are threatening or contain sudden noises or unexpected change will strongly activate the alerting and exogenous orienting networks (Corbetta, Patel, & Shulman, 2008). Environments that are difficult to comprehend (low in coherence/extent) will activate the executive network as the individual seeks to make sense of the surroundings and maintain orientation (Petersen & Posner, 2012). This suggests that pleasant, coherent, and unthreatening environments will place little demand on attention networks (low level activation of exogenous orienting, resting of other networks), enabling restoration of attention control that enhances creative performance. Table 2 provides the key elements of ART applied to explain how nature experience supports creativity.

It is noteworthy that several authors who have used ART to explain the nature-creativity link have suggested that the theory cannot fully explain the relationship. Plambech and Konijnendijk (2015) speculate that in addition to enabling attention restoration, the fascination with nature we experience may also make us more curious, and so enhance our capacity to see new possibilities. van Rompay and Jol (2016) suggest that by restoring attention, nature experience may primarily establish a pre-condition for creativity. These authors conceptually link the experience of 'soft fascination' in nature to a sense of mystery, tentatively suggesting that the awareness that there is more to explore might stimulate a 'widening' of attention and greater imagination. To do this they draw on previous research showing that experiencing relatively 'wild' forms of nature produces surprise and cultivates curiosity and creativity, while open space promotes a sense of serenity that facilitates creativity (Plambech & Konijnendijk, 2015). These authors still acknowledge that much work is required to understand this relationship. To understand the more flexible or associative forms of cognition that are also vital to creativity, we must consider alternative explanations.

3.2. Mind wandering and creativity

One alternative proposal is that nature experience boosts creativity through mind wandering (Atchley et al., 2012). This explanation is interesting given mind wandering involves a decoupling of attention away from perceiving the world (Schooler et al., 2011). The explanation is perhaps also surprising in the light of well-established negative effects of mind-wandering such as increased errors and accidents (He, Becic, Lee, & McCarley, 2011), unhappiness (Killingsworth & Gilbert, 2010), depressive rumination (Berman et al., 2010) and post-traumatic stress disorder (Ehlers, Hackmann, & Michael, 2004). Mind wandering or daydreaming however is also linked to positive outcomes, including

Table 2
Comparison of how attention restoration and mind wandering can be applied to explain creativity benefits of nature experience.

	Attention restoration theory	Mind wandering
Attention orientation during nature experience	Primarily but not exclusively external	Primarily internal
Attention control during nature experience	'Gentle' exogenous control	Unfocused or unconstrained
Environmental characteristics that support creativity	Non-threatening, coherent, softly fascinating (effortlessly draw attention, aesthetically pleasing), affording distance from routine demands and mental contents	Low demand tasks (e.g. following familiar and well-established trail)
Brain network activity during nature experience	Gentle activation of ventral attention network (exogenous orienting of attention); resting of executive, alerting, and dorsal attention networks (endogenous orienting of attention)	Activation of default network; deactivation of dorsal attention network (endogenous orienting of attention)
Key incubation mechanism	Improved conscious work following incubation period, through reduced fatigue	Unconscious work enables new association of ideas, perhaps through spreading activation
Key creativity mechanisms	Improved attention control	Associative processes connect ideas in new ways

Key sources: Baird et al., 2012; Berto, Baroni, Zainaghi, & Bettella, 2010; Christoff et al., 2016; Kaplan & Kaplan, 1989; Petersen & Posner, 2012, Smallwood & Schooler, 2015.

increased creativity (Baird et al., 2012; Ellamil, Dobson, Beeman, & Christoff, 2012; Mooneyham & Schooler, 2013). Atchley et al. (2012) therefore conclude it is a strong candidate to similarly explain creativity benefits of nature experience.

As a mechanism for incubation, mind wandering is closely related to unconscious work hypotheses of incubation. Researchers have speculated that creative thoughts may result from mind wandering due to the loose forms of associative cognition that occur. As thoughts flow across diverse, previously un-associated pieces of information, mind wandering may improve access to novel combinations of ideas and allow more flexible structuring of relationships between those ideas (Baird et al., 2012; Tan, Zou, Chen, & Luo, 2015). As such, benefits of mind wandering would be expected to begin during the nature experience, potentially resulting in 'aha' moments of insight but also making new ideas available following nature experience. Mind wandering also broadly aligns with the associative theory of creativity (Beaty et al., 2014). Mind wandering can be understood as a state in which disparate ideas have a better chance of becoming associated, as thoughts freely move across different semantic categories. Drawing on the work of Barr et al. (2015), we might anticipate that mind wandering during nature experience will boost dimensions of creativity most closely related to these associative mechanisms, such as fluency and flexibility (Barr et al., 2015).

At a neurological level, mind wandering and creativity are both linked to the default network, incorporating the posterior cingulate cortex, the medial prefrontal cortex, the inferior parietal lobule, and the medial temporal lobes. (Buckner et al., 2008; Fox, Spreng, Ellamil, Andrews-Hanna, & Christoff, 2015). Activation of the default network is associated with several forms of self-generated thought, including mind wandering, mental simulation, episodic memories, and future-focused thinking (Fox et al., 2015; Schooler et al., 2011; Smallwood & Schooler, 2015). Default network activation is most strongly associated with thought that is both task unrelated and stimulus independent, as mind wandering is commonly described. Studies have shown that the default network also plays a critical role in creativity (Beatyet al. 2015; Ellamil et al., 2012; Fox et al., 2015). Beaty et al. (2015) have temporally mapped brain activity during creative idea production and found default network activation during all stages of the task.

While mind wandering is a good candidate for explaining creativity boosts, we know very little about how it occurs during nature experience. Early articulations of ART suggested that in the presence of unthreatening nature the mind readily wanders (Kaplan & Kaplan, 1989), but we are not aware of any research specifically addressing this proposition. There is evidence that two forms of cognition seemingly related to mind wandering, reflection and rumination, may be influenced by nature experience, though in contrasting ways. Empirical work demonstrates that natural environments are preferred as places to reflect on important life concerns (Herzog, Black, Fountaine, & Knotts, 1997; Staats, Kieviet, & Hartig, 2003). While 'reflection' shares the internal focus of mind wandering, reflection is operationalised by Herzog and colleagues as a strongly goal oriented activity: 'thinking deeply about these problems is your goal' (p. 167). This suggests an endogenously controlled form of cognition that differs substantially from mind wandering. There is also evidence rumination decreases during nature experience, both with a single visit (Bratman, Hamilton, Hahn, Daily, & Gross, 2015) and in repeated encounters in the context of therapeutic horticulture for the treatment of depression (Gonzalez, Hartig, Patil, Martinsen, & Kirkevold, 2010). Rumination has sometimes been characterised as an affectively negative form of mind wandering, but the fixed, even obsessive quality of rumination contrasts sharply with the dynamic nature of mind wandering (Christoff et al., 2016; Smallwood & Schooler, 2015). In summary, foundational research is required to determine how mind wandering occurs during nature experience.

Studies provide some insights into the situational factors that trigger mind-wandering (Smallwood & Schooler, 2015), and perhaps provide the best starting point for considering what forms of nature experience might promote mind wandering. Mind wandering is more likely to occur where a low demand, goal-oriented task is set (Baird et al., 2012; Sio & Ormerod, 2009). Nature experience often occurs in the context of goal-oriented activities such as walking, camping, rock climbing, mountain bike riding, foraging, bird watching, or intentional reflection. Activities such as rock climbing or bird watching may at times require high levels of concentration on features of the environment, while in contrast walking a familiar and well-maintained path commonly places relatively little demand on attention. Nature experience may best promote mind wandering (and so creativity) where it involves a task that requires little attention. For example, walking a well-marked trail would likely place far less demand on directed attention than orienteering, where way-finding requires concentration and problem-solving. Consistent with this, Atchley et al. (2012) speculate that mind wandering in natural environments might be 'triggered' by the undemanding form of attention, soft fascination.

In conclusion, mind wandering is a promising mechanism for explaining how nature experience might promote creativity but is unlikely to be solely responsible. Evidence that both associative abilities and attention control play a role in creativity, and the increasing support for dual (conscious top-down and unconscious bottom-up) process models generally, warn against reliance on a single mechanism (Beaty et al., 2015; Sowden et al., 2015). In line with this, Atchley et al. (2012) tentatively suggest that both mind wandering and attention restoration may be involved in conferring the creativity benefits of nature experience. In the following section, we theorise the form of such an integration by joining attention restoration and mind wandering in a dual process model for incubation during a nature experience.

4. Complementary and mutually reinforcing roles for attention restoration and mind wandering

Separately, ART and mind wandering provide plausible but insufficient explanations of how nature experience might promote creativity. Table 2 reveals similarities between the accounts. Both describe attention control during nature experience as characterised by low levels of self-direction (cf. 'unfocused, unconstrained' and rest of directed attention). The environmental characteristics proposed as supporting both attention restoration and mind wandering could be characterised as placing low demand on an individual. The two accounts also contrast in important ways, especially in the processes thought to promote creativity: attention restoration highlights attention control that will benefit conscious work on a problem following the incubation period, while mind wandering highlights flexible association between ideas during unconscious work. Rather than being problematic, this contrast may be key to understanding how nature experience might promote creativity. If the mechanisms act in complementary or synergistic ways rather than competing, together they could provide a more complete picture of how nature experience boosts the range of cognitive capacities required for creativity. Below we consider whether the cognitive processes associated with attention restoration and mind wandering can co-occur, outlining key reasons we consider this plausible.

4.1. Gently alternating orientation of attention during nature experience

We first consider the contrasting orientation of attention associated with soft fascination and mind wandering. Both attention restoration and mind wandering theories point to psychological distance occurring during nature experience, but suggest very different forms of distance. In the case of ART, attention is shifted from the task to a softly fascinating environment, while mind wandering suggests withdrawal from both the task and the immediate environment to an internal focus. How can this be reconciled? Presentations of ART typically imply that soft fascination occurs more or less continuously throughout nature experience: attention is effortlessly drawn to multiple fascinating aspects of the natural environment (Fig. 1, soft fascination). We consider it more likely that during extended nature experience, the low demand on attention allows scope for thoughts to turn to other matters. This means that over time, attention may be drawn to internal thoughts, potentially initiating a period of mind wandering (Fig. 1, mind wandering).

This appears to be the pattern anticipated by the few scholars who have given thought to how nature experience might promote creativity. For example, van Rompay and colleagues (2016) suggest that attention restoration sets the preconditions for a 'widening of attention' that enables cognitive flexibility, while Atchley et al. (2012) suggest that soft fascination might 'trigger' mind wandering. There are many nature experiences that might promote this pattern of attentional focus. For example, on following a path into a woodland, one's attention might be exogenously drawn toward the colours and forms of plants in that area. But where that environment is relatively unchanging, the (already gentle) exogenous constraints on attention might further weaken, so that internal thoughts have greater chance of arising in one's mind. The anticipated progression is also consistent with evidence that the likelihood of mind wandering increases with time on a task (Farley, Risko, & Kingstone, 2013).

The anticipated shift from the external world to internal thoughts is also consistent with some of the earliest articulations of attention restoration theory. Rachel and Stephen Kaplan (1989) described softly fascinating environments as ones that 'leave room in the mind for other thoughts as well' and give an 'invitation for the mind to wander' (p. 193). They described a sequence of progressively deeper levels of benefit, with benefits building from simply 'clearing the head', to recovery of directed attention, to establishing a sense of cognitive quiet, to reflection on bigger issues of life and the world. These deeper levels of restoration were proposed to occur only during extended periods in relatively high-quality restorative environments (Kaplan & Kaplan, 1989). Considering how soft fascination and mind wandering might co-occur during nature experience does not challenge ART, and instead highlights an often-overlooked temporal aspect of attention restoration theory.

Possibly in contrast with Atchley et al. (2012), we do not view soft fascination as a unidirectional activator of mind wandering. Rather, we propose that the non-goal directed nature of mind wandering also means that attention can be readily drawn once again to the natural world. We suggest that extended nature experience is not characterised by continual externally oriented soft fascination nor by continual internally focused mind wandering, but by a gentle movement between these two states (note the oscillation between soft fascination and mind wandering in Fig. 1). Described experientially, attention is first drawn to softly fascinating aspects of the external environment, but where it demands no response, the mind is free to wander for a time and attention may become inwardly focused. As one's view or position in the environment changes (or as the environment changes around a person, for example a setting sun, or changing cloud formations), attention may again be exogenously oriented toward interesting and attractive aspects of the environment. Assuming that again no response is demanded, the cycle of mind wandering – exogenous orientation of attention may continue. In summary, we propose that soft fascination and mind wandering both occur during an extended nature experience, through gently alternating orientation of attention.

4.2. Complementary and mutually reinforcing influences on creativity

Second, we consider the apparently contrasting cognitive mechanisms for creativity. Fig. 1 describes how the outcomes of these processes arise differentially across the four stages of creativity. An attention restoration theory approach suggests that resting of attention networks during the incubation period results in restored attention control following the incubation period. Increased attention control supports more strategic and persistent searching for original ideas, as well as suppression of less original ideas - benefits observable during the idea generation and evaluation stages (Beaty et al., 2014). In contrast, a mind wandering approach suggests that associative processes occurring during the incubation period may contribute to new combinations of ideas. These may emerge into consciousness even during incubation (in the form of an 'aha' moment or insight problem-solving) as well as being potentially available during idea generation (Kounios & Beeman, 2014). At this level, the processes can be understood as complementary: acting at different times, and in different but non-competing ways.

The neurological basis of these pathways also suggests a more synergistic relationship may be occurring. Mind wandering is associated with activation of the default network (Fox et al., 2015; Schooler et al., 2011; Smallwood & Schooler, 2015). Recruitment of the default network is broadly considered to be inversely associated with activation of the dorsal attention network, the network responsible for endogenous orienting of attention (Christoff et al., 2016). While dorsal attention network activation is linked to *selective* (voluntary or endogenous) attention - whether to the external environment or internal thoughts (Christoff et al., 2016) - it is also one of the networks expected to rest during soft fascination (see however Berman et al., 2008 who found evidence only for rest of the executive network). Both attention restoration and mind wandering theories therefore suggest that the period spent in nature is characterised by reduced endogenous orienting of attention. In line with this, Christoff et al. (2016) suggest that some forms of spontaneous, stimuli-oriented cognition may be closely related to mind wandering as they are relatively free of deliberate or goal-directed constraints. The following example from Christoff and colleagues has striking resemblance to descriptions of soft fascination: 'While hiking on a forest trail, a woman's thoughts move from the gravel on the path in front of her to a slug crawling up a stump, and then to a leaf floating in a puddle' (p. 723). This raises the possibility that ART and

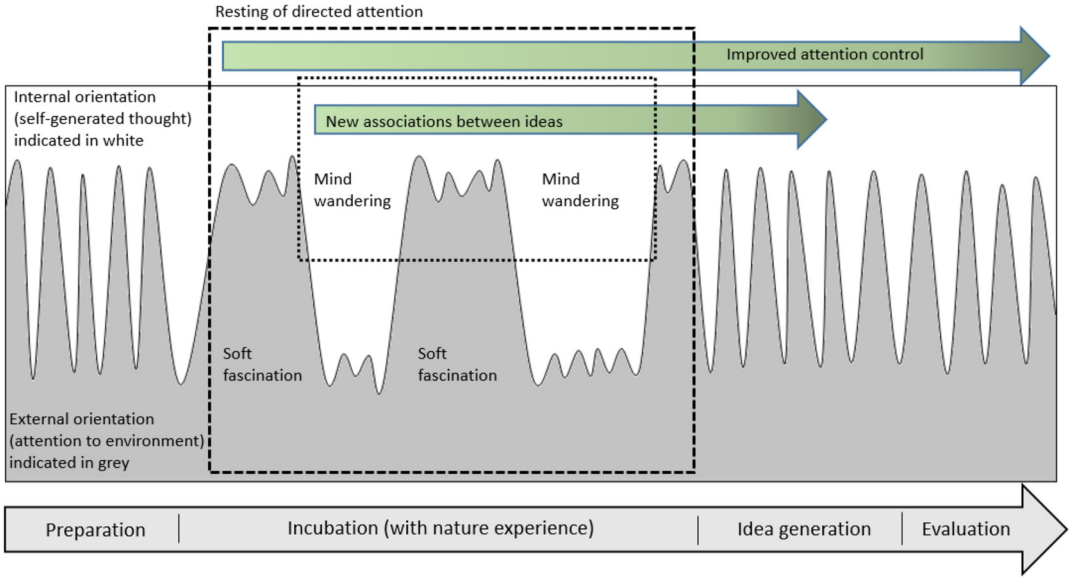


Fig. 1. Hypothesised representation of attentional orientation, resting of attention, and associated cognitive outcomes across the creative process (preparation, incubation, idea generation and evaluation).
Figure note: Grey shading represents the relative proportion of attention given to external environment, while white space indicates relative proportion of attention given to internal stimuli. Dashed rectangles represent key mechanisms occurring during incubation, with arrows showing the increasing cognitive contribution of these to creativity. Soft fascination and mind wandering are respectively represented by moderate dynamic peaks of external and internal orientation (cf. hard fascination and rumination, which are less dynamic forms of externally and internally oriented cognition). We propose gentle oscillation between soft fascination and mind wandering during incubation in natural environments. Both soft fascination and mind wandering place little demand on attention resources, and could work in mutually reinforcing ways to restore the capacity for attention control (hence both mechanisms are incorporated within a process of restoration labelled 'resting of directed attention'). Greater attention control enables more strategic searching and greater persistence during the idea generation and evaluation stages after incubation. Where mind wandering also occurs during the incubation period, newly associated ideas and greater cognitive flexibility may strengthen idea generation.

mind wandering theories of the nature-creativity link might in fact be describing distinct but related, and potentially mutually reinforcing, cognitive states occurring during nature experience.

5. Summary

Extending attention restoration theory to explain creativity, we suggest that soft fascination in natural environments might enable restoration of attention control, allowing more strategic and persistent searching for creative solutions following a period of incubation. Mind wandering during nature experience might support creativity by facilitating new associations between previously unconnected ideas. These mechanisms have both contrasting and common aspects. We propose that they act in a combination of complementary and mutually reinforcing ways to promote creativity. Soft fascination and mind wandering might both occur during nature experience, with attention first drawn to fascinating aspects of nature, but later free to wander inward given the 'gentle' way that natural environments are thought to commonly capture attention. Given the relatively low demand that both soft fascination and mind wandering place on attention networks, these processes might both act to promote attention control during idea generation and evaluation. Where mind wandering also occurs, it might enable access to new combinations of ideas and more flexible cognition. We conclude that an explanation of the creativity benefits of nature experience based on mind wandering is not inconsistent with explanations grounded in ART. Instead it complements ART by accounting for cognitive benefits beyond attention restoration, and it highlights an aspect of restorative experience that deserves greater consideration: changes in orientation of attention to external and internal thoughts over the course of time.

6. Future research directions

The previous section demonstrated ways in which attention restoration and mind wandering might plausibly co-occur during nature experience and across the creative process. This has brought forward hypotheses, collected in Fig. 1, that can guide further research to evaluate our proposed theoretical integration. In this section we outline future research needed to test whether, and how, complementary processes of attention restoration and mind wandering help explain the nature-creativity link (see Table 3).

First and foremost, further research is needed to more fully understand the relationship between socio-physical environments and creativity. While diverse experiences of nature – from passive viewing of potted plants to multi-day walks in extensive wilderness environments – have been associated with greater creativity, the body of work explored here suggests that not all nature experiences will result in improved creative performance. A small number of studies have begun to identify potential boundaries, focusing on the characteristics of natural environments that support creativity (Plambech & Konijnendijk, 2015; van Rompay & Jol, 2016), but much more work is needed. Our analysis suggests that consideration should be given not only to the characteristics of natural environments that support creativity, but to the characteristics of environments generally that support creativity through the proposed mechanisms. All environments can be considered with regard to the degree to which they support restoration, including environments entirely without natural features (e.g., Lindal & Hartig, 2013). Consideration should also be given to the activities occurring during the experience in nature or another environment high in restorative quality, as well as the duration of the experience. The immediate social context (e.g., being alone or in the company of a friend) may also play a role since it is likely that it shapes restorative outcomes (Staats, Jahncke, Herzog, & Hartig, 2016).

Beyond this, considerable effort is required to understand the processes by which nature experience promotes creativity. In relation to the specific processes addressed in this paper – attention restoration and mind wandering – there is considerable scope to develop a clearer empirical understanding of whether and how these processes boost

Table 3
Summary of future research directions and potential methodological approaches.

Topic	Questions	Approaches
Conditions under which environments influence creativity	Under what conditions do natural and other environments support creativity? Target factors include: • environmental characteristics • social context • activity (high and low demand tasks) • duration (shorter and longer periods in nature)	Experimental and quasi-experimental designs to test for creativity outcomes under specific circumstances.
Aspects of creativity influenced by nature experience	To what degree are different dimensions of creativity (e.g. fluency, flexibility, originality) boosted through nature experience, and how does this reflect on the role of attention control?	Use multiple measures of creativity and related cognitive capacities to test for specific outcomes
Nature experience and mind wandering	When does mind wandering occur during nature experience, and how does this relate to soft fascination?	Experience sampling, retrospective self-report of mind wandering, eye tracking studies
Brain network activity, nature experience and creativity	What brain networks are activated during nature experience, and how do these relate to subsequent creative performance?	Brain imaging using virtual environments, or portable EEG in field settings.
Affective processes, nature experience and creativity	How do changes in mood associated with nature experience (e.g. reduced negative affect) influence cognitive capacities and creativity?	Assess for changes in mood over time, in association with changes in cognitive flexibility and creative performance.

creativity.

An initial point to address is whether ART might provide a sufficient explanation of the creativity benefits of nature experience. Our analysis concludes that since ART is primarily considered a theory of restoration of directed attention, this is unlikely to be the case. We must consider the possibility that soft fascination contributes to more than restoration of attention control. To test this proposal, researchers could examine how soft fascination relates to specific cognitive processes underpinning creativity. If soft fascination primarily boosts creativity through attention control, this would predict boosted performance on indices of creativity best linked to analytic thought (for example, the Remote Associates Task). On the other hand, improved performance on indices of fluency and flexibility (for example, flexibility as measured through Category Inclusiveness Task; see Barr et al., 2012) would not be expected. Testing this proposal requires studies that systematically vary the level of soft fascination experienced during exposure to environments (natural or built). Such designs have been used previously to understand whether more fascinating natural scenes benefit subsequent attention control (Berto et al., 2010).

A second task is to understand more about the relationship between mind wandering and time spent in natural environments. While noting existing studies on related forms of thought such as reflection and rumination (Bratman et al., 2015; Herzog et al., 1997), we are not aware of any research examining mind wandering during nature experience. Several methods could be applied to understanding whether and how minds wander during nature experience. Standardised approaches to retrospective self-report of mind wandering are most common, while use of experience sampling or momentary ecological assessment methods are increasingly being used to observe thoughts at random or at systematically selected points in time during experience (Smallwood & Schooler, 2015). Eye tracking also offers some possibilities as mind wandering is linked to divergent eye movements and more frequent blinking (Smallwood & Schooler, 2015). These methods could be readily employed to identify whether mind wandering occurs during nature experience and the relationship between this occurrence and creative performance following nature experience.

Studying the kinds of nature experiences that support creativity might also provide insights into the role of mind wandering. Duration of experience is an obvious starting point. Attributing creativity benefits to mind wandering potentially links them to longer nature experiences since the likelihood of mind wandering increases with time on task (e.g. measured in 5-min blocks as in Farley et al., 2013; Thomson, Seli, Besner, & Smilek, 2014). In contrast, attention restoration has been shown to occur even following very short periods in or observing natural environments (Lee, Williams, Sargent, Williams, & Johnson, 2015), though the persistence of such benefits may be similarly short-lived. Examining creativity benefits of shorter versus longer nature experiences might provide some insights into the kinds of processes that support creativity. Similarly, studies could be designed to test creativity outcomes of nature experiences involving activities that encourage or discourage mind wandering. High attention demand tasks undertaken during nature experience – for example complex way finding activities – are likely to preclude mind wandering (Baird et al., 2012). Comparing the creativity outcomes of nature experiences involving high and low attention demand tasks would help in specifying the particular cognitive processes associated with nature experience.

Third, our conceptual framework points to the importance of understanding temporal variations in attention during nature experience and how these might promote creativity. Of particular interest is the movement of attention between the external environment and internal thoughts. Momentary ecological assessment could be particularly helpful for exploring this issue. Thought probes at random points in time across a nature experience would provide insights into whether attention is continuously oriented toward the external environment, whether it moves between the physical environment and internal thoughts, and to the temporal patterning of any such shift. Such techniques could be used to compare attention orientation during nature experiences with different temporal-spatial characteristics, and whether variations in temporal patterns of attention are differently associated with creative performance. One might anticipate that nature experiences in relatively homogenous environments would be more likely to result in continual internally focused mind wandering. In contrast, complex or varying environments – perhaps biodiverse rock pools or gardens with many different flowering plants – are more likely to be associated with more frequent gentle exogenous orienting of attention. Experimental designs could compare attention patterns while walking through natural environments selected for systematic variation on a homogeneity-heterogeneity dimension, an approach previously used with walking speed as an indicator of preference (e.g. Axelsson-Lindgren & Sorte, 1987). Comparing the temporal patterns of attention associated with these experiences and the benefits for different facets of creativity might provide insights into relationships between processes underpinning the nature-creativity link.

Fourth, brain imaging studies could be useful in understanding temporal patterns of soft fascination and mind wandering during nature experience. In the first instance, it is important to establish which brain networks are activated and deactivated during different types of nature experience. Two studies demonstrate more widespread brain activation including in the dorsal attention network when viewing or thinking about built or unpleasant environments (Martínez-Soto, Gonzales-Santos, Pasaye, & Barrios, 2013; Vedder et al., 2015). Neither study directly addressed default network activation during nature experience however, and this is an issue for consideration. Brain imaging research might also provide insight into the temporal patterns of cognition

during nature experience, a topic largely unstudied even using self-report methods (for an exception see Hartig, Evans, Jamner, Davis, & Gärling, 2003). Neuroscientists are increasingly using dynamic approaches to understand changes in activation of brain networks, including during creative performance (Beaty et al., 2015, 2016; Christoff et al., 2016). In time, these strategies might also be applied to understand the temporal patterns of attention and associative processing during nature experience. For example, patterns of activation of the ventral attention and default mode networks (e.g. those involved in autobiographic memory) during nature experience would provide insights into how and when attention is exogenously oriented to the external environment or focused on internal mind wandering. The few studies that have observed brain network activity during nature-related experiences have used single point observations, rather than observing variation across time (Martínez-Soto et al., 2013; Vedder et al., 2015). Portable EEG has been used to observe neural activity in actual rather than simulated natural environments (Aspinall, Mavros, Coyne, & Roe, 2013) and might provide insights into the occurrence of mind wandering when in different environments (Smallwood & Schooler, 2015). Future studies might be designed to understand such patterns, once behavioural studies provide clear guidance and the measurement technology is refined.

The scope of this paper has been limited to two processes concerned with properties of attention orientation during nature experience, however other processes may also be involved. For example, there is considerable evidence that affect influences creativity; activated positive affect such as joy is most strongly linked to creativity, but so is activated negative affect such as anger (Baas et al., 2008; Nijstad, De Dreu, Rietzschel, & Baas, 2010). Nature experience is well understood to play a role in boosting mood and reducing negative affect (Bowler, Buyung-Ali, Knight, & Pullin, 2010), with a handful of papers examining the role of affect in explaining how physical environments promote creativity (Amabile et al., 2005; McCoy & Evans, 2002). Such changes in affect may have complex relationships with the cognitive pathways explored here. Positive moods are thought to broaden the scope of perceptual and visual attention and reduce reliance on predominant ways of thinking and behaving (Fredrickson, 2001; Kounios & Beeman, 2014). A final area for future research is to understand the roles of attention, affect and the inter-relationships between these in nature experience and creativity.

7. Conclusion

A key contribution of this paper is the clearer articulation of processes only obliquely mentioned in past discussions of how nature experience might enhance creativity. We propose that attention restoration and mind wandering plausibly provide complementary and mutually reinforcing mechanisms for the creativity benefits of time spent in natural environments. Despite contrasting cognitive bases and attention orientation, our temporal approach hypothesises how attention restoration and mind wandering can co-occur during nature experience and across the creative process. Our approach is distinctive because it proposes how characteristics of nature experience may enable patterns of cognition that act in complementary and synergistic ways to promote both the controlled attention and flexibility that are required for creativity.

For restorative environments researchers, this proposal raises some broader theoretical issues. While ART is a widely applied explanation for particular psychological benefits of environments, researchers are increasingly seeking to explain effects well beyond renewed capacity for attention control (see for example Pasanen, Neuvonen, & Korpela, 2017). We suggest that for some benefits at least, greater explanatory power is likely to be found by looking beyond the attention control pathways emphasised in ART. Extending ART to incorporate mind wandering or related forms of associative cognition provides a plausible and potentially more powerful explanation of creativity benefits. This was hinted at long ago by Kaplan and Kaplan (1989), but not developed in their subsequent work. ART will be strengthened by more robust (re) consideration of how environments impact on diverse cognitive processes including mind wandering, mood, and reflection, in addition to directed attention.

Finally, our theoretical proposition leads us to call for further empirical research to understand the situations under which nature experience promotes creativity, and the processes through which this occurs. Future research can use a range of experimental and momentary assessment strategies to further explore the psychological benefits of soft fascination, the presence of mind wandering during nature experience, and temporal patterns of externally and internally oriented attention during nature experience. In particular, much research is required to understand the ebb and flow of attention during environmental experience and how this accounts for variation in creativity. Environmental psychology has much to contribute to research on creativity, ensuring practical benefits for our understanding of education, therapeutic and work environments where creative work is undertaken.

Acknowledgements

Thanks to Kerrie Unsworth, Jeff Joireman and three anonymous reviewers who provided helpful comments on drafts of this manuscript. Kate Lee's contribution was supported by the Australian Government's National Environmental Science Program through the Clean Air and Urban Landscapes Hub.

References

Allen, A. P., & Thomas, K. E. (2011). A dual process account of creative thinking. *Creativity Research Journal, 23*(2), 109–118.
Amabile, T. M., Barsade, S. G., Mueller, J. S., & Staw, B. M. (2005). Affect and creativity at work. *Administrative Science Quarterly, 50*(3), 367–403.
Aspinall, P., Mavros, P., Coyne, R., & Roe, J. (2013). The urban brain: Analysing outdoor physical activity with mobile EEG. *British Journal of Sports Medicine, 49*, 272–276.
Atchley, R. A., Strayer, D. L., & Atchley, P. (2012). Creativity in the wild: Improving creative reasoning through immersion in natural settings. *PLoS One, 7*(12), e51474.
Axelsson-Lindgren, C., & Sorte, G. (1987). Public response to differences between visually distinguishable forest stands in a recreation area. *Landscape and Urban Planning, 14*, 211–217.
Baas, M., De Dreu, C. K., & Nijstad, B. A. (2008). A meta-analysis of 25 years of mood-creativity research: Hedonic tone, activation, or regulatory focus?. *Psychological Bulletin, 134*(6), 779.
Baird, B., Smallwood, J., Mrazek, M. D., Kam, J. W., Franklin, M. S., & Schooler, J. W. (2012). Inspired by distraction mind wandering facilitates creative incubation. *Psychological Science, 23*(10), 1117–1122.
Barr, N., Pennycook, G., Stolz, J. A., & Fugelsang, J. A. (2015). Reasoned connections: A dual-process perspective on creative thought. *Thinking & Reasoning, 21*(1), 61–75.
Beaty, R. E., Benedek, M., Kaufman, S. B., & Silvia, P. J. (2015). Default and executive network coupling supports creative idea production. *Scientific Reports, 5*, 10964.
Beaty, R. E., Benedek, M., Silvia, P. J., & Schacter, D. L. (2016). Creative cognition and brain network dynamics. *Trends in Cognitive Sciences, 20*(2), 87–95.
Beaty, R. E., Silvia, P. J., Nusbaum, E. C., Jauk, E., & Benedek, M. (2014). The roles of associative and executive processes in creative cognition. *Memory & Cognition, 42*(7), 1186–1197.
Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science, 19*(12), 1207–1212.
Berman, M. G., Peltier, S., Nee, D. E., Kross, E., Deldin, P. J., & Jonides, J. (2011). Depression, rumination and the default network. *Social Cognitive and Affective Neuroscience, 6*, 548–555.
Berto, R., Baroni, M. R., Zainaghi, A., & Bettella, S. (2010). An exploratory study of the effect of high and low fascination environments on attentional fatigue. *Journal of Environmental Psychology, 30*(4), 494–500.
Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health, 10*(1), 456.
Bratman, G. N., Hamilton, J. P., Hahn, K. S., Daily, G. C., & Gross, J. J. (2015). Nature experience reduces rumination and subgenual prefrontal cortex activation. *Proceedings of the National Academy of Sciences, 112*(28), 8567–8572.
Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network. *Annals of the New York Academy of Sciences, 1124*(1), 1–38.
Ceylan, C., Dul, J., & Aytac, S. (2008). Can the office environment stimulate a manager's creativity? *Human Factors and Ergonomics in Manufacturing & Service Industries, 18*(6), 589–602.
Christoff, K., Irving, Z. C., Fox, K. C., Spreng, R. N., & Andrews-Hanna, J. R. (2016). Mind-

wandering as spontaneous thought: A dynamic framework. *Nature Reviews Neuroscience, 7*, 718–731.
Corbetta, M., Patel, G., & Shulman, G. L. (2008). The reorienting system of the human brain: From environment to theory of mind. *Neuron, 58*(3), 306–324.
Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience, 3*(3), 201–215.
Dul, J., Ceylan, C., & Jaspers, F. (2011). Knowledge workers' creativity and the role of the physical work environment. *Human Resource Management, 50*(6), 715–734.
Ehlers, A., Hackmann, A., & Michael, T. (2004). Intrusive re-experiencing in post-traumatic stress disorder: Phenomenology, theory, and therapy. *Memory, 12*(4), 403–415.
Ellamil, M., Dobson, C., Beeman, M., & Christoff, K. (2012). Evaluative and generative modes of thought during the creative process. *NeuroImage, 59*(2), 1783–1794.
Farley, J., Risko, E., & Kingstone, A. (2013). Everyday attention and lecture retention: The effects of time, fidgeting, and mind wandering. *Frontiers in Psychology, 4*(619).
Ferraro, F. M., III (2015). Enhancement of convergent creativity following a multiday wilderness experience. *Ecopsychology, 7*(1), 7–11.
Fox, K. C., Spreng, R. N., Ellamil, M., Andrews-Hanna, J. R., & Christoff, K. (2015). The wandering brain: Meta-analysis of functional neuroimaging studies of mind-wandering and related spontaneous thought processes. *NeuroImage, 111*, 611–621.
Fredrickson, B. L. (2001). The broaden-and-build theory of positive emotions. *American Psychologist, 56*(3), 218–226.
Gilhooly, K. J. (2016). Incubation and intuition in creative problem solving. *Frontiers in Psychology, 7*(1076).
Gilhooly, K. J., Georgiou, G., & Devery, U. (2013). Incubation and creativity: Do something different. *Thinking & Reasoning, 19*(2), 137–149.
Gonzalez, M. T., Hartig, T., Patil, G. G., Martinsen, E. W., & Kirkevold, M. (2010). Therapeutic horticulture in clinical depression: A prospective study of active components. *Journal of Advanced Nursing, 66*(9), 2002–2013.
Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*(2), 109–123.
He, J., Becic, E., Lee, Y.-C., & McCarley, J. S. (2011). Mind wandering behind the wheel performance and oculomotor correlates. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 53*(1), 13–21.
Herzog, T. R., Black, A. M., Fountaine, K. A., & Knotts, D. J. (1997). Reflection and attentional recovery as distinctive benefits of restorative environments. *Journal of Environmental Psychology, 17*(2), 165–170.
Jellen, H., & Urban, K. K. (1986). The TCT-DP (Test for creative thinking - drawing production): An instrument that can be applied to most age and ability groups. *Creative Child and Adult Quarterly, 11*, 138–155.
Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169–182.
Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective.* Cambridge: University of Cambridge.
Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science, 330*(6006) 932–932.
Kounios, J., & Beeman, M. (2014). The cognitive neuroscience of insight. *Psychology, 65*(1), 71.
Lee, K. E., Williams, K. J., Sargent, L. D., Williams, N. S., & Johnson, K. A. (2015). 40-second green roof views sustain attention: The role of micro-breaks in attention restoration. *Journal of Environmental Psychology, 42*, 182–189.
Lindal, P. J., & Hartig, T. (2013). Architectural variation, building height, and the restorative quality of urban residential streetscapes. *Journal of Environmental Psychology, 33*, 26–36.
Martínez-Soto, J., Gonzales-Santos, L., Pasaye, E., & Barrios, F. A. (2013). Exploration of neural correlates of restorative environment exposure through functional magnetic resonance. *Intelligent Buildings International, 5*(sup1), 10–28.
McCoy, J. M., & Evans, G. W. (2002). The potential role of the physical environment in fostering creativity. *Creativity Research Journal, 14*(3–4), 409–426.
Mednick, S. (1962). The associative basis of the creative process. *Psychological Review, 69*(3), 220.
Mooneyham, B. W., & Schooler, J. W. (2013). The costs and benefits of mind-wandering: A review. *Canadian Journal of Experimental Psychology, 67*(1), 11.
Nijstad, B. A., De Dreu, C. K., Rietzschel, E. F., & Baas, M. (2010). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology, 21*(1), 34–77.
Nusbaum, E. C., & Silvia, P. J. (2011). Are intelligence and creativity really so different?: Fluid intelligence, executive processes, and strategy use in divergent thinking. *Intelligence, 39*(1), 36–45. https://doi.org/10.1016/j.intell.2010.11.002.
Pasanen, T. P., Neuvonen, M., & Korpela, K. (2017). The psychology of recent nature visits: (How) are motives and attentional focus related to post-visit restorative experiences, creativity, and emotional well-being? *Environment and Behavior*. https://doi.org/10.1177/0013916517720261.
Petersen, S. E., & Posner, M. I. (2012). The attention system of the human brain: 20 years after. *Annual Review of Neuroscience, 35*, 73–89.
Plambech, T., & Konijnendijk, C. C. (2015). The impact of nature on creativity–A study among Danish creative professionals. *Urban Forestry and Urban Greening, 14*(2), 255–263.
Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13*, 35–42.
van Rompay, T. J. L., & Jol, T. (2016). Wild and free: Unpredictability and spaciousness as predictors of creative performance. *Journal of Environmental Psychology, 48*, 140–148.
Schooler, J. W., Smallwood, J., Christoff, K., Handy, T. C., Reichle, E. D., & Sayette, M. A. (2011). Meta-awareness, perceptual decoupling and the wandering mind. *Trends in Cognitive Sciences, 15*(7), 319–326.
Schulman, G., Astafiev, S., Franke, D., Pope, D., Snyder, A., McAvoy, M., et al. (2009). Interaction of stimulus-driven reorienting and expectation in ventral and dorsal Frontoparietal and basal ganglia-cortical networks. *Journal of Neuroscience, 29*(14), 4392–4407.
Shibata, S., & Suzuki, N. (2004). Effects of an indoor plant on creative task performance and mood. *Scandinavian Journal of Psychology, 45*(5), 373–381.
Sio, U. N., & Ormerod, T. C. (2009). Does incubation enhance problem solving? A meta-analytic review. *Psychological Bulletin, 135*(1), 94–120.
Sio, U. N., & Ormerod, T. C. (2015). Incubation and cueing effects in problem-solving: Set aside the difficult problems but focus on the easy ones. *Thinking & Reasoning, 21*(1), 113–129.
Smallwood, J., & Schooler, J. W. (2015). The science of mind wandering: Empirically navigating the stream of consciousness. *Annual Review of Psychology, 66*, 487–518.
Sowden, P. T., Pringle, A., & Gabora, L. (2015). The shifting sands of creative thinking: Connections to dual-process theory. *Thinking & Reasoning, 21*(1), 40–60.
Staats, H., Jahncke, H., Herzog, T. R., & Hartig, T. (2016). Urban options for psychological restoration: Common strategies in everyday situations. *PLoS One, 11*(1), e0146213. https://doi.org/10.1371/journal.pone.0146213 1-24.
Staats, H., Kieviet, A., & Hartig, T. (2003). Where to recover from attentional fatigue: An expectancy-value analysis of environmental preference. *Journal of Environmental Psychology, 23*, 147–157.
Strick, M., Dijksterhuis, A., Bos, M. W., Sjoerdsma, A., Van Baaren, R. B., & Nordgren, L. F. (2011). A meta-analysis on unconscious thought effects. *Social Cognition, 29*(6), 738–762.
Studente, S., Seppala, N., & Sadowska, N. (2016). Facilitating creative thinking in the classroom: Investigating the effects of plants and the colour green on visual and verbal creativity. *Thinking Skills and Creativity, 19*, 1–8.
Tan, T., Zou, H., Chen, C., & Luo, J. (2015). Mind wandering and the incubation effect in insight problem solving. *Creativity Research Journal, 27*(4), 375–382.
Thomson, D. R., Seli, P., Besner, D., & Smilek, D. (2014). On the link between mind wandering and task performance over time. *Consciousness and Cognition, 27*, 14–26.
Torrance, E. P. (1966). *The Torrance tests of creative thinking: Technical-norms manual.* Princeton, NJ: Personnel Press.
Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments1. *Journal of Environmental Psychology, 11*(3), 201–230.
Vedder, A., Smigielski, L., Gutyrchik, E., Bao, Y., Blautzik, J., Pöppel, E., et al. (2015). Neurofunctional correlates of environmental cognition: An fMRI study with images from episodic memory. *PloS one, 10*(4), e0122470. https://doi.org/10.1371/journal.pone.0122470 .