Exploring the effects of outdoor activities and connectedness with nature on cognitive styles and creativity

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This is dedicated to

Low Ah Tian

(1922 - 2006)

My paternal grandmother who loves me unconditionally

Abstract

The natural environment's potential to improve education, work, and lifestyles is receiving increasing attention by policy makers and practitioners. Psychological research has demonstrated that stress reduction, attention restoration, and increased creativity can result from exposure to nature. Such evidence notwithstanding, the precise psychological mechanisms explaining these effects remain unclear. This thesis provides a systematic examination of how contact with nature might affect humans. Four studies were conducted. Study 1 reports two meta-analyses (N = 10701, k = 100) involving: (i) 66 studies using pre- and post-test designs, and (ii) 32 experimental studies that include a control group. Although outdoor activities have been found overall to affect personal and social outcomes positively, there has been limited research into the effects on cognitive variables of exposure to outdoor environments. To address this gap in the literature, I aim to investigate whether contact with nature (in two dimensions–the psychological attachment to nature and the physical exposure to it) is associated with processes related to creativity (i.e., cognitive styles and divergent thinking creativity). Study 2 (N = 138) tests the relationship between connectedness with nature and cognitive styles and reports a significant positive association between connectedness with nature and both innovative and holistic thinking styles. Building on this finding, Study 3 (N = 185) not only replicates the results of Study 2 by controlling for well-being processes, but includes a new creativity test to examine the link between connectedness with nature and creative processes (connectedness with nature is found to be positively linked with divergent-thinking creativity). As these three studies employ cross-sectional data where causality cannot be inferred, the last study involves an experimental design. Study 4 (N = 93) manipulates active versus passive engagement with nature and examines the mediating impact of connectedness with nature on the link between outdoor activities and divergent-thinking creativity. Some theoretical explanations as to how nature might affect our creativity

are proposed. Potential limitations and suggestions for future research are discussed. The findings are intended to provide supporting evidence for the relationship between nature and creativity, and hopefully inform educational pedagogy and lifestyle choices likely to enhance creativity.

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"It takes a village to raise a child."

African proverb

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Preface

"Let Nature be your teacher."

William Wordsworth

This thesis explores the impact of contact with nature, with a focus on creativity outcomes. In addition to the effects of being in a natural environment, the examination of a connectedness with nature is proposed here as a useful approach to exploration of the nature-creativity relationship.

My interest in this topic–the nature-creativity relationship–arises from my passion for and commitment to outdoor education (i.e., the teaching of and learning from outdoor experiences). Although there has been growing emphasis on outdoor education in school systems (Ho, Atencio, Tan, & Ching, 2016; Ministry of Education Singapore, 2016; O'Brien, 2009; Schäffer & Kistemann, 2012; Zink & Boyes, 2006), it seems to me that implementation of such learning involves a number of challenges. I will discuss two significant concerns here that motivate the aims of this thesis.

First, apart from anecdotal and statistical evidence regarding the effectiveness of outdoor experiences, we know little about how these experiences affect human thoughts and behaviour, and what ideal factors might make these experiences beneficial. In my professional experience as an outdoor educator, I have noticed that teachers have often had to design lesson plans for teaching in the outdoors despite having limited knowledge of and few skills in outdoor education. The process was essentially one of trial and error, as there was no formula to design effective outdoor programmes, and lessons were often planned in accordance with available resources and expertise. This calls for a need to further clarify the overall effectiveness of outdoor programmes on psychological outcomes, in order to gain a deeper

understanding of how contact with nature may affect us and what it is that makes outdoor programmes successful or unsuccessful.

Second, while there is evidence now to support the link between outdoor activities and cognition (Atchley, Strayer, & Atchley, 2012; Ferraro, 2015), little is known as yet about how or why outdoor activities might influence our creative cognition. Participation in outdoor activities has been used however as a potential intervention to foster innovative and creative thinking skills believed to be lacking in students (Gassner & Russell, 2008; Lim, 2012).

Inspired by recent research demonstrating that prolonged outdoor participation may foster creativity (Atchley et al., 2012; Ferraro, 2015), my hope in this thesis is to provide further insights into the understanding of the nature-creativity relationship by examining whether contact with nature (both physical immersion in and psychological connectedness with it) affects our creative thinking. It is noteworthy that the investigation of this relationship does not discount the effects of other ways by which creative cognition might be improved. Placed in a social or educational context, such clarification may hopefully encourage more people to benefit from nature engagement by engaging in meaningful outdoor activity.

Table of Contents

List of Tables

List of Figures

CHAPTER 1. INTRODUCTION

"All ethics so evolved rest upon a single premise: that the individual is a member of a community of interdependent parts … The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land … It is inconceivable … that an ethical relation to land can exist without love, respect, and admiration."

Aldo Leopold

Contact with nature may influence our thoughts, feelings, and actions in a positive way so that we can function more effectively. People are often inspired by nature: in biomimetic inventions, for example, nature and natural systems are used as a resource to create new products or solutions (J. B. Kim et al., 2012). Besides anecdotal evidence, research has demonstrated that various forms of contact with nature are beneficial for us in different ways (see Bowler, Buyung-Ali, Knight, & Pullin, 2010; Capaldi, Dopko, & Zelenski, 2014; Grinde & Patil, 2009 for recent reviews). Some researchers (Collado, Staats, & Sorrel, 2016; von Lindern, Bauer, Frick, Hunziker, & Hartig, 2013) however have also shown that some people reported greater restoration effects of being in nature than others. This evidence suggests that effects of contact with nature may be affected by other factors associated with natural environments (e.g., a sense of being away from daily routine). In other words, the relationship between contact with nature and positive benefits does not seem to be simple.

Furthermore, an understanding of the mechanisms that underpin the effects of contact with nature remain elusive. Research to date into the cognitive effects of contact with nature, for example, has been based strongly on attentional processes; i.e., how nature might affect our attentional capacity. Ohly et al. (2016) have argued, however, that it is unclear which precise attentional processes explain the observed restorative effects. Given the current limited state of knowledge regarding the potential cognitive processes, there is even less clarity as to whether other cognitive effects (e.g., positive creativity effects reported by

Atchley et al. (2012) and Ferraro (2015)) are due to exposure to the natural environment or to other factors associated with such a restorative environment.

Inspired by previous evidence that contact with nature may affect our creativity, this thesis aims first to provide a detailed assessment of the overall effects of outdoor experiences, and then to explore how contact with nature might be related to our cognition by examining the effects of such contact on creativity. This introductory chapter will begin with a brief review of evidence for the psychological effects of contact with nature, and how such contact might affect human cognition. The next section focusses on the effects on creativity, on how contact with nature may influence creativity, and on existing research gaps. Finally, I will outline how this thesis will examine the impact of contact with nature, and the nature-creativity relationship.

1.1. The 'human-nature' relationship

E. O. Wilson (1984) proposed the biophilia hypothesis, which states that an innate connection[1] exists between people and the natural world, and that we might benefit from contact with nature. Thus, biophilia is an "innately emotional affiliation of human beings to other living organisms" (E. O. Wilson, 1993, p. 31). According to the evolutionary perspective of Kellert and Wilson (1993), the 'fondness' many humans feel for nature has developed because most of our evolutionary history has been spent in natural (rather than built) environments. Consistent with this idea, Falk and Balling (2010), for instance, suggest that people have evolved preferences for savannah-like environments (i.e., spacious environments that are open but that also contain survival items such as trees, waterways, and

[1] According to Wilson (1993, p.31), "Innate means hereditary". In accordance with evolutionary psychology (L. Barrett, Dunbar, & Lycett, 2002), this suggests that our preferences for nature may be naturally selected because they are 'fitness' enhancing. In other words, such preferences may maximise our relative reproductive success. Kellert (1993) also states that humans have a need for other living systems, as the natural world influences our holistic development beyond materialistic and survival purposes. As a result, this relationship between people and nature somehow affects human identity and personal self-realisation.

sources of food).[2] These evolutionary ideas suggest that humans might be more physiologically and psychologically adapted to non-threatening natural than to urban environments (Ulrich et al., 1991).

Building on these ideas, Falk and Balling (2010) suggest that the innate preference for savannah-like environments can be modified by enculturation and experiences. Herzog, Herbert, Kaplan, and Crooks (2000) for example, have demonstrated that Australians like Australian settings better than Americans do, which is perhaps due to the familiarity of Australians with the surroundings in question. Lückmann, Lagemann, and Menzel (2013) also report, in a small sample of adolescents, that young people prefer more structured natural settings (e.g., botanical gardens) to nature-orientated surroundings (e.g., untouched wilderness). This implies that our preference for natural environment might not extend to all natural environments or objects that are found in nature.

Thus, the idea of that there exists an evolved biophilic preference for nature is by no means straightforward. It remains unclear which particular features of natural environments people prefer or feel an affiliation with. Such preferences may not be wholly innate but are influenced by other factors such as familiarity, experiences, or enculturation. It is even possible that these various kinds of 'learning' may overwhelm our evolved preferences so that some people have become more attracted to built environments than natural ones. If this is the case, it raises important questions about the universality and power of the biophilic impulse.

Thus, it is still far from clear whether we possess an innate biophilia as E. O. Wilson (1984) and others have argued. There are good reasons, and some evidence, to believe that humans have evolved to prefer particular kinds of natural environment. Yet it is also clear

[2] It has been argued that in such environments, people have evolved so that their perceptual systems (powerful long-distance, colour vision which requires a lack of visual clutter), their modes of locomotion (upright bipedalism, ability to run), their omnivorous diets and many of their behavioural/social strategies have adapted to the constraints/possibilities afforded by these environments (Falk & Balling, 2010).

that these preferences can be overshadowed or modified by learning and enculturation. More importantly, for the purposes of this thesis, environmental psychologists have shown *how* being in natural environments may benefit us psychologically–so although we do not know how people (might have) developed an affiliation with the natural world, there are good reasons to think that such an affiliation could be useful because of the positive effects natural environments have on us. It is to these topics that we turn below: the first focusing on restorative natural environments, the second emphasising psychological connectedness with nature. The next two sub-sections will provide a broad overview of current research relevant to the study of contact with nature as well as some outstanding questions and areas where further research is called for.

1.1.1. Research focus 1: The psychological effects of restorative natural environments

Using the biophilia hypothesis as their starting point of reference, various psychological studies investigating the effects of nature focus upon one or more theories of environmental psychology. Two popular theoretical explanations of how nature might affect people's well-being or cognition relate to the restorative effects of the natural environment, namely stress reduction theory (SRT) (Ulrich, 1993; Ulrich et al., 1991) and attention restoration theory (ART) (Kaplan, 1995). The former examines 'emotional restoration', and the latter, renewal of cognitive resources. Drawing on these two theories, current research has concentrated predominantly on the benefits to well-being, attention, and memory, which result from contact with the natural world. Both theories suggest that contact with nature helps a person to recover his or her psychological capacity (e.g., positive well-being) and cognitive resources (e.g., increased attention).

The SRT states that after stressful experiences, non-threatening aspects of the natural environment promote psychophysiological stress recovery, and that such recovery occurs

more readily in a natural than in an urban environment[3] (Ulrich, 1993; Ulrich et al., 1991). This recovery is driven by attentional responses evoked by the natural environment (i.e., aesthetic and affective responses to certain visual stimuli); natural environments, for instance, often possess qualities such as moderate complexity and depth, and natural contents (e.g., water and greenery) (Ulrich, 1983). Arguing from an evolutionary standpoint, Ulrich et al. (1991) posit that humans possess an automatic tendency to respond positively to elements of the natural environment as opposed to elements in human-made settings, which enables stress recovery and attention responses. Following a stressor, the restorative effects of the natural environment, accompanied by sustained attention responses, may therefore induce an automatic increase of positive affect, limit negative thoughts, and reduce negative physiological responses in a way that urban environments will not (Ulrich, 1993; Ulrich et al., 1991). The SRT idea, to some extent, has been supported by various studies reporting positive restorative effects in the natural environment (see Bratman, Hamilton, & Daily, 2012; Grinde & Patil, 2009 for reviews)

The ART, on the other hand, states that the natural environment promotes 'effortless attention' (Kaplan, 1995). Kaplan's (1995) explanation of 'effortless attention' seems in keeping with the 'involuntary attention' (James, 1892) that demands little or no mental effort. Kaplan (1995) posits that this form of attention may be resistant to fatigue and that the process of engaging this attention allows 'directed attention' (i.e., the type of forced concentration demanding effort) to be restored. While ART assumes that prolonged or intense periods of 'directed attention' (e.g., to challenging duties and to management of environmental stresses) may lead to mental fatigue, distraction, and irritability (e.g., van der Linden, Frese, & Meijman, 2003), it also has as its premise that environments dominated by nature and/or the natural elements may restore mental capacity. It is argued that natural

[3] For the purposes of this thesis, an urban setting refers to a built environment with human-made facilities and development. In contrast, the natural environment includes, but is not restricted to, non-threatening natural landscapes, such as nature reserves, with limited human-made facilities.

stimuli have the ability to fascinate people and engage us effortlessly; our mental capacity may be restored, in short, during this process of 'soft-fascination' with nature. According to Kaplan (1995), 'soft fascination' refers to the process of engaging 'effortless attention', which provides the opportunity to reflect during exposure to certain nature-related stimuli. Engaging in 'effortless attention' allows us to recover our depleted cognitive resources (i.e., recovery from 'directed attention' fatigue when we are not using such resources when resting). Additionally, restorative environments are psychologically and physically distinct from many people's habitual activities, consisting of a scope of rich and coherently connected elements in which immersion might take place, and matching a person's expectations and predispositions (Kaplan, 1995).

A typical study in restorative natural environmental research compares the restorative effects of exposure to a nature condition on the one hand, to an urban condition on the other. Hartig, Evans, Jamner, Davis, and Gärling (2003), for example, report that participants who were exposed to a nature condition (sitting in a room with tree views, followed by a walk in a nature reserve) reported greater stress reduction–evident, for example, in lower blood pressure readings–than participants who sat in a room without views and then took a walk in an urban setting comprising office and retail buildings. Participants in the nature condition also reported increased positive affect and reduced anger, while those in the urban condition reported emotional effects opposite to these. Additionally, participants performed slightly better on an attentional test at the midpoint of the walk in the nature reserve than they had done in their pre-test performance; for the urban condition, however, there was a decline at the midpoint. Such comparisons frequently show greater restorative effects in natural environments, for both stress reduction and cognitive restoration.

Although SRT and ART are consistent with the biophilia idea of an innate preference for natural environments and suggest that people could benefit from restoration effects from such environments, such restoration effects may be more complicated than that. These classic

theories and research imply that restorative effects occur when one is exposed to 'tame nature', i.e., to natural environments that are non-threatening. The presence of snakes or lions in the wild, for instance, is unlikely to engage people's 'effortless attention' or to reduce their anxiety levels. Building on this assumption, however, more recent research has provided different perspectives. Von Lindern et al. (2013) studied whether work related to a natural environment might constrain restoration effects in nature during leisure time. They found that people with a forestry-related profession reported lower levels of restoration than forestry non-professionals did. To be working in forestry was associated with greater familiarity with nature, and with a lesser sense of being away from routine during forest visits. Von Lindern et al. (2013) also found that forestry professionals reported lower restorative effects for forest visits, partially mediated however by a sense of being away. Similarly, Collado et al. (2016) found that children who helped their parents in agricultural work reported fewer restorative effects during free time spent in agricultural areas than counterparts did who spent only leisure time in such environments. This correlational evidence suggests that restorative effects may not be completely accounted for by simple contact with nature. Other factors such as a sense of being away from daily routine, and level of familiarity with the environment may also explain such restorative effects.

Such recent studies, therefore, point to other possible ways of explaining evidence of restorative effects. Firstly, non-threatening natural environments may be considered novel, and might perhaps offer stimulation and relaxation for people who feel a sense of being away from daily life when in nature. This idea is consistent with previous meta-analytical evidence (de Bloom et al., 2009) reporting an improvement in health and well-being as a result of a vacation. In addition, different environments might be associated with goals that will vary depending on individual circumstances. Whereas nature exposure could be relaxing for some people because it equates to a holiday or a break, it will be stressful for others (farmers, for example) because it represents work (in the same way cities and offices do for urban

workers). In other words, factors such as a sense of being away and goals relating to the environment, may, for some people, explain any restorative effects produced.

Alternatively, the restorative effects experienced by people whose professions are not related to natural environments may be explained by a classic conditioned response (Pavlov, 1927). As most people now live in urban areas (United Nations Population Division, 2014), they probably mostly go to parks and green spaces during their free time. Perhaps such natural environments might be associated (via classical conditioning) with free time, with being off work, or on a holiday, and the positive psychological and physiological states embodied in those activities. These conditioned positive emotions may therefore lead to other positive responses (e.g., creative thinking) when in nature. According to the Broaden-and-Build Theory (Fredrickson, 2001), people are more likely to play, explore, and learn when they are feeling positive, and this positivity broadens their capability to focus, think, and act. Consistent with this theory (Fredrickson, 2001), the conditioned positive emotions from being in natural areas may encourage the process of play and exploration, for instance, and this may in turn positively influence our thoughts such as fostering creative thinking. This may also explain why adults working in forests or children from agricultural work backgrounds do not experience restorative effects when spending free time in natural areas (Collado et al., 2016; von Lindern et al., 2013). For these people, spending free time in natural areas is associated with work and routine rather than on a holiday and they may feel less positive when in natural areas. In other words, the benefits of being in natural environments might arise from classical conditioning rather than from the inherent qualities of natural environments.

Most studies, moreover, have drawn comparisons between restorative effects in ‘tame nature’ conditions with limited stressors, and urban conditions that include various stressors (e.g., crowds, vehicle traffic, and habitual activities associated with stress). Such comparative studies (e.g., Hartig et al., 2003) often include statistical noise; thereby making it unclear why

natural environments are better for recovery. This suggests that the restorative effects are possibly due to the removal of threatening stressors in 'tame nature' conditions that may be associated with less cognitively demanding tasks.

The current state of knowledge also does not adequately explain the restorative effects of contact with nature. A recent systematic review of ART (Ohly et al., 2016) has critiqued the lack of clarity in understanding the precise attentional processes relevant for the ART effects. Only three out of the ten attention measures reviewed displayed statistically significant evidence of restorative effects on attention scores after nature exposures, as compared to non-nature exposures. The studies reviewed had different operational definitions of directed attention and used different cognitive measures requiring varying demands on working memory (e.g. the number of things to be remembered or the need for cognitive manipulation). While Berman, Jonides, and Kaplan (2008) suggest that more cognitively demanding tasks are of greatest relevance in measuring impact on attention and are most likely to be affected by nature exposures, Ohly et al. (2016) report otherwise. Some demanding cognitive measures fail to show significant effects for nature exposure. Other less cognitive demanding measures, however, have demonstrated similar impacts to more cognitive demanding measures when compared to control groups. Current evidence does not seem to support any specific attentional mechanism relating to the ART nor offer a good explanation of the restorative claim of ART.

Given these conflicting findings, current theories do not seem to adequately explain why natural environments are better for people. It remains unclear whether all people are attracted to the natural environment as proposed by the biophilia hypothesis (E. O. Wilson, 1984). Some evidence (Collado et al., 2016; von Lindern et al., 2013) fails to support restorative effects for people whose work relates to the natural environment. There are alternative explanations for restorative effects in nature, which may be a result of other factors such as a sense of being away and goals associated with such environments. Reported

preferences for nature may also be learned rather than due to evolutionary explanations. These suggest that the biophilia idea is not simple. Research to date implies a need then for better understanding of the cognitive processes that explain the effects of nature exposure on people's psychological wellbeing. A closer and more fine-grained examination of the features of the natural environment are responsible for the positive effects (other than their being low stress when they present no threat) is called for.

1.1.2. Research focus 2: The psychological sense of a connectedness with nature

Besides studying the theories that attempt to explain the restorative effects of physical contact with the natural world, environmental psychologists are interested in examining the psychological connections that people have with nature. Several researchers (Mayer & Frantz, 2004; Nisbet, Zelenski, & Murphy, 2009) have attempted to investigate the psychological connection between people and the natural world (also termed *connectedness with nature* or *nature connectedness* in this thesis), and to examine how it impacts on pro-environmental behaviour and wellbeing. There are a number of concepts and measures to assess nature connectedness with slightly different expressions but refer to the same underlying construct of one's subjective connectedness with nature (see Capaldi et al., 2014 for a recent review). These variables are often found to be highly correlated with each other (Capaldi et al., 2014). For some, nature connectedness refers to the degree to which individuals embrace nature as part of their identity (Schultz, 2002). Consistent with this idea, Mayer and Frantz (2004) define connectedness with nature as the extent to which one feels affectively attached to the natural world (the definition adopted for the purposes of this thesis). They suggest that nature connectedness can be regarded as similar to establishing a

close relationship with another person.[4]

One theory that Mayer and Frantz (2004) have borrowed in order to explore the idea of a close relationship with nature is the self-expansion model (Aron, Aron, Tudor, & Nelson, 1991). According to these researchers, close relationships involve a cognitive inclusion of others in the self,[5] so individuals are more likely to integrate the resources, perspectives, and identity of others in the self (Aron et al., 1991; Mattingly & Lewandowski, 2014). Those who feel strongly connected to others may broaden their own perspectives: they consider how other people think and feel, and see problems from other points of view. This idea of self-expansion might not necessarily be limited to relational contexts with humans (Mattingly & Lewandowski, 2014). Mayer and Frantz (2004) have used the notion of self-expansion to understand and explicate the nature of the relationship between people and nature. They argue that nature might assume a human-like role in a close relationship.

Similarly, Tam (2013) argues that some people may view the natural world or its elements as sentient. They may, for example, adopting particular views of nature, such as anthropomorphism (attribution of human characteristics to nonhumans) and animism (the view that *all* natural objects are animate and alive, and possess agency). Such ways of thinking about nature has been observed in many different cultures (Epley, Waytz, & Cacioppo, 2007). This suggests that people who consider the natural world as sentient may perceive the needs of nature, for example.

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[4] Presumably, when such an analogy is drawn, the two phenomena are not assumed to be identical. Although some may assume a connection of any kind to be a reciprocal one, a close relationship with nature might be rather more one-sided. Others may argue, however, that a reciprocal relationship is possible with nature, e.g., with pet animals. Tam (2013) argues that some people consider themselves as part of nature, while others view humans are separate from, or even above, nature. Alternatively, some may see nature as human-like while others do not (Tam, 2013).

[5] Aron et al. (1991) use the term 'self' in their description of the model and refer to self-concepts when examining the inclusion of others in the self. This thesis adopts similar terminology when describing the self-expansion model.

Such perspective taking may expand one's inclusion of nature in self and increase the closeness that one perceives between self and nature (Schultz, 2000). In support of this argument, Mayer and Frantz (2004) demonstrate a link between connectedness with nature and a perspective-taking ability which enables people to consider views other than their own. They found that people who feel a closer connection with nature are more likely to judge things and people in terms of the effects or attitudes these might have with regard to the environment. They argue that if people are connected to nature there is less likelihood that they will harm it. Some researchers (Schultz, 2000; Sevillano, Aragonés, & Schultz, 2007) have demonstrated that participants who had taken the perspective of animals that had been harmed exhibited more concern and compassion towards the biosphere as a whole than participants who had not taken such a perspective. These findings suggest that some people are able to take the perspective of nature when they are connected with it. Thus, connectedness with nature allows individuals to regard nature as part of their identity and to view the world from the perspective of the other (nature).

Evidence of nature connectedness has been linked to variables such as exposure to nature and well-being outcomes. Researchers (Nisbet et al., 2009) have found that this connectedness is positively correlated with time spent outdoors and in natural environments while others have demonstrated that participants exposed to a nature, as opposed to an urban, experience reported a greater sense of affiliation with nature (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). This suggests that while nature connectedness is a stable trait across time (Nisbet et al., 2009), it can also be understood as a state that varies according to amount of time spent in natural environments (Mayer et al., 2009). As in most studies into the benefits of exposure to nature, nature connectedness has been reported to relate to positive well-being, i.e., positive affect (Nisbet & Zelenski, 2011; Nisbet, Zelenski, & Murphy, 2011), happiness (Capaldi et al., 2014; Zelenski & Nisbet, 2014), and level of vitality (Cervinka, Röderer, & Hefler, 2012; Nisbet et al., 2011). Most of the evidence relating to connectedness

with nature focusses on improved psychological well-being (Capaldi et al., 2014; Zelenski & Nisbet, 2014).

It has also been argued that when people take the perspective of nature, they may feel more connected with and empathic towards it, and that this, in turn, encourages pro-environmental attitudes and behaviours (Mayer & Frantz, 2004). Some evidence has shown that connectedness with nature is significantly associated with perspective taking (Mayer & Frantz, 2004) and with pro-environmental action (Mayer & Frantz, 2004; Nisbet et al., 2009). Supporting this idea, Tam (2013) has demonstrated that empathy with nature (i.e., the extent in which one understands and shares the emotional experience of the natural world) mediates the effect of connectedness with nature on conservation behaviour. Given the non-experimental design and exploratory findings indicating that empathy with nature could also increase connectedness with it, there seems a possibility that empathy and connectedness with nature may have an effect on each other. Similarly to connectedness with nature, empathy with nature also involves the cognitive process of perspective taking, as one is required to take the perspective of the other before showing any empathy, and being close to others is a way to gain access to their perspectives (Tam, 2013). Tam (2013) also demonstrated positive correlations between empathy with nature, and perspective taking and connectedness with nature.

Based on current evidence, connectedness with nature may possibly have an effect on other cognitive processes besides perspective taking. Perspective taking is a cognitive ability that has been argued to provide access to new ideas for creativity (Galinsky, Maddux, Gilin, & White, 2008), in addition to the idea that perspective taking may influence empathy with nature and pro-environmental behaviour (Mayer & Frantz, 2004; Tam, 2013). As connectedness with nature is correlated with perspective taking, such connectedness may also be linked to our creative cognition. As connectedness has been found to relate significantly to increased time spent in nature (Nisbet et al., 2009), it might motivate people to get out and

experience the natural world; thereby providing opportunities for restorative effects in humans, such as improvement of cognitive processes. Thus, there is a possibility that connectedness is associated with cognition or has an effect on it.

1.1.3. Evidence for the psychological effects of outdoor experiences

This section describes research that has studied the effects of outdoor experiences (another form of contact with nature). In this thesis, outdoor experiences/activities refer to participation in outdoor adventure for leisure purposes, or outdoor education whereby learning in the outdoors occurs in educational settings.[6] A typical outdoor programme is often physically demanding, and may last for days or weeks. Examples include camps (Marsh, 1999b), adventure programmes (Cason & Gillis, 1994; Hattie, Marsh, Neill, & Richards, 1997), expeditions (Beames, 2004), challenge courses (Bunting & Donley, 2002; Gillis & Speelman, 2008; Rohnke, Rogers, Tait, & Wall, 2007), Outward Bound programmes (Hattie et al., 1997; McKenzie, 2003), and adventure therapy (Bowen & Neill, 2013; Staunton, 2003; S. J. Wilson & Lipsey, 2000). Shorter programmes such as nature walks are generally non-residential, take place within a day, and may last no longer than a few hours. Participation in outdoor activities such as these lies at the core of a typical outdoor programme.

Outdoor activities refer to physical activities engaged in during exposure to natural settings (Pretty et al., 2007). Such activity often involves an element of adventure (J. Barrett & Greenaway, 1995); a state of mind willing to commit to uncomfortable emotions of fear and uncertainty, while acknowledging the shift towards joy and satisfaction that may be experienced upon success (Mortlock, 1984). As such, outdoor activities are often *not* low-stress, and may be physically demanding, even mentally taxing, in comparison with 'restful'

[6] As the name suggests, adventure lies at the core of outdoor adventure for recreational, educational, therapeutic, or developmental purposes. In contrast, outdoor education refers to the use of the outdoors for educational purposes, such use comprising physical outdoor activities with a residential component (Higgins, 2002). More recently, outdoor education has become widely accepted by the European Union (Higgins & Nicol, 2002) as including the three interconnecting circles of outdoor activities, personal and social development, and environmental education, all guided by safe and professional practices (Higgins, 2002; Higgins & Loynes, 1997).

nature exposures (simply viewing a natural setting, for example). Depending on the type of activity or the environment in question, some degree of potential hazard may also be involved, ranging from a minor accident such as a sprained ankle to a somewhat higher-risk, even life-threatening situation–encountering a landslide or a rockfall while being in natural environments, for instance. Most outdoor activities are therefore perceived as involving a more or less stressful degree of exposure to nature. Most outdoor education researchers argue that participation in such activity can lead to a variety of positive outcomes, such as improved well-being and improvements in self, leadership, and interpersonal qualities (Hattie et al., 1997; Higgins, 2002; Higgins & Loynes, 1997).

Several researchers evaluated research on the psychological impact of outdoor activities or programmes. Table 1 summarises the key findings of a number of meta-analyses that examine the effectiveness of these outdoor programmes in terms of various personal and social outcomes, such as positive well-being and improvements in self, leadership, and interpersonal qualities. These meta-analyses (Bunting & Donley, 2002; Cason & Gillis, 1994; Gillis & Speelman, 2008; Hans, 2000; Hattie et al., 1997; Laidlaw, 2000; Marsh, 1999b) indicate the wide variety of programmes and outcomes associated with outdoor activities. In addition to such evidence, some scholars argue that such programmes may have a positive effect on our cognition; and a number of researchers regard outdoor activities as a potential medium for stimulation of creativity (Cooper, 1994; Higgins, 1997; Higgins & Nicol, 2002; Higgins, Ross, Lynch, & Newman, 2004). This idea is consistent with evidence from the restorative environmental research demonstrating that effects of contact with nature may affect our cognition (Berman et al., 2008; Hartig et al., 2003; Kaplan, 1995).

The research in this area raises a number of questions regarding the nature of the effects discovered. For instance, as shown in Table 1, the studies synthesised in most meta-analyses (Gillis & Speelman, 2008; Hans, 2000; Hattie et al., 1997; Marsh, 1999b) were conducted in the United States or Australia, and involved outdoor programmes lasting at least

a day and sometimes a few weeks. If cultures can influence our preferences for certain environments (Falk & Balling, 2010), might this also influence our experiences and the consequences of being immersed in these environments too? Little is known as to whether the positive effects of outdoor activities can be generalised across cultures, beyond Western nations. Such investigation might provide interesting insights regarding the universality and power of the biophilic impulse.

Some findings appear contradictory: Longer programmes (e.g., exceeding 20 days in Hattie et al. (1997)) were found to be the most effective in some meta-analyses; whereas Laidlaw (2000) found no differences between short and long programmes. It also seems uncertain at this stage which age group benefits the most from outdoor programmes. Some researchers (Gillis & Speelman, 2008; Hattie et al., 1997) found that outdoor programmes are most effective for adults, while others (Cason & Gillis, 1994; Marsh, 1999b) report that younger children and adolescents derive the most benefit from programmes taking place in the outdoors. To address some of these areas of uncertainty, there is a need for a more comprehensive integration of previous studies.

Despite participants reporting improvements on a wide range of psychological outcomes of the kind listed above, the criticism has also been made that it remains unclear how, precisely, outdoor activities affect us (Ewert, 1983; McKenzie, 2000). According to Ulrich (1999), being in nature tends to correlate with more physical activity, higher socialisation (e.g., interactions when hiking with friends), and temporary escape from habitual activities (e.g., removal of stressors). In addition to the fact of being in nature, these factors are possible explanations for any reported effects of outdoor activities. It is unclear to what extent the interaction with the natural environment also affects us. Based on the current meta-analytical evidence, little is known about the cognitive effects of outdoor activities, despite the argument that the natural environment may improve our cognition. If we are to

better understand the human-nature relationship, there is a need to clarify further the effects of outdoor experiences in order to address some of the issues listed so far.

1.1.4. Summary

The above theories and current research suggest that both physical contact with nature and a sense of connectedness with nature have positive, restorative effects. Most research evidence suggests that much, but not necessarily all, contact with nature may positively affect our well-being. Other evidence also shows that physical contact with a restorative environment may positively influence our cognition, while outdoor activities may also affect our personality.

Despite the widespread agreement in the literature about the benefits of 'being in nature', the arguments advanced thus do not adequately explain how such contact may affect our well-being, cognition, and personality. Evidence supportive of restorative effects appears to be confounded, furthermore, by the presence of different types of stressors in different environments; and this makes it challenging to attribute such any positive effects to exposure to nature per se.

There is a possibility that the effects of connectedness with nature and outdoor activities may affect our cognition. It has been argued that our cognition (creativity, for example) may benefit from contact with nature (Cooper, 1994; Higgins, 1997; Higgins & Nicol, 2002; Higgins et al., 2004). Recent research has also demonstrated that prolonged outdoor participation can affect our creativity (Atchley et al., 2012; Ferraro, 2015). The next section will discuss in greater depth the possible effects of contact with nature and creativity.

Table 1

Summary of Meta-Analyses of the Effectiveness of Outdoor Programmes and Challenge Courses

Meta-analysis	Cason and Gillis (1994)	Hattie et al. (1997)	Marsh (1999a)	Laidlaw (2000)	Hans (2000)	Bunting and Donley (2002)	Gillis and Speelman (2008)
Focus	Adventure programmes	Outdoor education	Camps	Outdoor education	Adventure programmes	Challenge (ropes) course	Challenge (ropes) course
Outcomes	Various	Various	Self-concept and self-esteem	Various	Locus of control	Affective	Challenge course related outcomes
Programme Duration	36–5400 hours (ten months)	1–120 days	1–8 weeks	1–110 days	2 days–9 months		
Participant group	Adolescents	All	Children/ Adolescents	All	All	All	All
Participant Age	11 years-university freshman	11–42 years	6–22 years	-	8–32 years		
Comparison	Pre-post test	Pre-post test	Pre-post test	Pre-post test Control group	Pre-post test	-	Control group
Country source	-	United States and Australia	United States		United States and Australia	-	United States
Sample year	1970–1994	1986–1994	1969–1996	Unclear	1972–1995	-	1986–2006
No. of studies	43	96	22	48	24	15	44
Effect sizes no.	147	1728	37	389	30	-	390

Meta-analysis	Cason and Gillis (1994)	Hattie et al. (1997)	Marsh (1999a)	Laidlaw (2000)	Hans (2000)	Bunting and Donley (2002)	Gillis and Speelman (2008)
No. of participants	11238	12057	1139	3550	1632	-	2796
Effect size of overall effectiveness	.31	.34	.20	.49	.38	.55	.43
Age	Younger adolescents	Adults	Younger campers (6–10 years)	n/a	n/a		Adults
Duration	Longer	Longer (greater than 20 days)	n/a	No difference	Residential programmes	Longer (14 hours or longer)	Longer (21–30 hours)
Others	Less rigorous research design	Australian Outward Bound programmes	Camp focus on self-enhancement	Less rigorous research design Aligned programme focus and outcomes	Programme focus on therapy		Outcome of family measures

1.2. The nature-creativity relationship

"The naturalistic tendency has been cited as providing an important basis for outdoor fitness and the acquisition of various outdoor skills such as climbing, hiking … The mental benefits of these activities have been related to tension release, relaxation, peace of mind and enhanced creativity derived from the observation of diversity in nature."

Stephen Robert Kellert

As creativity is deemed an important skill for the future workforce (Ananiadou & Claro, 2009), there is an increasing interest in the possibility that outdoor experiences can foster creativity skills believed to be lacking in students (Gassner & Russell, 2008; Lim, 2012). Given the growing interest in the use of outdoor experiences to encourage creativity, it is important to understand whether contact with nature and creativity are related, and how they affect each other. Currently, there is some evidence supporting the relationship between contact with nature and obtaining creativity improvements. A few recent studies have indicated, on the one hand, a positive association between exposure to the natural physical environment and creativity (Ma, 2009), and, on the other, the impact of nature-related activities in fostering the creative impulse (Atchley et al., 2012; Ferraro, 2015). Before surveying the research on the nature-creativity relationship, it will be helpful to briefly describe the construct of creativity, and review some factors of creativity that might be relevant to an understanding of nature's impact on it.

1.2.1. Overview of creativity research

Plucker, Beghetto, and Dow (2004) define creativity as an interaction between personality, process, and environment to produce a creative product recognised as both original and useful within a social context. According to (Amabile, 1983b), an item or an idea will be considered creative if "(a) it is both novel and appropriate,

useful, correct, and (b) the task is heuristic rather than algorithmic" (p. 360). The rating of the creative product involves a degree of subjectivity that may hinder independent evaluation of the product (Amabile, 1983b). These definitions indicate the complexity of the construct. There are three subcomponents to creativity: personality, process, and environmental. Within each subcomponent, there are various variables that are likely to influence creativity. For instance, a particular personality trait or cognitive style is likely to increase the creativity potential of a person. The following section briefly reviews some variables relating to the three subcomponents potentially influencing our creativity, and relevant to an understanding of the impact that contact with nature has upon our creativity.

1.2.1.1. Three subcomponents of creativity and related variables

The Creative Personality. A number of studies have specifically sought to identify personality traits related to creativity (Feist, 1998). Creativity research (Feist, 1998; George & Zhou, 2001) highlights the personality traits that a creative person is likely to exemplify: open-mindedness, preparedness to take risks, and adventurousness. McCrae (1987), for instance, reports that the trait of openness to experience is linked to both creative personality scores and to the creative process of divergent thinking. Beghetto (2006) also discovered that creative people possess a stronger sense of creative self-efficacy, and so believe that they have the capability to produce imaginative ideas or items. Additionally, Ee, Seng, and Kwang (2007) found that creative people prefer an innovative as opposed to an adaptive thinking style. An innovative thinking style, according to Kirton (1993), refers to thinking outside the norms and to doing things differently, while in an adaptive thinking style, emphasis is placed on efficiency and on working according to rules and regulations. Thus,

variables such as openness to experience, creative self-efficacy, and innovative thinking style are likely to enhance the creativity potential of a person.

The Creative Process: Divergent and Convergent Thinking. Within the creativity field, cognitive processes such as divergent and convergent thinking underlie the germination of original and useful ideas (Guilford, 1960). Guilford (1960) refers to divergent thinking as the ability to generate diverse ideas, and to convergent thinking as the ability to produce one perfect solution. Divergent thinking emphasises the quantity and quality (e.g., originality and usefulness) of novel ideas generated (Amabile, 1983b; Guilford, Merrifield, & Wilson, 1958), while convergent thinking focusses on a single right solution to a problem and assumes that there is a correct way to do things (K. H. Kim & Pierce, 2013; Mednick, 1962). According to Cropley (2006), a creative person requires divergent thinking skills to create a variety of novel ideas and then go through the process of convergent thinking to assess the novelty of these ideas and select the best solution to the problem. This suggests that divergent thinking is an important process in creativity, and that significant creative skills may be required to generate new ideas.

The Creative Process: Perspective Taking. Research also seems to suggest that perspective taking is another cognitive process facilitating creativity. This ability to adopt different perspectives allows one to take the values, preferences, and needs of others into consideration (Parker & Axtell, 2001). According to K. H. Kim and Pierce (2013), different perspectives may be required in divergent thinking in order for an individual to connect seemingly unrelated ideas and create different solutions. Some researchers also argue that accessibility to different viewpoints provides new ideas (Galinsky et al., 2008) and may serve as a reference to gauge the usefulness an idea has for other people (Berry, 2013). Such usefulness is a key criterion when evaluating

creative ideas, i.e., how appropriate and relevant a creative idea is in a given situation (Amabile, 1983b; Berry, 2013). Some researchers such as Grant and Berry (2011) have found that perspective taking mediates the relationship between intrinsic motivation and creativity. When an intrinsically motivated individual generates novel ideas, for example, perspective taking is likely to allow him/her to determine how to develop and elaborate on creative and useful solutions for problem solving. Hoever, Van Knippenberg, van Ginkel, and Barkema (2012) have also demonstrated that when individuals are instructed to take other members' perspectives, perspective taking fosters higher creativity within teams made up of people from diverse, as opposed to homogeneous, backgrounds. Such evidence of creativity provides indications that perspective taking may increase creativity.

The Creative Environment. Some creativity researchers have examined the importance of the environment in creative production. In one meta-analysis, Ma (2009) summarises the effectiveness of the different subcomponents of creativity, which include variables of the creative person, process, and environment. Specifically, Ma (2009) found a large mean effect size for the environmental factors is conducive to creativity. An environment conducive to creativity should be "quiet, alcohol-free, natural, relaxed and unrestrained" (Ma, 2009, p. 38). Some researchers (Alawad, 2012; Lichtenfeld, Elliot, Maier, & Pekrun, 2012; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004; van Rompay & Jol, 2016) have demonstrated, moreover, that people performed more creatively after exposure to certain natural stimuli (e.g., potted plants, sounds of nature). Such evidence proposes a possible relationship by which some contact with the natural environment might positively influence our creativity.

A comprehensive examination of creativity may include investigating the creative personality (e.g., openness to experience, creative self-efficacy, innovative thinking), the creative process (e.g., divergent thinking), and the creative environment (Ma, 2009). Some studies into what constitutes a creative environment indicate that a natural environment may facilitate the process of creative production (Ma, 2009). The next section will focus on the studies that have examined the links between the natural environment and creativity.

1.2.2. Evidence for a nature-creativity relationship

Most creativity studies that examine nature-creativity relationships have focussed on the examination of visual and auditory stimuli relating to the natural world (e.g., potted plants, images of nature, and sounds of nature) and shown to have positive effects on creativity. Some studies (Shibata & Suzuki, 2002; Shibata & Suzuki, 2004) suggest that the presence of a plant will play a facilitative role for creative work. Other researchers (Lichtenfeld et al., 2012) consider the colour green to be ubiquitous in nature[7] and investigated its effects. They reported medium effect sizes of green on creativity as compared to other colours: Participants who were exposed to a brief glimpse of green before a creativity task performed more creatively than those exposed to either achromatic (white or grey) or chromatic (red or blue) contrast colours. A recent study by van Rompay and Jol (2016) examined the effects of nature-based imagery on creative performance, and showed that unpredictability and spaciousness, two possible characteristics of green environments, enhanced creativity. Alawad (2012) demonstrated that in a pre-post-test comparison, female

[7] The colour green is generally ubiquitous in many natural environments, but may not feature particularly in alpine, desert, tundra, and marine environments, for example. It remains unclear therefore whether people who live in different natural environments prefer, and benefit from, the colours in those environments.

students completed their artwork more creatively after listening to sounds from nature.

Some studies investigating creative performance in natural settings have examined prolonged participation in outdoor activities. They have gone beyond investigation of the presence of a physical item or an element of the environment– both often used in previous studies (Ma, 2009). Atchley et al. (2012) conducted an experimental study of the effects of outdoor programmes such as Outward Bound. Use of such programmes–which include hikes lasting at least three days in natural settings–established that those who had taken part in hiking in nature scored almost 50% better in creative performance than a control group of participants who were assessed before embarking on a similar hike. Atchley et al. (2012) measured creativity using the Remote Associates Test (Mednick, 1962), which measures the convergent thinking aspect of creativity and focusses purely on when the associated tasks are used (Mednick, 1962). During the test, participants have to produce one correct answer that associates three different items/words (e.g., cues: 'elephant' 'lapse' 'vivid'; answer: 'memory'). Another study found similar results for a kayaking expedition: Ferraro (2015) reports that students who had participated in such an expedition performed better on the Remote Associates Test than those who had not done so. These findings suggest that being in a natural environment and experiencing the combined effects of the various natural stimuli may be more inspiring than anything one natural stimulus could provide on its own. Such evidence supports the view that prolonged participation in outdoor activities may positively influence creative processes such as convergent thinking.

Current evidence, demonstrating that people perform more creatively in cognitive tasks after exposure to the natural environment or to its related stimuli

(Alawad, 2012; Lichtenfeld et al., 2012; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004; van Rompay & Jol, 2016), suggests a possible relationship between nature and creativity (termed *nature-creativity relationship* or *effect* in this thesis). Atchley et al. (2012) have proposed explanations as to how nature might affect creativity: nature experiences engage the brain's 'default mode' networks (i.e., the resting state connections between brain areas), and, as a result, these networks may be involved in efficient performance for demanding tasks (e.g., divergent thinking tasks) requiring frontal lobe function. They also argue that according to the attention restoration theory (Kaplan, 1995), engaging in nature experiences generates 'soft-fascination', and this allows the mind to enter a resting state of contemplation in promoting the default mode of the brain.

Research to date does not, however, allow us to adequately explain how nature is related to creativity. If the above explanations put forward by Atchley et al. (2012) are true, it is unclear, despite statistically significant findings, whether such effects are due to exposure to nature or result from general resting or relaxation. People may perhaps feel more relaxed and rested after being away from daily routines by engaging in nature experiences. This rested state, rather than restorative attentional effects, may promote the default mode of the brain. Furthermore, given the current state of research (e.g., Ohly et al., 2016), it is unclear what specific attentional processes account for restorative effects (see section 1.1.1). Therefore, the attention restoration theory does not seem to be effective in explaining the creative effects of being in nature.

There is also a lack of clarity regarding which sub-components of creativity and variables related to creativity that may be the most relevant to the effects of nature exposure, given the variety of creativity measures used. Some studies (Atchley

et al., 2012; Ferraro, 2015) examined the impact of prolonged outdoor participation on the convergent thinking process; Lichtenfeld et al. (2012) examined the impact of natural stimuli on the divergent thinking process; and in other cases (Alawad, 2012; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004), the cognitive process examined was unclear, given the creativity measures used (e.g., students' art project, association task). This suggests the study of the nature-creativity effect has yet to agree on the best way to operationally define creativity. In addition, little is known about the optimal duration of nature exposure required for the effects of nature exposure. Some studies employed prolonged and intense periods of exposure while others examined short and less demanding exposure to natural stimuli. Would, for instance, an easy nature walk of short duration (e.g., less than an hour) help us to be more creative?

1.2.2.1. Methodological caveats

Potential confounds may affect the study of the nature-creativity effect. Some studies report that the hypothesised restorative effects have failed to control for various confounding variables. Many studies such as Hartig et al. (2003) and Ferraro (2015), for example, compared nature versus urban conditions that were associated with different types of stressors, and statistical noise that may make effects harder to detect. The urban environmental condition might have been associated with increased stress resulting from the high cognitive demands needed to navigate such settings (e.g., crossing a busy, congested street without being hit by a car). The lack of such stressors in natural settings makes it unclear whether the reported effects are due to exposure to nature or to relaxation due to removal of such stressors.

Therefore, the comparison between nature and urban conditions makes it challenging to control confounding variables. Previous studies compared the creative performances of an active group in a natural setting, and a passive group in an urban

setting (Atchley et al., 2012; Ferraro, 2015). This comparison confounds the level of physical activity in each of the two conditions (walking, for instance), which has been found to promote creative performance (Oppezzo & Schwartz, 2014). As the experimental group engaged in more demanding physical activity than the control group did, it remains unclear if physicality was a confounding factor that accounted for the participants' improved creative performance. There is also a need to consider other potential confounds (e.g., higher socialisation and temporary escape from stressors) often associated with being in nature. Are the observed effects explained by such associated benefits or by the mere exposure to nature?

Selection bias is a possible threat to internal validity which may influence the reported effects. Previous studies (e.g., Ferraro, 2015) used existing (non-randomly selected) groups (e.g., university students enrolled in an experiential outdoor course). The self-selected groups may have undermined the strength of the study design. Participants in the experimental group would be more physically able and motivated to engage in outdoor activities, for example, as compared to the control group (e.g., university students enrolled in a seminar psychology course). Hence, it is unclear whether the reported effects are due to exposure to nature or to the inherent differences between groups due to self-selection.

1.2.3. Summary

The study of creativity has included investigation of the three subcomponents of creativity (i.e., the creative environment, creative processes, and creative traits) (Plucker et al., 2004), as illustrated in Figure 1. Within creativity research, some researchers are interested in studying the effects of exposure to the natural environment viewed as a creative environment, and in establishing a link between creativity and exposure to nature-related stimuli, as shown in Connector (a), Figure 1.

By mapping the effects of nature onto various creativity outcomes, scholars have attempted to examine such effects in relation to different subcomponents of creativity. Some studies link exposure to nature-related stimuli with creative processes involving divergent thinking tasks (Lichtenfeld et al., 2012) (see Connector (b) in Figure 1). Another group of researchers has investigated the effects of outdoor activities on creativity measuring convergent thinking (see Connector (c) in Figure 1). Broadly speaking, the three connectors indicate that the current research trend has focussed investigation of the nature-creativity relationship on physical contact with nature (i.e., presence of natural stimuli and immersion in natural settings).

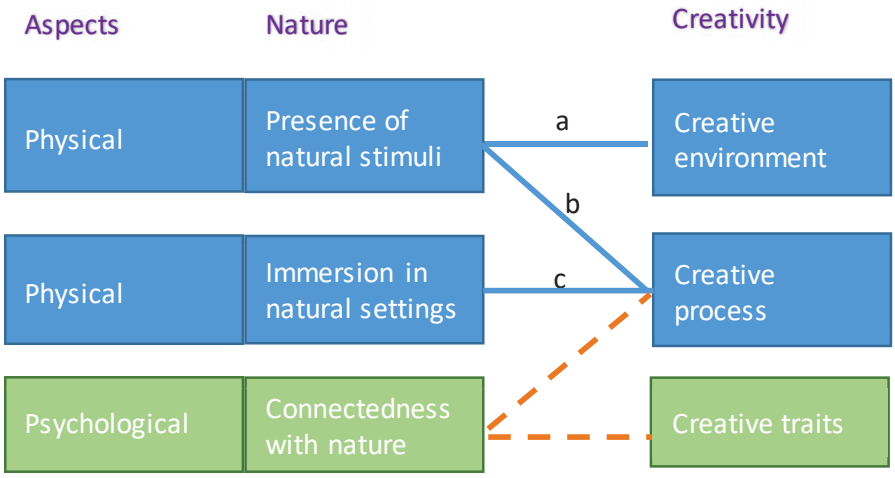

Figure 1. Previous and potential research areas of nature-creativity relationship.

1.2.3.1. Potential relationships of the nature-creativity effect

Based on the literature, the dotted lines in Figure 1 represent areas in which there is a lack of research pertaining specifically, in investigation of the nature-creativity relationship, to psychological factors such as connectedness with nature, creative traits and creative processes. We do not know, for example, whether connectedness with nature is linked to creativity outcomes (e.g., innovative thinking style), and whether the effects of outdoor activities are applicable to divergent-

thinking creativity. The current literature highlights a lack of understanding and evidence regarding whether the psychological connectedness with nature might affect our creativity.

Nonetheless, existing research within the fields of environmental psychology and creativity appears to provide clues as to how psychological connectedness with nature may be linked to creativity. Firstly, connectedness with nature may be associated with creative traits. Nisbet et al. (2009), for example, report openness to experience as a trait commonly found in people who are strongly connected with nature. Earlier studies have also shown that this openness to experience relates to creative features such as an innovative cognitive style (Ee et al., 2007) and divergent thinking (McCrae, 1987). Mayer and Frantz (2004) also found that nature connectedness is significantly associated with perspective taking, a creativity-related ability. Thus, creative people, and people who feel more connected with nature, share similar traits. Secondly, this connectedness may also be linked to creative processes. Empirical evidence has demonstrated that physical exposure to nature influences creative processes in a positive way: Prolonged outdoor participation fosters creativity using convergent thinking (Atchley et al., 2012; Ferraro, 2015), and nature-related stimuli (i.e., the colour 'green') encourages divergent thinking creativity (Lichtenfeld et al., 2012). It is possible that connectedness with nature would influence creative processes, much as physical exposure to nature does. If this connectedness allows us to take on the perspectives of others (Mayer & Frantz, 2004), such perspective taking may provide inspiration for different new ideas (Galinsky et al., 2008), which is a good source for divergent thinking creativity (K. H. Kim & Pierce, 2013).

The examination of these possible relationships between connectedness with nature and creativity outcomes will further explore the psychological link between

nature and creativity. Given that previous studies are constrained by several methodological caveats, there still exists a need for further robust quantitative research to explain the potential processes underlying the effects of such activities, in particular, their creativity effects. This will hopefully provide a clearer insight into the nature-creativity relationship before development of a better theoretical understanding, based on the limited evidence currently available, of how nature and creativity are linked.

1.3. Importance of this thesis

The aims of this thesis are to clarify the effects of outdoor programmes, and to explore the link between connectedness with nature and creativity outcomes. If connectedness with nature is associated with creativity, I will test whether engagement in nature may affect creativity because of increased connectedness with nature.

Some of the key ideas proposed in the earlier sections inform the research directions for this thesis. While contradictory evidence of restoration effects suggests that not everyone is attracted to natural environments, there are potentially some positive effects (e.g., exercise, sense of being away, relaxation) associated with contact with nature than being in an urban/built environment does in general. It is important to better understand the possible effects of contact with nature. In sections 1.1.1 and 1.2.2, it was argued that the current understanding of how attention may affect our cognition (i.e., the attention restoration theory) is limited within current literature and may not be as relevant to explain the effects of being in nature and creativity. Furthermore, in sections 1.1.2 and 1.2.3, it was suggested that a possible effect may exist between connectedness with nature and creativity. My hope in this thesis is therefore to study another construct related to nature, i.e., connectedness with

nature, that may link to cognition and the investigation of this relationship contributes to the aims of this thesis.

The difficulty of this endeavour arises from the fact that the study of the nature-creativity relationship combines two distinct research areas: environmental psychology and creativity research. Given the complexity of both research areas, the current state of knowledge seems to oversimplify the relationship between contact with nature and creativity. There is a lack of systematic testing as to whether there is an effect between contact with nature and creativity, and how strong this effect is. Overall, this thesis provides an original contribution to the field in that it combines environmental psychology with creativity research and explores how nature might influence cognition.

In the next section, I will provide an outline of the studies in this thesis and discuss how they address existing research needs. The debate as to whether both physical contact with and psychological connectedness with nature can be linked to creativity is a fundamental one, since it tackles not only theoretical issues but also methodological concerns, i.e., problems regarding conduct of the research. I also position my own research in terms of how it will meet existing research needs.

1.3.1. Addressing existing research needs

The first goal of the thesis is to clarify the effects of outdoor experiences on psychological outcomes. Previous research on outdoor activities has focussed on the examination of various psychological outcomes such as positive well-being and improvements in self, leadership, and interpersonal qualities. As little is known about the effects of cognitive outcomes resulting from participation in outdoor activities, there is a need to clarify the state of current evidence regarding the outcomes of such experiences. Next, there is a need to understand the impact of the optimal duration for

the greatest effects resulting from outdoor participation, given the contradictory results relevant to programme length. This finding will inform my decision as to the duration of an outdoor activity as an independent variable, to be tested in the experiment examined in Study 4 (see below). In addition, this study will test whether culture might influence the effects of outdoor experiences. While the biophilia hypothesis (E. O. Wilson, 1984) suggests the innate preference for nature, other researchers (Falk & Balling, 2010) argued that such preferences can be modified by enculturation and experiences (see section 1.1). This finding might provide interesting insights to whether culture might affect our experiences in nature. These are some of the questions that will be examined in Study 1.

The second research goal is to explore the relationship between the psychological connectedness with nature and creativity outcomes. Given the complexity inherent in the study of nature and creativity, this thesis adopts a comprehensive approach to further explore the relationships between nature and creativity. For this purpose, there are two ways of making contact with nature (i.e., physical exposure to the natural environment and a psychological contact through a sense of connectedness with nature), and three subcomponents of creativity (i.e., the creative environment, creative processes, and creative personality traits). A possible strategy is to examine new relationships between nature and creativity in order to gain a clearer insight into this nature-creativity effect. In the previous section, it was suggested that connectedness with nature may be associated with creative traits such as innovative thinking and creative processes such as divergent thinking. Studies 2 and 3 will explore some possible associations between connectedness with nature and creativity (e.g., variables of creative traits and processes).

Given that the above correlational studies do not offer much potential for explanations as to how nature may affect creativity, Study 4 will examine the possible mediating role of connectedness with nature. Physical contact with nature has been demonstrated to foster our connectedness with it (Mayer et al., 2009). Consistent with my earlier proposition that connectedness with nature is positively related to creativity, this connectedness may be increased due to nature experiences and thereby affect our creativity. Although it has been suggested that attentional processes might explain the nature-creativity relationship (Atchley et al., 2012), there is a lack of clarity regarding these attentional processes relevant to the effects of exposure to nature (Ohly et al., 2016). This study of connectedness with nature will hopefully identify another potential mediator that may explain this relationship.

To achieve this, a robust experimental design is required to overcome some potential limitations and eliminate alternative explanations. A way to examine this hypothesis is to randomly subject participants to different levels of manipulation in their engagement with nature and to observe whether the different conditions of engagement (i.e., being focussed or unfocussed when engaging in nature) influence creativity (measuring divergent thinking) as our dependent variable and connectedness with nature as our mediating variable. This avoids the self-selected group bias and allows better control of stressors and statistical noise associated with the nature versus urban comparison. It is important to maintain high internal validity and avoid confounding variables or threats when testing for causal relationships.

A secondary aim of Study 4 is to test creative responses to natural environments for a shorter period, as opposed to prolonged exposure. Previous studies (Atchley et al., 2012; Ferraro, 2015) have relied on prolonged outdoor participation to examine the impact of contact with nature on creativity. A question remains as to the

'ideal' length of time to be spent in nature for creativity benefits to occur. It is not, however, within the scope of this thesis to find the greatest marginal return for dose-response relationship in the nature-creativity effect. Depending on the finding of Study 1 regarding the effect of short duration on outdoor programmes, it is my hope that Study 4 will examine whether a shorter time spent in nature may also affect our creativity.

Overall, this thesis comprises four studies conducted in three phases shown in Table 2. The next section provides an overview of the studies, featuring as five chapters of the thesis.

Table 2

Study Phases

Phase	Objectives
1	To provide a more comprehensive assessment of the general effectiveness of outdoor experiences.
2	To explore correlational relationships between connectedness with nature and creativity-related variables (i.e., creative traits and creative process).
3	To examine causal relationships between outdoor activities, connectedness with nature, and divergent-thinking creativity.

1.4. Structure: Thesis by papers

Following this introduction, the thesis is presented in five chapters; one a published journal article, and three other manuscripts submitted for journal reviews. These manuscripts are written for the specific audience of the journal(s) to which they will be submitted, and to fit their style. It is possible therefore that readers of this thesis may encounter repeated information in the published papers. Chapters Two to Five describe four empirical studies in the thesis. A schematic overview of the purpose and main characteristics of these studies is illustrated in Table 3. To facilitate

the flow between the five chapters mentioned, the remainder of this section will discuss briefly how the chapters interconnect, in order to establish a coherent overall picture for the thesis.

For the purpose of the first study phase (see Table 2), Chapter Two presents Study 1, which aims to summarise the overall effectiveness of outdoor experiences and including school programmes and Asian studies, both often omitted from previous meta-analyses. The chapter examines whether the effects of these outdoor experiences are long-lasting, and who benefits most from the effects. Several programme characteristics are examined as moderating factors to determine their effectiveness for future research designs and this will inform the design of Study 4 for the purposes of this thesis.

In the second study phase (see Table 2), the exploration of the nature-creativity relationship begins in Chapters Three and Four by testing whether a relationship exists between the trait of psychological connectedness with nature and creativity outcomes. Chapter Three describes Study 2 and part of Study 3, as these share an aim; i.e., an exploration of the relationship between connectedness with nature and creative cognitive styles. Chapter Four illustrates the second aim of Study 3, which is to further investigate the link between connectedness with nature and creativity which measures the divergent thinking process. Hierarchical regression models were used to test the effects of various creativity outcomes on the predictive validity of connectedness with nature. Any significant evidence reported in Studies 2 and 3 will support a link between connectedness with nature and creativity outcomes, but these correlational studies are unable to explain any causal relationship. To address this issue, one approach is to examine whether connectedness with nature might affect creativity. The next study, therefore, examines the mediating effects of

connectedness with nature on the effects of engagement in nature and divergent-thinking creativity.

Relating to the third study phase (see Table 2), Chapter Five presents Study 4, which describes an experimental study that explores whether focussed or unfocussed engagement with nature impacts on connectedness with nature and divergent-thinking creativity. The effect sizes found in Study 1 will serve as a benchmark for comparison with those reported in Study 4. If in Study 1 short outdoor experiences are found to be as effective as, or of greater effectiveness than, long experiences, this finding will inform the design of Study 4, which aims to explore the impact of short outdoor experiences on creativity. In Study 4, university students are randomly assigned to either focussed or unfocussed engagement with nature conditions, then take part in a forty-minute nature walk. Their pre- and post-test creativity scores are compared and the mediating role of connectedness with nature is also examined. In short, Studies 2 to 4 examine different aspects of nature and creativity and explore the relationships between them.

Finally, Chapter Six concludes with a general discussion of the key findings reported in the thesis and how they contribute to the literature. It provides possible explanations as to how people's experience of the natural world might positively affect the way they perform creativity tasks in particular. The strengths and limitations of the studies are discussed. This discussion in Chapter Six also leads to possible ideas for future research and finally, to suggested implications for practitioners and policy makers.

Table 3

Overview of the Research Plan for the Thesis

	Study 1	Study 2	Study 3	Study 4
Research focus and purpose	To identify the psychological outcomes of outdoor activities.	To explore the relationship between connectedness with nature and creative cognitive styles.	To replicate the results of Study 2 and further explore the link between connectedness with nature and cognitive styles. To explore the relationship between connectedness with nature and creative performance related to divergent thinking.	To test whether active or passive engagement with nature impacts on connectedness with nature and creativity. To control confounds.
Research question	How effective are outdoor activities? Are these effects lasting?	Is connectedness with nature associated with creative cognitive styles?	Is connectedness with nature associated with creative performance related to divergent thinking?	Does active participation in natural environments influence connectedness with nature and nature-related creativity?
Methodology (Main method)	Meta-analysis (Random effects ANOVAs analysis)	Online survey (Correlational analysis and multilevel regression analysis using HLM)	Pen and paper survey and creativity test (Correlational analysis and Multilevel regression analysis using HLM)	Pre-post randomised experimental design (Power analysis, Correlational analysis, t-tests, and PROCESS modelling)
Data source	Secondary data analysis using different surveys	Primary data analysis using CNS, NR, KAI, AHS, PANAS, WEMWBS, GHQ	Primary data analysis using CNS, KAI, CSE, PAS, OCT	Primary data analysis using CNS, OCT

	Study 1	Study 2	Study 3	Study 4
Main variables	Variables from different surveys	IV: Well-being and connectedness with nature indicators DV: innovative thinking and holistic thinking scores	IV: Scores of connectedness with nature, innovative thinking, creative and physical self-efficacy DV: originality scores	IV: Nature conditions Mediator: Connectedness with nature scores DV: originality scores
Respondents (*N*)	10701	138	185	93
Reported in Chapter	2	3	3 and 4	5

Note. CNS: Connectedness to Nature Scale; NR: Nature Relatedness Scale; KAI: Kirton's Adaption-Innovation Inventory; AHS: Analytic-Holistic Scale; PANAS: Positive and Negative Affect Scale for Children; GHQ: General Health Questionnaire; WEMWBS: Warwick-Edinburgh Mental Well-being Scale; CSE: Creative Self-Efficacy Scale; PAS: Perceived Physical Ability Scale for Children; OCT: Outdoor Creativity Task.

CHAPTER 2. STUDY 1

"Nature holds the key to our aesthetic, intellectual, cognitive and even spiritual satisfaction."

Edward Osborne Wilson

Meta-analysis of outdoor experiences: Are these effects lasting and what makes them successful?

The following manuscript has been submitted for review. The version shown here includes minor formatting changes for consistency with the rest of this thesis. References for this manuscript, are included within the consolidated list in the *References* section. For studies included in the meta-analysis, please refer to Appendix A.

The manuscript is currently under review: Leong, L. Y. C., Hill, S., & Fischer, R. (2017). *Meta-analysis of outdoor experiences: Are these effects lasting and what makes them successful?* Manuscript submitted for review.

2.1. Abstract

Outdoor education programmes for enhancement of personal and social skills are becoming increasingly popular in schools. A meta-analysis (N = 10701, k = 100) of the effectiveness of outdoor experiences was conducted for this study. Its aims were to examine if programmes for outdoor experiences are beneficial for school students, and to determine programme factors that may be manipulated in school settings. Outdoor programmes resulted in a statistically significant, but relatively modest improvement in learning outcomes for studies of both pre-test–post-test (average weighted effect size [ES] = 0.41) and control group comparisons (ES =

0.26). These positive effects were not long-lasting, however. Outdoor programmes were most effective for younger school students. School-organised programmes and Asian programmes were found to be more effective. Additionally, programme effectiveness was shown not to be related to length of programme, programme type, or type of environment. The findings show that participants benefit from participating in outdoor programmes, especially for improvement of social skills.

Keywords: outdoor education, learning outcomes, culture, programme characteristics

2.2. Introduction

Outdoor education has developed significantly in recent years. School systems in Western countries such as Denmark, Sweden, New Zealand and the United Kingdom have been introducing outdoor learning experiences (also termed outdoor education) into the school curriculum (Fuks, 2004; Hilton, 2012; O'Brien, 2009; Zink & Boyes, 2006), while in Asia, Singapore has also included outdoor education as part of its own formal curriculum (Ministry of Education Singapore, 2013). The implementation of outdoor education as part of a school curriculum and the proliferation of outdoor education providers suggest it is important to consider the potential benefits to students of such developments. Current environmental studies have shown some positive effects, such as well-being, improved attention span, and better creativity performance when people are exposed to the natural rather than the urban environment (Atchley et al., 2012; Bratman et al., 2012; Ferraro, 2015; Grinde & Patil, 2009). Furthermore, through various types of intervention, research evidence has demonstrated the impact of outdoor interventions in building personal and group abilities (Bowen & Neill, 2013; Gillis & Speelman, 2008; Hans, 2000; Hattie et al., 1997; Staunton, 2003; S. J. Wilson & Lipsey, 2000). At the same time, a number of uncertainties remain. Is outdoor education equally effective for school-aged children

and adults, or are there participant group differences? Are longer programmes more effective than shorter programmes? Is it important to implement an outdoor education programme in an urban setting, or does it need to be delivered in a wilderness environment? Are there differences between different programme providers? Do these programmes work as well in Asian contexts as in European settings, or are there differences? The goal of our meta-analysis is to summarise the literature and examine these questions. We first introduce the six concerns that outdoor education programmes face.

2.2.1. Participant groups

The first matter of concern is whether differences exist between participant groups of different ages. Typically, people from a variety of groups–primary or secondary school pupils, university students, or adults–take part in outdoor programmes. To examine the effectiveness of outdoor programmes, a comparison of different participant groups is necessary. It is important, for example, to understand whether outdoor education programmes are equally effective for school-aged children and adults, and whether they are more effective for primary or for secondary school students. Previous studies have demonstrated the effects of age on outdoor programme effectiveness. Some research involving younger participants has shown that younger adolescents (Cason & Gillis, 1994) and children aged from six to ten (Marsh, 1999b) obtain the greatest benefit from outdoor programmes. In contrast, other research (Gillis & Speelman, 2008; Hattie et al., 1997) focusing on participants of a variety of ages reported more significant effects for adult groups. It is unclear, therefore, whether outdoor programmes are equally beneficial both for school-aged students and for adults.

2.2.2. Environment types

The second question relates to the type of environment in which the intervention takes place. Different environments may influence learning outcomes: the biophilia hypothesis, for instance, proposes that the natural environment is more beneficial for development because people have an innate preference for nature (E. O. Wilson, 1984). Research has found that people exposed to the natural environment reported more positive benefits–improved well-being, higher self-esteem, better pro-environmental and cooperative behaviour, increased attention span, and higher levels of creativity–than was the case for the control group exposed to an urban setting (Atchley et al., 2012; Bratman et al., 2012; Grinde & Patil, 2009). Notwithstanding evidence of this sort, there has been an increasing trend towards incorporating into educational programmes adventure-oriented learning activities taking place in some form of urban environment. An example includes a challenge course in a locale constructed specifically for outdoor interventions. Two meta-analyses (Bunting & Donley, 2002; Gillis & Speelman, 2008) have reported significant effectiveness for challenge-course programmes, with effect sizes of .55 and .43 respectively. This seems to conflict somewhat with other research suggesting that urban environments may not be suitable for developmental programmes. There is a lack of clarity as to whether outdoor programmes delivered in an urban setting are as effective as those implemented in green spaces such as wilderness areas and parks.

2.2.3. Programme duration

The third question relates to whether longer programmes are more effective than shorter ones, judging in terms of the length of exposure to an outdoor education intervention. For two main reasons, there is a growing trend towards implementation of shorter outdoor programmes in schools. Firstly, long outdoor experiences reduce

the time available for curriculum focus on important skills such as reading and mathematics. Secondly, financial constraints have also contributed to the increasing prevalence in recent decades of shorter school-based programmes (lasting two or three days) (Tay, 2006). It is unclear, however, whether such pragmatic approaches to shorter outdoor programmes are indeed effective. One of the main concerns for any intervention strategy is the dose-response relationship. This is one way of studying the change in effect on an outcome caused by different levels of exposure to a stressor, e.g., in this case, an outdoor intervention (Calabrese & Baldwin, 2003). Previous research has shown that longer programmes appear to be more effective than shorter ones. These results apply to adventure programmes (Cason & Gillis, 1994), outdoor education programmes (Hattie et al., 1997), and challenge courses (Bunting & Donley, 2002; Gillis & Speelman, 2008). In an apparent contradiction of these findings, however, Barton and Pretty (2010) have shown that short dosages of outdoor activities are also effective for both self-esteem and mood outcomes. Such contradictory conclusions seem to suggest that the duration of an effective programme might differ according to outcome goals. Nevertheless, it is difficult on the strength of research to date, to draw firm conclusions regarding the relative effectiveness of shorter or longer outdoor programmes.

2.2.4. Programme types

The fourth question links to whether differences exist between types of outdoor programmes in terms of the patterns of exposure to an intervention. Some outdoor programmes are designed on the assumption that participants will be able to derive maximum benefit from round-the-clock experiences (i.e., a concentrated pattern of exposure). According to Beames (2004), overnight camps provide critical opportunities for participants to spend most of their time on outdoor learning. Those

taking part are unable, for instance, to remove themselves from fellow group members and their experiences–positive or negative. As a result, they learn how to cope better with such situations. Day programmes also exist, for which participants are not of course required to stay overnight. These programmes may be one-off experiences (one day only), or participants may repeat day visits to a location in order to engage with the programme. Given their limited time frame, these programmes are typically activity-centric rather than student-centric. In other words, different programme types involve varying patterns of exposure to outdoor interventions and maybe different learning processes. One meta-analysis (Hans, 2000) reported greater effect sizes, in terms of locus of control, for mixed and residential adventure programmes than for day programmes. In view of this, we would like to clarify whether outdoor programmes taking place overnight are indeed more effective than day programmes.

2.2.5. Service providers

The fifth question relates to whether there are differences between different service providers of outdoor programmes. Outward Bound[8] is a key provider within the outdoor industry and there has always been high regard for the outdoor programmes offered by this organisation. A number of research projects (Hattie et al., 1997; McKenzie, 2000) supporting the effectiveness of these programmes have been carried out, with Hattie et al. (1997) indicating that courses conducted by Outward Bound, specifically in Australia, are more effective than those of other providers. Such research suggests that the particular approach taken by Outward Bound may play a crucial role in enhancing the effectiveness of outdoor programmes. It is

[8] An international organisation that offers a range of outdoor education programmes.

possible, however, that existing research has failed to take fully into account distinctive features of Outward Bound programmes that may explain some of their positive outcomes. Unlike many participants in school-organised outdoor programmes, those who take part in Outward Bound programmes are often self-selected. Such characteristics may influence these participants' capacity to perform better than their counterparts in the control group who had no exposure to outdoor programmes. Nevertheless, the Outward Bound success story has encouraged an increase in various outdoor programmes on the part of non-Outward Bound providers. In a pragmatic attempt to make outdoor education programmes more affordable and accessible, schools may either organise these programmes internally for their students or outsource the teaching involved to service providers other than Outward Bound. Given that prior research has focussed largely on Outward Bound programmes, little is apparently known about non-Outward Bound programme effects. It is crucial to understand whether, Outward Bound aside, the favourable effects of outdoor activities extend to alternative types of programme offered by outdoor providers or schools. In other words, does it truly matter who the provider of the outdoor programme is?

2.2.6. Culture

The final question relates to cultural relevance. When linking outdoor activities to other psychological constructs, outdoor education researchers and practitioners have apparently neglected the question of whether outdoor education is equally successful in all cultures, or whether the targets for assessment of effectiveness are of equal relevance everywhere (Purdie & Neill, 1999). The theory and pedagogy of outdoor education programmes originated in Europe (Higgins, 2002). When the influence of outdoor education and its benefits was extended to non-Western participants, the effects of outdoor activities were assumed to be the same the

world over. Such an assumption contradicts the experimental evidence that has demonstrated cross-cultural variability in psychological constructs such as achievement motivation (Dekker & Fischer, 2008) and self-esteem (Schmitt et al., 2007; for optimism, see Fischer & Chalmers, 2008). In short, the interpretation of results may vary across cultures. These findings suggest that outdoor programmes adopted from Western pedagogy and designed to influence attributes in Western students may fail to impact on Asian students in a similar way.

Cross-cultural variability across outdoor programmes may then exist for participants of different cultural backgrounds. Purdie and Neill (1999), for example, studied the impact of an Australian outdoor education programme on the self-concepts held by visiting Japanese students. They found no improvement in self-concept for these students when they were compared to their control group peers in Japan. This finding suggests that there were no programme effects for these Japanese students. It is also possible that non-outdoor activities would have been equally helpful for them, or even that the measures used to assess effectiveness were culturally irrelevant or inappropriate. For all that, there has been little discussion to date of the effects these Western-influenced outdoor programmes have for Asian participants. Furthermore, none of the previous meta-analyses have examined the cross-cultural variations within outdoor programmes in different countries, and most data collected has been based on Western outdoor education programmes (Bowen & Neill, 2013; Gillis & Speelman, 2008; Hans, 2000; Hattie et al., 1997; Staunton, 2003; S. J. Wilson & Lipsey, 2000). The apparent success of such programmes, however, has resulted in their replication by Asian countries seeking to gain similar psychological benefits for their own students. The trends towards greater use of outdoor education in Asian societies, and the concerns arising from cross-cultural

variability, suggest a need for further investigation into whether cross-cultural variability exists across programmes in Asian, as opposed to non-Asian, countries.

2.2.7. Aims

The current meta-analysis has two main objectives. The first and most important one is to examine the degree of effectiveness of these outdoor programmes, in particular by summarising studies that have used control groups to examine the effectiveness of outdoor education programmes. While pre-test–post-test comparisons have been useful in examining changes over time, it remains unknown whether any change occurring is the result of intervention. One challenge is to determine whether the positive change is due to outdoor intervention, natural maturation, or simply to a factor such as retest familiarity. Additionally, participants' dropping out may lead to a higher post-test score because those participants remaining are more successful and persistent. The inclusion of a control group, on the other hand, ensures a level of certainty that the observed effects are indeed the consequence of outdoor programmes (S. J. Wilson & Lipsey, 2000). This study will include both pre-test–post-test and control group comparisons as part of the meta-analysis.

The second aim of this study is to explore six potential moderating factors to determine the generalisability of findings about outdoor programmes. Do factors such as programme duration, programme type, or a particular environment affect personal, cognitive, attitudinal, and behavioural outcomes? As outlined above, we have identified a number of potential moderator variables that require greater attention. Our investigation is motivated by the current lack of comprehensive reviews of the pragmatic considerations faced by schools when designing appropriate outdoor programmes. Since publication of the findings of Hattie et al. (1997), many new evaluative studies of outdoor education programmes have become available, and the

call for schools to implement such programmes has intensified. A systematic review of the new evidence since the seminal meta-analysis provides insights to inform future research designs and pedagogical practices for outdoor education–identification of the appropriate dose level for effective outdoor programmes, for instance.

2.3. Method

2.3.1. Literature search

We used four strategies to systematically locate all relevant and eligible studies: (1) an extensive search using various databases, (2) a review of the bibliographies relating to previous meta-analyses, (3) a review of references in research studies, and (4) email requests for related sources. Potentially eligible studies were found in the University library and through Google Scholar, obtained via interlibrary loans, or requested directly from the authors. Searches for publications were conducted during 2012. To maximise the number of relevant studies found, we used broad search terms such as "outdoor education", "adventure education", "outdoor recreation", and "outdoor adventure" within the fields "title" or "keywords" when searching in databases. Despite the large number of irrelevant results or qualitative studies, we systematically examined the list and selected the studies using the following exclusion criteria:

1. Articles that were used as meta-analytical data in Hattie et al. (1997).
2. Outdoor sports programmes (such as football), or camps that did not involve any elements of outdoor activities.
3. Results for outcome measures that were presented in qualitative prose or that did not permit any computation or reasonable estimation of an effect size (e.g., standardised mean difference).

Using guidelines based on Lipsey and Wilson (2001), each study was coded for means and SDs of various outcome scores. All longitudinal and experimental designs were included that provided sufficient information to calculate a standardised mean difference between at least two points in time or between experimental and control groups. These studies involved intervention programmes that primarily used outdoor activities for educational, psychological, and behavioural therapeutic purposes. Extra care was also taken to avoid duplicated samples.

2.3.2. Computation of effect size

All effect sizes were calculated as the standardised mean gain (*d*), representing pre-post contrasts in which a variable is more than once compared over time on the same sample, and randomised trials with control group contrasts in which groups are compared across a single variable (Lipsey & Wilson, 2001). For pre-post contrasts, *d* was calculated from the means at Time 1 and Time 2, mean gained scores, pooled standard deviation of Time 1 and Time 2 scores, standard deviation of gain scores, common sample size at both times, and correlation between Time 1 and Time 2 scores. For group contrasts, *d* was calculated from the means for Group 1 and Group 2, group size for Group 1 and Group 2, and the pooled standard deviation of Group 1 and Group 2 scores. We used the formulas provided in Lipsey and Wilson (2001) to obtain the calculations.

2.3.3. Coding the studies

For this paper, every study reviewed was coded for the following descriptive variables: (a) participant profile (e.g., primary school students, secondary school students, university students, working adults, delinquent, medical condition, army, general), (b) environment types (e.g., green spaces, challenge course setting, a

mixture of both), (c) length of programme, (d) types of programme (e.g., day, residential, expedition), (e) service providers (e.g., school-run, university, outdoor education centres, Outward Bound, others), (f) country where the programme took place (Asian or non-Asian), (g) publication type (e.g., journal article, other), and (h) experimental design (e.g., control, no control group).

2.3.4. Data analysis procedure

In this paper, most mean effect sizes were assessed based on two sets of guidelines for *d*. According to Cohen (1992), an effect size of less than or equal to 0.20 is small, 0.50 medium, and more than or equal to 0.80 large. Wolf (1986) also states that an effect size of .25 is educationally significant while that of .50 is practically significant for therapeutic purposes. For various outdoor variables, we conducted separate analyses to investigate the effect outdoor programmes have on each outcome. Using the random effects ANOVAs analysis, we examined whether the moderators influence the effectiveness of the outdoor programmes (see Lipsey & Wilson, 2001).

2.3.5. Outcome variables

We categorised fifteen outcome variables into four outcome clusters: self, life effectiveness, affect/well-being and group. There are two outcome variables in the self cluster: (a) self-esteem such as self-reported measures of self-esteem, self-perception, self-description, and self-satisfaction; and (b) self-efficacy such as various measures of general self-efficacy, and different self-efficacy scales related to outdoor adventure. The life effectiveness cluster uses most subjective measures from the life effectiveness questionnaire (LEQ) such as leadership, social competence, self-concept, time management, achievement motivation, emotional control, active

initiative, self-confidence, and LEQ total score. The affect/well-being cluster is reflected in mood and well-being scales, which assess positive affect and ratings of happiness, vigour, success, general well-being, and satisfaction, as well as negative affect and ratings of anxiety, depression, distress, etc. Finally, the group cluster included team cohesiveness measures (e.g., subjective measures of group cohesion, group effectiveness, team performance, trust, group behaviour, and teamwork) and interpersonal measures relating to communication, self-perception, self-efficacy, personality, interdependence, interpersonal relationships, etc.

2.4. Results

2.4.1. The effectiveness of outdoor programmes

To examine the degree of effectiveness of outdoor programmes, we conducted two meta-analyses by calculating differences in various self, well-being and group indicators for (a) experimental versus control groups in 32 experimental studies (39 samples), and (b) pre-post-outdoor programmes in all 66 longitudinal studies with 91 samples. First, we calculated, within every study, effect sizes *d* for every outcome variable in that study. In total, 15 outcome variables were studied which summed to 15 effect sizes.

For experimental studies (see Table 4), only six significantly positive effect sizes (improvement in outcomes) were reported. All these positive effect sizes were small to medium (ranging from .12 to .59). According to Wolf (1986), four of the sizes were educationally significant, as they were greater than .25. The overall mean *d* across all 39 studies was +.26, indicating a small positive outdoor programme effect.

Table 4

Outdoor Programme vs Control Group Comparison: Overall Effectiveness

Outcome construct	Weighted Mean ES[a]	N_c	N_e	95% CI		Q	k
				Lower	Upper		
Self							
Self-esteem	.24**	514	548	.06	.41	114.11***	22
Self-efficacy	-.33	204	160	-.95	.30	58.10***	4
Life Effectiveness Questionnaire (LEQ)							
Task Leadership	.39**	508	356	.11	.66	59.48***	6
Social Competence	.36**	583	438	.15	.58	79.56***	12
Self-concept	.27	1020	988	-.22	.75	108.28***	5
Time Management	.12	481	315	-.29	.54	113.15***	5
Achievement	.12*	179	206	.01	.24	.40	2
Emotional Control	.54*	346	272	.12	.95	39.09**	3
Active Initiative	.40	346	272	-.06	.82	47.55***	3
Self-confidence	.09	369	312	-.32	.51	94.09***	6
LEQ Total	.28	481	315	-.01	.57	55.19***	5
Affect/Well-being							
Positive	.59	137	119	-.31	1.49	52.53***	3
Negative	.08	295	352	-.25	.41	81.48***	9
Group outcomes							
Team Cohesiveness	.59*	561	281	.16	1.01	214.36***	9
Interpersonal	.39	122	114	-.25	1.04	48.83***	4
Total Mean *d*	.26***			.12	.40	523.23***	39

* p <.05, ** p <.01, *** p <.001

[a] Weighted mean effect size was standardised mean gain.

N_c: Control sample size; N_e: Experimental sample size

Table 5

Longitudinal Pre-Post-Test Comparisons: Overall Effectiveness

Outcome construct		Weighted Mean ES[a]	*N*	95% CI		Q	*k*
				Lower	Upper		
Self							
Self-esteem	Post	.20**	1208	.06	.35	201.64***	26
	Follow up	-.07		-.19	.04	12.95	10
Self-efficacy	Post	.25	431	-.04	.53	106.47***	11
	Follow up	.45		-.19	1.09	73.29***	4
Life Effectiveness Questionnaire (LEQ)							
Task Leadership	Post	.46***	3299	.34	.59	233.72***	18
	Follow up	.07		-.06	.21	40.99***	7
Social Competence	Post	.39***	2619	.24	.53	235.08***	18
	Follow up	-.16*		-.33	-.00	53.23***	7
Self-concept	Post	.11	1307	-.53	.75	1037.25***	12
	Follow up	-					
Time Management	Post	.47***	2406	.32	.62	151.81***	13
	Follow up	-.13		-.30	.04	45.90***	6
Achievement Motivation	Post	.36***	2251	.20	.51	120.62***	9
	Follow up	-.16*		-.29	-.02	17.35***	4
Emotional Control	Post	.45***	2427	.29	.61	150.58***	10
	Follow up	-.13***		-.20	-.07	10.03	7
Active Initiative	Post	.37***	2104	.25	.48	42.54***	7
	Follow up	-.11**		-.19	-.03	8.31	5
Self-confidence	Post	.37***	2421	.20	.53	237.26***	15
	Follow up	-.16*		-.28	-.03	18.88***	5
LEQ Total	Post	.59***	2512	.43	.75	217.15***	16
	Follow up	-.14		-.29	.00	44.40***	7
Affect/Well-being							
Positive	Post	.06	665	-.16	.27	68.11***	8
	Follow up	.35***		.18	.52	2.92	2
Negative	Post	-.46***	1045	-.64	-.28	205.48***	23
	Follow up	.43		-.07	.94	124.38***	6
Group outcomes							
Team Cohesiveness	Post	.65***	2243	.37	.93	625.34***	20
	Follow up	-.11		-.34	.13	12.58**	4
Interpersonal	Post	.52***	393	.23	.82	81.08***	10
	Follow up	.30		-.07	.68	3.26	2
Total Mean *d*	Post	.41***	7881	.29	.53	2369.16***	82
	Follow up	-.06					

* $p < .05$, ** $p < .01$, *** $p < .001$

[a] Weighted mean effect size was standardised mean gain.

Table 5 shows the 15 effect sizes for the longitudinal studies; twelve were significantly positive (improvement in outcomes). Of these positive effect sizes, one was small (mean $d = .20$) and 11 were medium (ranging from .36 to .65). According to Wolf (1986) these medium effect sizes were educationally significant, as they were greater than .25. The overall mean *d* across all studies was +.41, indicating a moderate positive outdoor programme effect (similar to Hattie et al., 1997).

We then conducted an analysis for the homogenous outcome categories of self, life effectiveness, affect/well-being and group. For differences between experimental and control groups, the average *d* for the category self was -.05, indicating a small outdoor programme effect. With respect to the life effectiveness outcomes, the average effect size was .29, indicating a small effect. Next, a small average effect size ($d = .26$) was found for the category affect/well-being. Finally, the category group outcomes reported a small average effect size of .49. On the other hand, for the pre-post-outdoor programme difference, the average *d* for the category self was .23, indicating a small outdoor programme effect. With regard to the life effectiveness outcomes, the average effect size was .40, indicating a small effect. A small average effect size ($d = .26$) was then found for the category affect/well-being. Finally, the category group outcomes reported a medium average effect size of .59.

2.4.2. Do the outdoor programme effects last?

Using studies that compared the post-programme and follow-up test after the end of the programme, we found six significant effect sizes. The five negative effect sizes were small and the one positive effect size was medium. In comparison with the post-programme effect sizes, the five outcome effects decreased after the programme. Only positive affect/well-being improved after the programme ended. The overall mean *d* across all studies was -.06, indicating a small fade-out effect. Again, we conducted

an analysis for the homogenous outcome categories of self, life effectiveness, affect/well-being and group outcomes. All four effect sizes were small: self (d = .19), life effectiveness (d = -.04), affect/well-being (small/ medium) (d = -.04) and group outcomes (d = .10).

2.4.3. Moderators on outdoor programme effect

2.4.3.1. Participant groups

Here, we reported significant differences in effect sizes between different groups of participants during outdoor programmes. For experimental studies (Q (4) =11.16, p = .02), the effect sizes for the working adults were the greatest, followed by those of school students (Table 6). For longitudinal studies (Q (7) = 30.42, p < .001), effect sizes for the army participants were the greatest, followed by those of primary school students, working adults, participants with a medical condition, and secondary and university students (Table 7). As there was little information about the ages of the participants, these categories suggest that outdoor programmes are most meaningful for working adults and young participants.

Table 6

Outdoor Programme vs Control Group Comparison: Moderating Effects for Participant Groups.

Moderator	*k*	Weighted Mean ES	95% CI		Q
			Lower	Upper	
School students	12	.35**	.14	.55	15.65
University students	14	.15	-.05	.34	14.69
Working adults	2	1.06***	.52	1.60	1.25
Delinquent	7	.06	-.14	.46	4.61
Medical condition	4	.16	-.20	.51	3.12

* p <.05, ** p <.01, *** p <.001

Table 7

Longitudinal Pre-Post-Test Comparisons: Moderating Effects for Participant Groups.

Moderator	*k*	Weighted Mean ES	95% CI		Q
			Lower	Upper	
Primary students	3	1.29***	.73	1.85	23.50***
Secondary students	18	.43***	.22	.64	18.19
University students	26	.24*	.05	.42	15.37
Working adults	7	.68***	.30	1.06	7.89
Delinquent	7	.25	-.11	.62	2.19
Medical condition	4	.53*	.06	.99	2.85
General	13	.22	-.05	.48	14.35
Army	2	1.52***	.88	2.15	.75

* p <.05, ** p <.01, *** p <.001

2.4.3.2. *Environment types*

Little information was provided regarding the location of the programmes held, other than that they took place at a challenge course site, in green spaces such as an expanse of wilderness or a recreational park, or in an area that was both residential and green. For the experimental studies, the Q statistic for the regression model was .34 and not statistically significant, Q (2) = .34, p = .84. For the longitudinal studies, the Q statistic for the regression model was 5.79 and near-significant, Q (2) = 5.79, p = .06. In short, the types of environment where the programmes were held did not moderate the effects for outdoor programmes.

2.4.3.3. *Programme duration*

The length of the programme varies from courses of a single session within a day to semester courses of more than 20 days. We did not find any significant difference between programme durations in our two studies. The Q statistic for the regression model of the experimental studies was .26 (Q (3) = .26, p = .97), while the Q statistic for the regression model of the longitudinal studies was 1.30 (Q (3) = 1.30, p = .73).

2.4.3.4. Programme types

Programme type was coded into day programme, overnight programme based in a residential centre, and journey-based overnight programmes taking the form of an expedition. No significant difference was reported between the different programme types in the two meta-analyses. The *Q* statistic for the regression model of the experimental studies was 1.54 (Q (2) = 1.54, p = .46), while the *Q* statistic for the regression model of the longitudinal studies was .45 (Q (2) = .45, p = .80).

2.4.3.5. Service providers

For the longitudinal studies, significant differences were reported between different service providers for outdoor education programmes in Table 8 (Q (4) = 10.12, p=.04). School-run programmes were found to be the most effective, followed by other service providers (which included therapeutic services) and Outdoor Education centres excluding Outward Bound programmes. The effects of Outward Bound courses were not found to be significant in this study. Nevertheless, there is an overlap between the confidence intervals for both Outdoor Education centres and Outward Bound programmes.

Table 8

Longitudinal Pre-Post-Test Comparisons: Moderating Effects for Programme Providers.

Moderator	*k*	Weighted Mean ES	95% CI		Q
			Lower	Upper	
Outdoor education centre	13	.47**	.18	.75	7.87
University	21	.21	-.01	.43	11.64
School	10	.74***	.42	1.06	36.54***
Others (including therapy)	25	.52***	.31	.72	22.14
Outward Bound	13	.23	-.05	.50	9.86

* p <.05, ** p <.01, *** p <.001

Table 9 reported significant differences for the effect sizes of the experimental studies (Q (3) =8.12, p = .04). The Outdoor Education centres reported the greatest effect size, followed by school-run programmes.

Table 9

Outdoor Programme vs Control Group Comparison: Moderating Effects for Programme Providers.

Moderator	*k*	Weighted Mean ES	95% CI Lower	95% CI Upper	Q
Outdoor education centre	7	.63***	.34	.91	8.05
University	12	.15	-.07	.37	13.58
School	8	.30*	.05	.55	11.44
Others (including therapy)	11	.16	-.07	.39	5.57

* p <.05, ** p <.01, *** p <.001

2.4.3.6. Culture

This paper is the first to include a number of studies outside the United States and Australia. We categorised the countries as either Asian or non-Asian. The latter group included Australia, Canada, Germany, Israel (geographically, though not perhaps culturally, a part of Asia), New Zealand, South Africa, Sweden, the United Kingdom, and the United States. Asian countries included China, Malaysia, Singapore, and Taiwan. In Table 10, we reported significant effect size differences between both groups of countries (Q (1) =5.61, p = .018). Asian countries gained greater effects than their non-Asian counterparts.

Table 10

Longitudinal Pre-Post-Test Comparisons: Moderating Effects for Culture.

Moderator	*k*	Weighted Mean ES	95% CI		Q
			Lower	Upper	
Asian countries	8	.81***	.46	1.16	7.99
Non-Asian countries	74	.36***	.24	.48	82.44

* p <.05, ** p <.01, *** p <.001

2.4.3.7. Other moderator variables

We further examined two alternative explanations relating to research technicality (publication type and research design) which may influence the effects of outdoor programmes. 'Publication type' refers to studies that were published in peer-reviewed journals, as opposed to studies reported as forming part of dissertations, reports, book chapters, and proceedings. 'Research design' compares studies with research design with and without a control group. Our analyses revealed that neither moderator influenced the reported effects of outdoor programmes. The *Q* statistic for publication type was .07 (Q (1) = .07, p = .80), while the *Q* statistic for research design was .04 (Q (1) = .04, p = .85). In short, the effect sizes are not related to either research design or quality of the study.

2.5. Discussion

The main objective of this paper has been to determine whether outdoor education programmes are an effective learning method for school students and to examine six moderating factors that may influence the effectiveness of outdoor programmes. Summarizing both experimental studies that included a control group and longitudinal pre-post comparisons, we found positive effects on personal and social outcomes after an outdoor intervention. These developmental gains, however,

may fade out over time. We have also found three factors that may be manipulated in educational settings to optimise these effects.

2.5.1. Beneficial effects of outdoor activities

Participation in outdoor activities substantially improved our personal and social outcomes. In this paper, both types of studies (longitudinal and experimental) consistently showed the beneficial effects of outdoor activities. The average *d* was +.41 for longitudinal studies, and the average *d* +.26 for experimental studies; indicating that the measured outcomes for both studies improved following an outdoor programme. This was similar to the *ES* of .38 reported by Hattie et al. (1997), even though there is no overlap in the studies used to calculate both effect sizes. This suggests that outdoor programmes are effective in improving personal and social outcomes.

For both meta-analyses, we found consistent effects regarding the variables most likely to be affected by outdoor activities. Outdoor programmes were most effective in facilitating development of interpersonal skills, followed by life effectiveness skills, then by affect/well-being. They were least effective, on the other hand, for personal outcomes relating to self-efficacy and self-esteem. Typical outdoor programmes involve group participation and are designed to impact on how participants think and behave in a group setting, for example. In attempting to achieve the group goals, individuals develop personal skills in social settings. Furthermore, and in accordance with the perspectives by Ulrich et al. (1991), who posited that exposure to natural surroundings will result in stress reduction and more positive well-being status, a significant effect size, albeit small, was reported for affect/well-being outcomes (see also Barton & Pretty, 2010). This paper has also found the weakest effects for self-related indicators: self-esteem was the only variable with a

significant effect size. This means that one's evaluation of self-worth seems to improve slightly immediately after outdoor participation. Overcoming personal challenges outside one's comfort zone (i.e., completing physically demanding activities with a group of strangers in unfamiliar natural surroundings) may increase one's self-esteem immediately after the experience.

In short, as our data showed, the effect from outdoor activities was more prominent for social outcomes that linked to the core concept of social interactions. By comparing the effectiveness of the various outcomes, our research provides a new avenue for establishing the hierarchy of potential process variables; and it is our hope that future research will explore some variables as possible mediating mechanisms to account for the effects of outdoor activities.

2.5.2. Temporary as opposed to lasting effects

There was evidence that beneficial effects did not last after the end of the outdoor programmes. The average *d* was -.06. This contrasts with Hattie et al.'s (1997) findings that the effects of outdoor activities lasted up to 18 months after Outward Bound expedition programmes. While the reasons why our data fails to replicate Hattie et al. (1997) are unclear, our fade-out effects appear reasonable. Firstly, our results are similar to the fade-out effects reported for the impact of a vacation on health and well-being (de Bloom et al., 2009). Applying this to the effects of outdoor activities, going away on a vacation may be analogous to participating in outdoor activities for a limited period of time. In both situations, participants are freed from daily routines, co-workers, and duties for the duration of the outdoor programme or the vacation. At the end of the programme they feel rejuvenated (as is evident from their improved state of well-being) but when they return to their busy daily lives, the positive effects gained from the programme begin to disappear. Future research might

investigate the factors that would prolong the effects of outdoor activities and delay the fading effect.

2.5.3. Differential effects by moderators

The answer to our question about the factors that may be manipulated in educational settings in order to enhance the effectiveness of outdoor interventions depends on who the participants are, the cultural background of the studies, and the programme organiser. Programme characteristics do not seem to play a role here, however.

Groups vary systematically in terms of whether they might benefit from outdoor education programmes. For both meta-analyses, outdoor programmes were more effective for adults and school students than for other groups. This finding echoes evidence from previous meta-analyses indicating that outdoor programmes were beneficial for older (Hattie et al., 1997; Laidlaw, 2000) as well as younger (Cason & Gillis, 1994; Marsh, 1999b) participants. Reviewing outdoor programmes in general, we found them to be most beneficial for working adults and for students in both primary and secondary schools.

Our study found culture to be an important determinant of the outcomes of outdoor activities. This suggests the beneficial effects of outdoor activities have greater impact for Asian collectivistic societies than for Western countries, which tend to be essentially individualistic. Cross-cultural variability exists and this needs more careful attention in the future. As mentioned earlier, most outdoor programmes are socially-oriented. While individualists are assumed to value the approach of employing social interactions for self-enhancement, those with a collectivist orientation may benefit most, in terms of developing interpersonal skills, from social contact in the outdoors. It is likely, for example, that collectivists will view any

development on their part resulting from social interactions in the outdoors as more valuable than their individualistic counterparts will do. This is an important area for further research.

The programme organiser or service provider appears to play a key role, furthermore, in the delivery of effective outdoor programmes. According to our data, both outdoor education centres and school-organised outdoor programmes were most effective. This finding contradicts Hattie et al.'s (1997) speculation regarding the ineffectiveness of school-organised programmes, as these are usually considered to be shorter in duration and to consist of non-challenging activities outside the classroom. Working from the premise, however, that these outdoor programmes are developed and run by school staff, the teachers involved will be in all likelihood more familiar with the students' learning capabilities and needs than would be the case for an outsider. They are therefore better equipped to design a student-centric outdoor programme to meet the needs of the student participants. During the programme, these teachers are able to stretch their students' comfort zone and challenge them appropriately on the basis of the students' existing knowledge and skills. At the end of the programme, these teachers have greater opportunities to facilitate the transfer of outcomes learned to the students' day-to-day lives.

Importantly, we did not find evidence that programme characteristics matter. Although previous research suggested that shorter programmes are less effective (e.g., Hattie et al. 1997), our data did not report any effects resulting from the length of programme. Even short outdoor exposures appear to be beneficial. No differential effects for the types of programme and environment were reported. Participants benefitted from day, residential, and expedition programmes, and both challenge course settings and green spaces seem to work well for facilitating effective outdoor

programmes. It is possible that different programme characteristics are specifically customised by educators to achieve different programme goals or outcomes. As a result, each factor may play an equally important role in enhancing the effectiveness of specific outdoor programmes, depending on the purpose of the programme.

Our paper has provided evidence that learning through outdoor activities is an effective approach, particularly for teaching social skills to school students. This is in contrast with the procedures followed in impartment-acquisition of traditional subjects, which mainly focus on mastery of specific academic goals. Outdoor education programmes appear therefore to complement academic learning and to provide students with a more holistic educational development.

2.5.4. Implications for educators

Our first recommendation is that children need to be exposed to outdoor education at a young age. Our data suggests that the sooner children receive exposure to outdoor learning, the more beneficial it will be for their development. This finding is consistent with that of Marsh (1997) regarding the benefits of outdoor programmes for younger students aged seven to twelve. In Singapore, educational initiatives such as the Programme for Active Learning were pioneered to teach outdoor education to primary students aged seven to eight (Ministry of Education Singapore, 2010). Although such initiatives are in keeping with our findings, we would go a step further and suggest the introduction of outdoor education or activities in early childhood education to pre-schools and childcare centres. In fact, the forest school movement has integrated teaching of outdoor education for early childhood education in several European countries and in the United States (David, 2013). Such early engagement with nature would help these children to feel comfortable learning in the outdoors (Schäffer & Kistemann, 2012) and would possibly provide a head start in outdoor

skills. This may also allow the learners more opportunities for an in-depth engagement with nature in their later learning years. Future studies should examine whether outdoor knowledge gained in early childhood might, in turn, enhance the effectiveness of outdoor programmes during primary school and beyond. The influence of outdoor learning as evidenced in the home environment, away from school, would be a further possible area for researchers to investigate. We therefore recommend that from a very young age, children should be exposed to outdoor activities in both the school and home environments, in order to enhance their learning.

We emphasise the importance of schools taking primary responsibility in delivery of outdoor education programmes. It is possible for school educators to play a key role in delivering effective outdoor education programmes because they are equipped with a depth of pedagogical knowledge and experience that would enable them to do so successfully. Moreover, they will know their students well enough to customise outdoor education programmes to meet the needs of the young people with whom they are working. Upon completion of the programme, they are also able to follow up on their students' outdoor learning during regular lesson time. In contrast, other outdoor service providers may lack such pedagogical expertise and opportunities, despite their in-depth knowledge of outdoor activities. Outdoor service providers are often criticised, indeed, for focussing programmes on participation in the activities themselves rather than on achievement of learning goals (Ho, 2011). To build their own capacity to provide a wider range of outdoor education programmes, schools need to enhance teachers' professional training and development in pedagogical skills relating to outdoor education, and to increase their competency in outdoor activities. We recommend that instead of relying on outdoor service

providers, school educators take the same responsibility for the design and delivery of regular outdoor education programmes that they do for all other teaching subjects.

2.6. Conclusion

The overall picture that emerges from this paper is that what matters most is the point at which one starts learning in the outdoors, not the length of a session. If they have not already done so, schools could consider integration of outdoor education programmes into their existing curriculum. This approach complements the traditional curriculum by developing socio-emotional outcomes, especially social skills, but the positive effects resulting from exposure to the outdoors are not necessarily of lengthy duration. To sustain these learning outcomes, we advocate regular outdoor education lessons instead of the one-off experience currently favoured. Such an outdoor approach might be extended to early childhood education, as younger children are likely to benefit the most from it. Furthermore, there appear to be cultural differences that may influence effectiveness, and that needs further investigation. We hope that the present study will stimulate educators to capitalise on their outdoor teaching strategies and resources. Similarly, researchers will hopefully be motivated to further explore this niche learning approach in existing educational settings.

CHAPTER 3. STUDIES 2 and 3

"I would feel more optimistic about a bright future for man if he spent less time proving he can outwit Nature and more time tasting her sweetness and respecting her seniority."

Elwyn Brooks White

Are nature lovers more innovative? The relationship between connectedness with nature and cognitive styles.

The following article has been published in the *Journal of Environmental Psychology*. The version that appears here is the one accepted after review, but with minor formatting changes for consistency with the rest of this thesis. The questionnaires used in the studies are provided in Appendices B and C. References for this article can be found within the consolidated list in the *References* section.

There are two studies (namely, Studies 2 and 3, for the purposes of this thesis) described in this chapter. It is important to note that Study 3 is described in both Chapter Three and Chapter Four to fit the research objectives for the published article. The data for Study 3 was collected at two separate times (see section 4.3.1.3 in Chapter Four for more information). The survey data for various scales used in this chapter was collected at Time 1.

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3.1. Abstract

This paper tests whether people's sense of connectedness with the natural environment is related to cognitive styles such as Kirton's adaption-innovation (KAI), and analytic-holistic thinking (AHT). We conducted two studies with Singaporean secondary students as participants. In this chapter, Study 2 (N = 138), using an online survey, established the significant positive relationship between the Nature Relatedness Self Subscale and both the KAI and the AHT cognitive styles. Study 3 (N = 185), using pen and paper surveys, replicated Study 2's findings and found that connectedness with nature was significantly related to both the KAI and the AHT cognitive styles beyond alternative explanations (demographic and well-being status). Students who were more connected with nature preferred innovative and holistic cognitive styles, while controlling for their general emotional status and well-being. These findings are the first to establish the link between connectedness with nature and cognitive styles. Future research and implications are discussed.

Keywords: connectedness with nature, nature relatedness, cognitive styles, innovative thinking, analytic-holistic thinking, well-being

3.2. Introduction

Does being connected with the natural environment influence us, particularly in the way we think? According to Atchley et al. (2012), the environment plays an important role in the way people think, feel and behave. Creativity has been shown to be related to both the natural environment (Ma, 2009), and participation in nature-related activities (Atchley et al., 2012). Until now, however, no research has investigated the relationship between connectedness with nature and cognitive styles. Generally, studies on connectedness with nature have focussed on its effects in two key areas, namely environmental behaviour (Mayer & Frantz, 2004; Nisbet et al.,

2009) and the ways we feel, such as our positive affect (Nisbet & Zelenski, 2011; Nisbet et al., 2011), and our level of vitality (Cervinka et al., 2012; Nisbet et al., 2011). Extending this line of research, we test whether connectedness with nature is associated with cognitive variables, specifically thinking styles. While tests have been carried out for participants from Western cultures, neither Connectedness to Nature nor Nature Relatedness scales have been examined, to the best of our knowledge, in any study within Asia. This paper is the first study to (1) examine the connectedness with nature measures among Singaporean students, and (2) examine the relationship between connectedness with nature and thinking styles; in particular, adaption-innovation and analytic-holistic thinking styles.

3.2.1. Connectedness with nature

The renowned ecologist Leopold (1949) advocated the idea of a relationship between humans and the land they inhabited. The biophilia hypothesis (E. O. Wilson, 1984) similarly proposed that humans have an intrinsic need to be connected to the natural environment and may benefit from this exposure to nature. Building on this theoretical idea of connection with nature, Mayer and Frantz (2004) developed a one-dimensional scale named the Connectedness to Nature Scale (CNS). This scale is supposed to measure an individual's trait level of affective connectedness with the natural environment. Mayer and Frantz (2004) found that individuals who felt a greater connection with nature were more likely to feel satisfied with their lives. A recent study, however, suggested that CNS does not measure the affective aspect of connectedness with nature, but is rather a measurement of cognitive beliefs (Perrin & Benassi, 2009). Clarifying the distinction between the affective and cognitive aspects of CNS is beyond the scope of this paper, so CNS will be employed as the measurement of one's general connectedness with nature. Additionally, although CNS

was reported by Mayer and Frantz (2004) to be a reliable scale, it lacks a comprehensive approach to measurement of a holistic connection with nature; failing, for example, to describe people's physical connection with nature (Nisbet et al., 2009).

To enable a more comprehensive understanding of people's connection with the natural world, Nisbet et al. (2009) developed a new construct, nature relatedness (NR), as an inclusive measure of the individual's level of connection with nature. There are three aspects of the nature-related attribute: (1) NR-self is supposed to capture the affective connection with nature through thoughts and feelings; (2) NR-perspective represents the cognitive connection relating to the impact of human actions on the natural world; and (3) NR-experience denotes a physical connection to nature via people's comfort and familiarity level and their physical desire to be in the natural world. This scale was found to correlate with environmental behaviours such as spending more time in nature, and personality measures such as openness to experience (Nisbet et al., 2009). In order to provide a more complete insight into the effects of connectedness with nature, this paper examines both Connectedness to Nature and Nature Relatedness scales.

3.2.2. Connectedness with nature and cognitive styles

Are cognitive styles–e.g., innovative and holistic thinking–associated with connectedness with nature? Previous research has established the link between cognitions like creativity and personality traits such as openness to experience (George & Zhou, 2001), with the trait of openness to experience associated in turn with connectedness with nature (Nisbet et al., 2009). These findings suggest that cognitive styles may be related to connectedness with nature. To date, however, little research has studied the effects of connectedness with nature on cognitive functioning

in general or cognitive styles in particular. Atchley et al. (2012) found that after three days of hiking in nature, Outward Bound participants scored 50% better in creative performance than a control group of participants assessed before they embarked on a similar hike. This was the first study to establish the effects of nature exposure on creative performance, and supports E. O. Wilson's (1984) proposition of beneficial effects when exposed to the natural environment. Because exposure to nature is associated with connectedness with nature (Mayer et al., 2009) and boosts cognitive benefits as well, we propose that connectedness with nature may also be related to our cognitive styles. We test this idea therefore by systematically studying the relationship between cognitive styles and measures of connectedness with nature.

3.2.3. Connectedness with nature and adaption-innovation thinking

On the basis of Atchley et al.'s (2012) findings, we propose that creative thinking style may be related to connectedness with nature. According to Csikszentmihalyi (1996), nature experiences commonly serve to nurture creativity. For example, engaging in outdoor activities has been used in Singapore as a potential intervention to foster innovative and creative thinking skills thought to be lacking in students (Gassner & Russell, 2008; Lim, 2012). As increased creativity is often associated with innovative thinking (Isaksen & Puccio, 1988), Kirton's (1976, 1993) Adaption-Innovation Inventory (KAI) is commonly used to examine creative thinking styles. It captures a continuum where individuals with adaptive thinking preferences are placed at one end and those with innovative preferences at the other. The adaptors prefer to work within a framework of systems and aim to do things more efficiently. The innovators, by contrast, prefer to break out of the norm and do things differently. The KAI assesses whether a person's thinking tendency is geared towards adaptive or innovative thinking. Previous research reported links between KAI on the one hand,

and creative behaviour and openness to experience on the other (Ee et al., 2007). Openness to new experiences is also a trait commonly found in nature lovers (Nisbet et al., 2009). Therefore, KAI is a relevant cognitive style for investigation, as it may be linked to connectedness with nature.

The first aim of our paper is to investigate the relationship between creativity as measured by the KAI and connectedness with nature. Innovative thinkers employ divergent thinking to generate as many ideas as possible in order to create an innovative idea/product (Baer, 1993). Likewise, nature lovers try to feel or think of all possible ways to be connected with the natural environment. Mayer and Frantz (2004) argued that connectedness with nature is similar to establishing a close relationship with other people. According to the self-expansion model (Aron et al., 1991), relationship closeness involves the inclusion of others in the self, which leads to greater perspective taking (Davis, Conklin, Smith, & Luce, 1996). As nature lovers are concerned about nature, they often consider divergent nature-related issues and may engage in more perspective taking. Therefore, Mayer and Frantz (2004) considered nature as one potential focus of self-expansion.

Additionally, innovative thinkers and nature lovers share similar characteristics, i.e., openness to new experiences (Ee et al., 2007; Nisbet et al., 2009). According to Mortlock (1984), activities in nature may be regarded as outdoor adventure which symbolises a sense of adventure in the natural world. This association with adventure arises from the fact that nature may be unpredictable and challenge people's comfort zones. Venturing into the natural environment often involves physically demanding activity (e.g., trekking), risks (e.g., getting lost) as well as opportunities for uplifting experiences (e.g., viewing a beautiful sunrise from a mountain summit). To be connected with nature, therefore, people need to be open

and to embrace this sense of adventure. Similarly, innovative thinkers need to be open-minded in order to generate innovative ideas (Ee et al., 2007). On the basis of these two different lines of argument, we propose that having a sense of connectedness with nature increases people's innovative thinking style.

3.2.4. Connectedness with nature and analytic-holistic thinking

Our second aim is to examine whether connectedness with nature relates to an analytic-holistic thinking style. Traditionally, collectivistic cultures (stereotypically East Asians) are considered to be holistic, whereas an individualistic culture such as that of the United States is said to be more analytical (Nisbett, Peng, Choi, & Norenzayan, 2001). To examine this culturally influenced cognition, Choi, Koo, and Choi (2007) propose the analytic-holistic thinking (AHT) dimension, which consists of four domains (locus of attention, causal theory, perception of change and the attitude toward contradictions) and places analytic and holistic thinking on a continuum. Analytic thinking refers to a linear analysis of an object which is in isolation from any related factors. Holistic thinking, on the other hand, refers to an emphasis on the interconnectedness of interactions between objects/people and their surroundings. Choi et al. (2007) demonstrated that AHT styles differ *between* cultures (Korean versus American) and *within* cultures (students of Oriental medicine versus others). They also found that holistic thinkers displayed more holistic performance trends (considering larger amounts of information, for example) during cognitive tasks like categorisation and causal reasoning. Our proposition is that connectedness with nature also has a positive relationship with AHT.

Interconnectedness within nature and knowledge of nature are very similar to core aspects of holistic thinking. These components focus on the interactions within the natural world, such as attention to the ecosystem, relationships within the

ecosystem, and a cyclic approach to food webs and life cycles. In the life cycle of a butterfly, for example, there are four separate stages, which are distinct in appearance and functions but interrelated to form a complete cycle. The butterfly also serves another function in a larger system (i.e., an ecosystem), in that it cannot function or survive in isolation from other living things within that system. Understanding nature in its complexity requires a more holistic consideration of seemingly independent events and facts. We speculate that individuals who are connected with nature will also be more likely to consider issues in a holistic manner. The two concepts share a common foundation whereby issues are felt and thought about in a more holistic and systemic way.

3.3. Study 2

Although exposure to nature is closely linked to connectedness with nature (Mayer et al., 2009) and found to enhance cognitive skills such as creativity (Atchley et al., 2012), this is the first study to explore the relationships between connectedness with nature and cognitive styles. By investigating the relation between the two sets of constructs, we wanted to address this research gap and gain theoretical insights to set a basis for future applied research. We hypothesised that connectedness with nature would be positively correlated with both innovative and holistic cognitive styles.

3.3.1. Method

3.3.1.1. Participants and procedure

Adolescents (N = 138, 75 males, 63 females) voluntarily participated in the online survey conducted through snowball sampling. Ages ranged from 13 to 17 years (M = 14.56 years, SD = 1.03). All participants were secondary school students in Singapore; 9.4% were studying in Secondary One, 60.9% in Secondary Two, 13.7%

in Secondary Three, 14.4% in Secondary Four, and 1.4% in Secondary Five. The proportion of participants studying in the express stream was 80.4%, whereas 19.6% were in the normal stream.[9]

3.3.1.2. Measures

The *Connectedness to Nature Scale* (CNS) is a 14-item scale developed by Mayer and Frantz (2004) to measure the trait level of one's connectedness with nature. Example items include "*I often feel a sense of oneness with the natural world around me*" and "*I often feel disconnected from nature*" (reverse scored). Participants rated how strongly they agreed or disagreed with each item on a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's alpha was .83.

Nature relatedness constitutes three subscales–Nature Relatedness Self (NR-self), Nature Relatedness Perspective (NR-perspective) and Nature Relatedness Experience (NR-experience)–which measure, respectively, the affective, cognitive, and experiential aspects of people's relatedness with nature (Nisbet et al., 2009). There are 21 items which may be positively or negatively worded: an NR-self item, for example, is "*I am very aware of environmental issues*", while an example item of NR-perspective reads "*Some species are just meant to die out or become extinct*". An NR-experience example item is "*I take notice of wildlife wherever I am*". Participants scored how strongly they agreed or disagreed with each item on a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The reliabilities were .78 for NR-self, .72 for NR-perspective, and .54 for NR-experience.

[9] Singaporean students are streamed during their secondary school education according to their performance at the national primary school leaving examinations. Generally, low achieving students will study five years in the normal stream, whereas the majority will spend four years in the express stream during their secondary school education.

The *Analysis-Holism Scale* (AHS) is employed to measure analytic versus holistic thinking preference. This is a 23-item scale adapted from Choi et al. (2007). Example items include "*The whole is greater than the sum of its parts*" and "*Everything that happens in the world is predictable*" (reverse scored). Participants indicated how strongly they agreed or disagreed with each item on a 7-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A higher AHS score indicates people's preference for a holistic thinking style and a lower AHS score indicates a more analytic cognitive tendency. The overall scale was shown to be reliable ($\alpha = .71$).

The *Kirton Adaption-Innovation Inventory* (KAI), a 32-item scale, assessed whether participants' preferred creative style was more innovative or adaptive oriented (Kirton, 1976, 1993). An example item from the innovative creative end is "*is always full of ideas*" and an adaptive item example is "*conforms*". Participants scored how well each item described them on a 5-point Likert-type scale ranging from 1 (not at all like me) to 5 (just like me), which gave a possible range of 32 to 160 KAI scores. A higher KAI score indicates a more innovative preference, while a lower KAI score suggests a more adaptive preference. The KAI scale was found to be reliable ($\alpha = .94$).

3.3.2. Results

Table 11 shows all the statistically significant correlations between the two cognitive styles and connectedness to nature. KAI correlated significantly with CNS and all Nature Relatedness (NR) subscales, whereas AHS only correlated significantly with the affective connectedness with nature, CNS and NR-self.

Table 11

Descriptive Statistics and Correlations between Connectedness with Nature and Cognitive Styles.

Variable	*M*	*SD*	1	2	3	4	5
1. CNS	3.61	.52	-				
2. NR-self	3.63	.55	.72**	-			
3. NR-perspective	2.86	.79	.41**	.17	-		
4. NR-experience	3.22	.60	.45**	.56**	.03	-	
5. KAI	110.63	18.00	.68**	.63**	.38**	.35**	-
6. AHS	5.08	.49	.32**	.47**	.00	.18	.45**

Note. CNS: Connectedness to Nature Scale; NR-self: Nature Relatedness Self Subscale; NR-perspective: Nature Relatedness Perspective Subscale; NR-experience: Nature Relatedness Experience Subscale; KAI: Kirton's Adaption-Innovation Inventory; AHS: Analytic-Holistic Scale.
* p <.05, ** p <.01

Two hierarchical multiple regression analyses were used for KAI and AHS scores. Both KAI and AHS were regressed on CNS and three NR subscales, after controlling demographics. At Step 1, we added age, gender, and educational status (both level and stream). At Step 2, we entered CNS and NR subscales.

The nature predictors in Step 2 explained an additional 47.6% of the variance over and above demographic variables (ΔR^2 = .48, $\Delta F(4, 111) = 28.94$, p <.01). Of the four scales, NR-self (standardised β = .31, p < .01), NR-perspective (standardised β = .17, p < .05), and CNS (standardised β = .37, p < .01) were significant predictors of KAI. All predictors together accounted for 54.4% of the variance (R^2 = .54, $F(8, 111)$ = 16.52, p < .01) in scores for KAI.

For AHS, the nature scales together accounted for 21.0% of the variance in AHS scores (ΔR^2 = .21, $\Delta F(4, 113) = 8.82$, p < .01), after controlling the demographics. NR-self (standardised β = .42, p < .01) was the only significant predictor for AHS. All predictors together explained 32.7% of the variance (R^2 = .33, $F(8, 113) = 6.86$, p < .01).

3.3.3. Discussion

Study 2 revealed significant correlations between connectedness with nature and both innovative thinking as measured by the KAI and holistic thinking as measured by the AHS. This is the first study to establish a relationship between connectedness with nature and cognitive styles. Both the Connectedness to Nature Scale and Nature Relatedness Subscales (self and perspective) were significant predictors of KAI beyond demographic effects. In other words, innovative thinkers feel more connected with nature and have a higher sense of agency regarding the impact of humans on the natural world. The Nature Relatedness Self Subscale also emerged as a significant predictor of AHS beyond demographic effects; holistic thinkers report being more connected with nature. In sum, the Nature Relatedness Self Subscale emerged as a significant predictor for both thinking styles.

3.4. Study 3

Study 3 (in this chapter) addressed two objectives. We wanted, first, to replicate our Study 2 findings, using this time a different survey mode (pen and paper). Second, we aimed to address the question of whether connectedness with nature would predict cognitive styles beyond alternative explanations such as well-being effects. Study 2 showed that connectedness with nature was the most significant correlate and predictor of both innovative and holistic thinking styles. Previous research reported robust links between connectedness with nature and well-being (Cervinka et al., 2012; Nisbet & Zelenski, 2011; Nisbet et al., 2011), and Zhang (2008) also found significant relationships between emotions and cognitive styles. This second study therefore explores the predictive validity of connectedness with nature for cognitive styles after controlling for well-being and demographics. In other

words, is there an effect of nature on cognitive styles once affective processes induced by nature are accounted for?

3.4.1. Method

3.4.1.1. Participants and procedure

Singapore secondary school students (98 male and 87 female) voluntarily participated in this pen and paper survey. Their ages ranged from 13 to 16 years (M = 13.45 years, SD = 2.15). 48.1% of the participants were studying in Secondary One, 40.5% in Secondary Two, and 11.4% in Secondary Three. The proportion of the participants studying in the express stream was 62.7% compared with 36.8% in the normal stream (see footnote 9).

3.4.1.2. Measures

As in Study 2, we employed the Connectedness to Nature Scale (Mayer & Frantz, 2004) and Nature Relatedness Scale (Nisbet et al., 2009) to assess connectedness with nature. For cognitive styles, we again used Kirton's (1976) Adaption-Innovation Inventory and adapted Choi et al.'s (2007) Analytic-Holistic Scale. The respective reliabilities are shown in Table 12.

Mood was measured adapting the Positive and Negative Affect Scale for children (Laurent et al., 1999). There were six items like "*active*" and "*happy*" for positive affect and six items like "*nervous*" and "*fright*" for negative affect. Participants were to rate how well the word described their mood over the past few weeks on a 5-point Likert scale, ranging from 1 (very slightly or not at all) to 5 (extremely). Their reliabilities were .76 for positive mood and .86 for negative mood.

Well-being was measured by the General Health questionnaire (GHQ) (Goldberg & Williams, 1988) and the Warwick-Edinburgh Mental Well-being Scale

(WEMWBS) (Tennant et al., 2007). The GHQ measures an individual's psychological well-being by using a 4-point Likert-type scale to rate his/her feelings over the preceding few weeks with 12 items, e.g., "*Lost much sleep over worry*". The GHQ scale showed good internal reliability ($\alpha = .83$). A lower GHQ score indicates greater psychological well-being.

WEMWBS is a 14-item scale that assesses the positive aspects of mental health. Participants rated statements that best described their thoughts or feelings over the previous few weeks on a 5-point Likert-type scale ranging from 1 (none of the time) to 5 (all of the time). Example items include "*I've been feeling relaxed*" and "*I've been thinking clearly*". A higher WEMWBS score indicates more positive well-being. The scale had good internal reliability ($\alpha = .91$).

3.4.2. Results

Descriptive statistics and correlational coefficients for all variables are shown in Table 12. Three of the nature variables, namely the Connectedness to Nature Scale (CNS), Nature Relatedness Self Subscale (NR-self), and Nature Relatedness Experience Subscale (NR-experience), correlated significantly with the two cognitive style variables: Kirton's Adaption-Innovation Inventory (KAI), and Analytic-Holistic Scale (AHS). The cognitive nature variable, Nature Relatedness Perspective Subscale (NR-perspective), correlated significantly with only AHS. Both CNS and NR-experience correlated significantly with three well-being scales, i.e., General Health Questionnaire (GHQ), Warwick-Edinburgh Mental Well-being Scale (WEMWBS), and positive mood. NR-self correlated significantly with positive well-being scales (WEMWBS and positive mood).

Table 12

Descriptive Statistics and Correlations between Connectedness with Nature, Cognitive Styles and Well-being.

Variable	α	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. CNS	.85	3.42	.46	-								
2. NR-self	.79	3.49	.60	.72**	-							
3. NR-perspective	.38	3.51	.57	.23**	.24**	-						
4. NR-experience	.65	3.23	.72	.44**	.42**	.12	-					
5. KAI	.91	110.83	15.82	.49**	.37**	.12	.22**	-				
6. AHS	.85	4.67	.54	.53**	.43**	.31**	.21**	.45**	-			
7. GHQ	.83	12.03	5.48	-.19**	-.08	.06	-.16*	-.18*	-.07	-		
8. WEMWBS	.91	49.67	9.48	.36**	.22**	.01	.26**	.58**	.40**	-.53**	-	
9. Positive mood	.76	3.62	.72	.38**	.28**	.08	.32**	.52**	.34**	-.32**	.68**	-
10. Negative mood	.86	2.50	.93	-.02	.07	-.12	-.06	.02	-.04	.35**	-.23**	-.12

Note. CNS: Connectedness to Nature Scale; NR-self: Nature Relatedness Self Subscale; NR-perspective: Nature Relatedness Perspective Subscale; NR-experience: Nature Relatedness Experience Subscale; KAI: Kirton's Adaption-Innovation Inventory; AHS: Analytic-Holistic Scale; GHQ: General Health Questionnaire; WEMWBS: Warwick-Edinburgh Mental Well-being Scale.
* $p < .05$, ** $p < .01$

Table 13

Hierarchical Multiple Regression Analyses Predicting Cognitive Thinking Styles

	Variables	KAI	AHS
Step 1	Gender	.02	-.05
	Age	.13	.05
	Education Level	-.06	-.03
	Education Stream	.00	-.23**
		R^2 = .02	R^2 = .07
		ΔR^2 = .02	ΔR^2 = .07
		$\Delta F(4, 175)$ = .72	$\Delta F(4, 175)$ = 3.09*
Step 2	GHQ	.15*	.20*
	WEMWBS	.59**	.42**
	Positive mood	.18*	.12
	Negative mood	.12	.03
		R^2 = .44	R^2 = .26
		ΔR^2 =.42	ΔR^2 = .19
		$\Delta F(4, 171)$ = 31.66**	$\Delta F(4, 171)$ = 11.05**
Step 3	NR-self	.09	.09
	NR-perspective	.08	.11
	NR-experience	-.08	-.08
	CNS	.25**	.38**
		R^2 = .52	R^2 = .44
		ΔR^2 =.09	ΔR^2 = .18
		$\Delta F(4, 167)$ = 7.79**	$\Delta F(4, 167)$ = 13.47**

Note. CNS: Connectedness to Nature Scale; NR-self: Nature Relatedness Self Subscale; NR-perspective: Nature Relatedness Perspective Subscale; NR-experience: Nature Relatedness Experience Subscale; KAI: Kirton's Adaption-Innovation Inventory; AHS: Analytic-Holistic Scale; GHQ: General Health Questionnaire; WEMWBS: Warwick-Edinburgh Mental Well-being Scale.
* p <.05,** p <.01

No multicollinearity problems were found (*VIF* = 1.62 for GHQ, 2.38 for WEMWBS, 1.96 for positive mood, 1.24 for negative mood, 2.22 for NR-self, 1.26 for NR-perspective, 1.40 for NR-experience and 2.44 for CNS). Two hierarchical multiple regression analyses were used for KAI and AHS scores respectively (see Table 13). To investigate the role of connectedness with nature in the prediction of cognitive styles, both KAI and AHS were regressed on CNS and three Nature

Relatedness (NR) Subscales, after controlling for demographics and well-being. At Step 1, we added age, gender, and educational status (both level and stream). At Step 2, we entered four well-being indicators (GHQ, WEMWBS, positive and negative mood). Finally at Step 3, we entered CNS and NR subscales.

For KAI, results indicated that all predictors accounted for 52.4% of the variance ($R^2 = .52$, $F(12, 167) = 15.30$, $p < .01$) at Step 3 of the regression. Well-being variables explained 41.9%, and connectedness with nature explained an additional 8.9% of the variance in KAI scores. CNS (standardised $\beta = .25$, $p < .01$) was the only significant nature predictor of KAI, ΔF (4, 167) = 7.79, $p<.01$.

For AHS, all predictors accounted for 43.9% of the variance ($R^2 = .44$, $F(12, 167) = 10.88$, $p < .01$) at Step 3 of the regression. In particular, demographics explained 6.6%, well-being variables explained 19.2% and connectedness with nature explained another 18.1% of the variance. Only CNS (standardised $\beta = .38$, $p < .01$) significantly predicted AHS scores, ΔF (4, 167) = 13.47, $p <.01$.

3.4.3. Discussion

Results for Study 3 replicated those of Study 2. Furthermore, the relationships between connectedness with nature and both KAI and AHS remained significant after controlling for well-being and affect variables. In particular, CNS emerged as the significant predictor for both cognitive styles, after controlling for demographic and well-being effects. In other words, higher degrees of nature connectedness were associated with a higher holistic thinking tendency and a greater innovative thinking style, as expected.

3.5. General discussion

As predicted, Kirton's adaption-innovation (KAI) and analytic-holistic thinking (AHT) cognitive styles were both found in the present studies to be significantly correlated with connectedness with nature. Individuals who have a closer connection with nature are more innovative-orientated and have higher holistic perspectives. In the online study (Study 2), the Nature Relatedness Self Subscale was a significant predictor for both cognitive styles, regardless of demographic status. For the pen and paper study (Study 3), the Connectedness to Nature Scale significantly predicted both cognitive styles, despite adding both demographic and well-being status as additional control variables. Overall, innovators and holistic thinkers are more connected with nature than adaptors or analytic thinkers, thus supporting our hypotheses.

These results show that connectedness with nature is significantly related to both KAI and AHT cognitive styles, a finding consistent with previous research into the benefits of nature exposure and creativity (Atchley et al., 2012). It supports our assumption that connectedness with nature relates to innovative thinking because of the similar characteristics shared by both innovative thinkers and nature lovers. In addition, connectedness with nature is linked to AHT because of the parallel fundamentals between holistic thinking and knowledge of nature. These studies are the first to demonstrate the relationship between connectedness with nature and key cognitive styles, expanding beyond previous research on connectedness with nature/well-being effects.

Our findings show that connectedness with nature emerged as an influential variable contributing to KAI and AHT cognitive styles. In other words, the more connected people are with nature, the greater their preference for innovative and

holistic thinking styles. Moreover, Study 3 showed that these effects held even when controlling for general affect and well-being. Although previous research has found that connectedness with nature is related to well-being (Cervinka et al., 2012; Nisbet & Zelenski, 2011; Nisbet et al., 2011), our studies have shown that the Connectedness to Nature Scale (CNS) differs from the general affect and well-being measures.

According to Perrin and Benassi (2009), CNS measures cognitive beliefs rather than emotional connectedness with nature, which may explain why it predicts cognitive styles. Our data provides some indirect data that is relevant to this debate. The CNS correlated quite highly with the three affect-related variables (positive mood, psychological well-being, and positive aspects of mental health), and somewhat higher than with nature relatedness. Among the nature relatedness items, the supposedly affective Nature Relatedness Self Subscale and the more experiential Nature Relatedness Experience Subscale are also positively correlated with positive mood and well-being. Perrin and Benassi (2009) make valid points about the phrasing of the items of the CNS, yet individuals who score higher on this scale also report more positive mood and higher well-being, suggesting that the scale is associated with affective processes. Consistent with our findings, some researchers (Beery, 2012) argue that beliefs tap into affective responses even though they are more formally characterized as cognitive responses (Perrin & Benassi, 2009). By relating the CNS to both cognitive and affective process variables, our research provides a novel avenue for addressing the conceptual status of these and other variables, and it is our hope that future research will explore possible mechanisms further.

Our study is significant for two main reasons. One of these is that this is the first paper to highlight the role of connectedness with nature in cognitive styles beyond the effects of the physical aspect of nature. Current research into the effects of

nature exposure on creativity has focussed on the physical properties of the environment, neglecting potential psychological explanations (Atchley et al., 2012; Ma, 2009). In our studies, connectedness with nature was the most consistent correlate and predictor for both the KAI and AHT cognitive styles. The concept of connectedness with nature is based on Leopold's (1949) vision of the connection of human beings with the natural environment. These findings, therefore, affirmed the importance of our connectedness with nature; a connectedness extending beyond well-being, and confirming the beneficial cognitive effects such a link has for humans (E. O. Wilson, 1984). This finding suggests that in future research, connectedness with nature may be a potential mediator in establishing the effects of nature on creativity.

Second, our studies have obtained initial evidence for connectedness with nature scales among a sample of secondary school students in Singapore. It has been mentioned already that while previous studies of connectedness with nature have been carried out with participants from Western cultures, this is the first time both Connectedness to Nature and Nature Relatedness scales have been examined within Asia. We found moderate to high reliabilities for both scales. We also reported high correlations between the Nature Relatedness Self Subscale (the supposed emotional aspect) and CNS. If CNS measures cognitive beliefs (Perrin & Benassi, 2009), further investigation into the reliability and validity of the Nature Relatedness Scale is recommended. Our studies show several new findings linking connectedness with nature and cognitive styles such as innovation and holistic thinking. These findings await further research; in particular, investigations of the process mechanisms linking these constructs, and clarification of the components of connectedness with nature that underpin these correlations.

This paper has two limitations; the first being that the research sample might be biased because the participants were students from a single national culture (Singapore). The results may not therefore apply to students from other countries, or to adults. Second, our studies are arguably limited by the methodological approach used, which encompassed online and pen and paper questionnaire methods. Current research lacks the ability to determine if the effects are due to other factors associated with connectedness with nature; exposure to nature, for example. An experimental design to investigate the impact of exposure to nature on connectedness with nature and cognitive styles would provide additional insight (as in Mayer et al., 2009). These studies provide the basis for future field studies to investigate the role of connectedness with nature as a potential mediator for the relation between nature and cognitive styles.

Such limitations notwithstanding, our research highlights practical implications for educators and parents in Singapore who are developing students' cognitive styles. Singapore's national and economic development requires the country's young people to be educated and to develop their capabilities so that, when confronting the challenges of the twenty-first century, they are able to make meaningful, efficient contributions (Ananiadou & Claro, 2009). Cognitive styles such as innovation are instrumental in maintaining the competitiveness of the twenty-first century workforce (APEC Human Resources Development Working Group, 2011). In line with previous research showing that training and exposure to nature enhance connectedness with nature, we speculate that such exposure, and education platforms linking to the environment and outdoor education, may foster students' connectedness with nature and in turn enhance people's cognitive styles.

It is likely that authentic, repeated interactions with nature are crucial in developing a sense of connectedness with nature, and these nature-related experiences could be integrated into students' lifestyles, both at school and at home. When reviewing the school curriculum and teaching pedagogies, schools and educators should consider incorporating ways to foster students' connectedness with nature. As some nature-related experiences are resource intensive for urban dwellers and may be cancelled due to inclement weather (the onset of a thunderstorm, for instance), it is becoming more common for schools to conduct outdoor lessons in synthetic environments: using artificial turf for soccer games, for example, as well as indoor sports halls and urbanised campsites. Restricting so-called nature experiences to this synthetic type may, however, hinder opportunities to cultivate students' connectedness with nature. Opportunities might be realised through different platforms, from formal academic lessons to learning trips at natural places, in order to encourage authentic engagement with the natural environment. Moreover, parents should encourage their children's love of nature by integrating nature experiences within their home lifestyle, although additional indoor tuition typically fills up the after-school schedule of a Singapore student. Parents should therefore consider engaging in activities such as gardening or hiking in nature reserves with their children over the weekends, because connecting with nature may be good for our thoughts. This is no less true of adults than of children. In sum, we have reported significant associations between connectedness with nature and both KAI and AHT cognitive styles. Beyond demographic and well-being status, connectedness with nature was the most significant predictor for both cognitive styles. Because of its significant association with cognitive styles, connectedness with nature should be promoted in schools and work places and during leisure time. Going outdoors to

connect with nature is both beneficial for our well-being and for our capacity to innovate and refresh our thinking.

CHAPTER 4. STUDY 3

"I took a walk in the woods and came out taller than the trees."

Henry David Thoreau

Do nature lovers generate diverse creative ideas? Exploring the relation of connectedness to nature and creativity

The following manuscript has been submitted for review. The version shown here includes minor formatting changes for consistency with the rest of this thesis. The Outdoor Creativity Task and questionnaires used in Study 3 are provided in Appendices C and D respectively. A supplementary document is provided in Appendix E and contains additional analyses for the Outdoor Creativity Task. References for this article are provided within the consolidated list in the *References* section.

In Chapter Four, the data for Study 3 was collected at two separate times (see section 4.3.1.3 for more information). The survey data described in this chapter was collected at Time 2. The Outdoor Creativity Task data collected at both Times 1 and 2 is used for analysis for the purposes of this chapter.

The manuscript is shown as: Leong, L. Y. C., McClure, J., Hill, S., & Fischer, R. (2016). *Do nature lovers generate diverse creative ideas? Exploring the psychological relation of nature to creativity*. Manuscript submitted for review.

4.1. Abstract

Previous research has established an association between experience of the natural physical environment and creativity. This paper is the first to explore the relationship between nature connectedness (people's psychological relationship with

nature) and divergent-thinking creative performance. We used a new creativity test to examine divergent-thinking creative performance in Singaporean secondary school students (N = 141). Our findings showed significant positive relationships between the Connectedness to Nature Scale and: (a) divergent-thinking creative performance (originality scores), and (b) creativity correlates (innovative thinking and creative self-efficacy). As expected, nature connectedness predicted originality scores, even after controlling for other creativity-related variables. Students who were more connected with nature generated a greater number of creative ideas, suggesting that nature connectedness is an important variable which captures processes beyond demographics, physical self-efficacy, and other well-established factors related to creativity. Future research needs to examine the mechanisms underlying the nature connectedness-creativity link.

Keywords: divergent thinking, creativity, outdoor education, connectedness with nature, cognitive styles, creative self-efficacy

4.2. Introduction

The argument that nature plays an influential role in improving creativity is not a new one. From ancient Greece to recent times, it appears that many influential ideas have been developed during immersion in the natural environment (Csikszentmihalyi, 1996). Recent researchers have established a link between nature and creativity (Atchley et al., 2012; Ferraro, 2015). It is not surprising that a number of educators view outdoor adventure activities as a potential opportunity to foster creativity, spontaneity, and discovery (Loynes, 2002). As compared to traditional sources of support for creative avenues such as arts and music, exposure to the natural environment is readily accessible at little or no cost. Several researchers have also shown that additional benefits may accrue through exposure to nature beyond

fostering creative thinking (Bowler et al., 2010; Bratman, Hamilton, Hahn, Daily, & Gross, 2015).

Given the growing attention to outdoor education in schools, it is important to understand the nature-creativity relationship in school settings. In contemporary education, there has been a growing emphasis on creativity as a desired result of outdoor education programmes (Gassner & Russell, 2008; Lim, 2012). This emphasis may be a spin-off from the new educational directions (Ananiadou & Claro, 2009) intended to equip students with future work abilities such as creativity. However, most of the nature-creativity studies have used adult or university samples (Atchley et al., 2012; Ferraro, 2015), and findings from those may lack generalisability to school settings. There is therefore a need to study the nature-creativity effects for school student samples in order to provide educational insights for policy makers, schools, and parents.

In conjunction with the lack of studies on student samples, most nature-creativity studies are limited to the examination of exposure to the physical aspects of the natural environment. Hitherto, some researchers have also shown that feeling a sense of oneness with nature plays an important role for our well-being, behaviour, and personality (Capaldi et al., 2014; Geng, Xu, Ye, Zhou, & Zhou, 2015; Zelenski, Dopko, & Capaldi, 2015). This feeling of oneness with nature, also referred to as connectedness with nature, is consistent with the biophilia hypothesis (E. O. Wilson, 1993), which proposes that people are inextricably attracted to nature and that this subjective closeness between people and nature is perhaps necessary for them to function more effectively. For all that, we know very little about the link between connectedness with nature and creativity, especially when there are different ways in which people have contact with nature, and diverse means of understanding creativity.

Within the nature-creativity literature, most studies appear to focus on the creative effects of visual/auditory natural stimuli (e.g., green plants and sounds of nature) (Alawad, 2012; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004), or the experience of being in natural environments (Atchley et al., 2012; Ferraro, 2015). A notable exception is a recent study that has linked connectedness with nature to innovative thinking (Leong, Fischer, & McClure, 2014).

As illustrated in the next section, there is evidence to support a link between nature and creativity. Such evidence is often focussed on the effects of contact with the physical natural environment on creativity outcomes. There is thus a need to further clarify the relationship between connectedness with nature and creativity because current knowledge of such effects remains limited.

4.2.1. Connectedness with nature-creativity research

This paper focusses on the exploration of the relationship between connectedness with nature and actual creative performance (i.e., as measured by scores on a test evaluating the creativity of an idea generated). This builds on research from the environmental psychological tradition that centres on the relationship between the connectedness with nature and creativity-related traits. As a nature-related personality variable, connectedness is a measure of people's subjective attachment to nature, i.e., how close they feel to, or how much they think about, the natural environment (Mayer & Frantz, 2004). According to Mayer and Frantz (2004), this connectedness also includes people's desire to embrace nature as a part of their own self and allows them to broaden their perspectives; by considering environmental consequences when making decisions, for example. Earlier research has demonstrated the links between connectedness with nature and creative personality traits such as

openness to experience (Nisbet et al., 2009), and a facet of creative ability such as perspective taking (Mayer & Frantz, 2004).

Some studies have found, furthermore, that connectedness with nature is positively associated with other psychological variables such as affect and well-being (Capaldi et al., 2014); these variables typically also predict creativity outcomes (Baas, De Dreu, & Nijstad, 2008). Similarly, the Broaden-and-Build Theory (Fredrickson, 2001) suggests that positive emotions may foster creative thinking because such emotions possibly encourage people to play, explore, and learn. Generally, this process in turn broadens our capacity for attention, cognition, and action. If this theory is applied to creativity, it is possible that positive emotions can broaden our cognitive capacity for the generation of creative ideas. In combination, these studies seem to suggest ways in which connectedness with nature could be linked to creativity.

Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) demonstrated in their first study that connectedness with nature is positively correlated with creative cognitive styles among adolescents. The study replicated this positive correlation between connectedness with nature and creative thinking styles by controlling for covariates such as positive affect and well-being. Although Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) showed that positive affect does not explain all of the variance associated with connectedness with nature for the connectedness with nature and creativity hypothesis, their findings have linked connectedness with nature with innovative thinking style, a creativity-related correlate.

Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) propose that both innovative thinking and connectedness with nature share similar

characteristics, such as openness to new experiences. They agree with Mortlock (1984) that activities in nature often include a sense of adventure, and venturing into the natural world might well require risk taking and instances of stepping outside one's comfort zone. Consequently, as Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) argue, people need to be open to new experiences if they want to engage in nature experiences so as to connect with nature. Similarly, accordingly to some researchers, openness to experience relates to creativity (Ma, 2009) and innovative thinking (Ee et al., 2007). This means that people who are more open-minded are also more likely to think differently and to solve problems in novel ways. Thus, collectively, these findings may suggest a link between subjective connectedness with nature and creativity-related correlates.

Surprisingly, no study has yet explored the link between subjective connectedness with nature and actual creative performance. Research evidence shows that a connection exists between creative performance and exposure to stimuli related to the natural environment (e.g., indoor plants, sounds of nature, and the colour green) (Alawad, 2012; Lichtenfeld et al., 2012; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004), or the experience of being in a natural environment (Atchley et al., 2012; Ferraro, 2015). Some researchers have reported, for instance, that having an indoor plant visible allows participants to perform better in association tasks (Shibata & Suzuki, 2002; Shibata & Suzuki, 2004). Others, such as Atchley et al. (2012), found that participants in a programme organised by Outward Bound (an international outdoor education organisation which offers challenging outdoor expeditions as a core programme) performed 47% better in creative scores after three days' hiking in nature than participants in the control group, who had not yet embarked on a similar hike. Although these studies (Lichtenfeld et al., 2012; Shibata & Suzuki, 2002;

Shibata & Suzuki, 2004) indicate the importance of exposure to nature when one is performing creativity-related tasks, the processes that connect these natural stimulus features with creativity appear unclear.

While evidence supports the link between exposure to the physical natural environment and better creative scores, little is known as to whether these effects on actual creative performance are applicable to the effects of another key aspect of nature, i.e., subjective connectedness with nature. Although Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) have linked connectedness with nature and innovative thinking, we do not know whether these effects can be translated into actual creative performance. In order to better understand the nature-creativity link, it appears necessary to clarify the relationship between connectedness with nature and actual creative performance.

4.2.2. Divergent-thinking creativity

A creative product can be generated by cognitive processes such as divergent and convergent thinking (Ma, 2009). Divergent thinking was first related to creativity in the theory of divergent production (Guilford, 1950, 1956), and aims to generate creative ideas by exploring diverse solutions to one problem. On the other hand, convergent thinking focusses on producing the perfect creative solution appropriate for the problem (Mednick, 1962). These two cognitive processes measure different creative outcomes, the first focussed on the production of a diversity of useful and original ideas, the second on the production of a single and accurate idea. Both processes have been identified as benefitting from exposure to nature (Atchley et al., 2012; Ferraro, 2015; Lichtenfeld et al., 2012; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004).

According to Ma (2009), both divergent and convergent thinking are considered to be of equal importance in creativity. When solving problems, divergent thinking allows a person to brainstorm and generate diverse creative ideas before using convergent thinking to decide on the most appropriate idea (Ma, 2009). Divergent thinking probably requires perspective taking in order to produce a variety of novel ideas. One way of generating a creative idea may involve perspective taking through an understanding of the preferences, values, and needs of others. According to Grant and Berry (2011), this ability to adopt the perspectives of others may direct a person to focus on generating not merely novel but also useful ideas relevant to a problem. Similarly, this perspective taking has been found to be linked to subjective connectedness with nature (Mayer & Frantz, 2004).

For the purposes of this paper, we examined creative performance by using divergent tasks, instead of focussing on the production of a single best solution for convergent tasks. For this study, therefore, the rating of an item or an idea will be considered creative if "it is both novel and appropriate, useful, correct," and if the task is heuristic with open-ended answers rather than a single correct solution (Amabile, 1983b, p. 360).

4.2.3. Research goal

The primary goal of our investigation was to explore the relationship between subjective connectedness with nature (a psychological nature-related variable) and actual creative performance. Because of the current emphasis on outdoor education in schools, we conducted this study in school settings for secondary students. Building on previous findings (Atchley et al., 2012; Ferraro, 2015; Leong et al., 2014, see previous Studies 2 and 3 in Chapter Three; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004), we speculate that individuals who are connected with nature will also

be more likely to generate diverse creative ideas (i.e., actual creative performance). Given the nature of correlational analysis, there are possibilities that creativity may increase our connectedness or a third variable is responsible for the correlation between the two variables of interest. For example, an innovative thinking style may be associated with both creative performance and connectedness with nature. As Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) has eliminated the positive emotion explanation in an earlier study, we will focus on other creativity-related correlates. This study has sought to answer the research question: Does connectedness with nature relate to creative performance beyond alternative variables such as creative traits or cognitive styles?

4.3. Method

4.3.1. Procedure overview

The procedure for this study had two parts. The first related to clarifying the scales' feasibility for use with adolescents in Singapore. While most of the self-reported measures had previously been used for a sample of secondary school students in Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three), feedback was also obtained from experienced teachers and a pilot test was carried out with a group of students to assess the scales' feasibility. The second part of the procedure involved conducting a survey to examine the intended research question for the study. The following two sections illustrate these two stages of the procedure.

4.3.1.1. Pilot test

To identify issues that may have hindered the students' understanding of the survey, the first author approached two current school teachers, each with over ten years' teaching experience, to review the various scales used in the questionnaire and

the newly designed Outdoor Creativity Task (OCT, see section 4.3.2 below). There were two forms in the OCT, consisting of a total of ten divergent-thinking tasks measuring creativity (for more information, see section 4.3.2). Based on their feedback, some minor amendments were made. Next, to assess the students' understanding of each item in the scales used in the questionnaire and to trial the OCT scales' feasibility, the first author conducted a pilot test with twelve student volunteers across different secondary levels in one of the participating schools. The students were timed to complete each task within three minutes. This was followed by completion of the questionnaire. Having completed the test and survey, the students were asked if they had had difficulties in understanding any item. The group did not raise issues for the questionnaire, but minor amendments were made to enhance understanding of the OCT. The revised form, for example, included a picture of a climbing helmet, specified that it was indeed a climbing helmet and not simply a 'helmet', and changed the word 'log' to 'tree log (tree trunk)' for the sake of clarity.

4.3.1.2. Survey participants

A total of one hundred and eighty-five school students (47.0% of them female) from two Singapore schools volunteered to participate in the study. This sample had adequate power to detect an effect of $d = .34$ (Faul, Erdfelder, Lang, & Buchner, 2007), based on a meta-analytically derived overall effect size estimate of the effectiveness of outdoor activities (Hattie et al., 1997). These students completed the Outdoor Creativity Task (OCT) form A (see section 4.3.2 for more details) and their mean age was 13.45 years ($SD = 2.15$), with a range from 13 to 16 years. To avoid fatigue effects, a few days later 141 of the original 185 participants (49.7% female) attended school during the second session and completed an alternative form of the OCT, in addition to questionnaires including demographic information and various

psychological scales at Time 2. The mean age of this second group was 13.66 years (SD = .78), with a range from 13 to 16 years.

4.3.1.3. Survey procedure

The student volunteers completed two of the OCT forms over two sessions.[10] Timed by their teacher (three minutes per task), they completed a total of five divergent thinking tasks in each OCT form. During the second session, after finishing the tasks for the second OCT form, the students also completed a questionnaire that included demographic information and various psychological scales. All measures were administered in English, which is the key medium for delivery in the Singapore education system and considered for educational purposes to be the first language of the pupils.

4.3.2. Materials

Dependent variable: Creative performance. For the purposes of this study, the Outdoor Creativity Task (OCT) was designed specifically to assess divergent-thinking creative performance. This section briefly covers the design of the test and items, the forms administered, the scoring method, and the measurement. We chose to design this new measure because some divergent thinking tests consisted of a single creativity task, so may have lacked dependable scores (Silvia et al., 2008), and previous studies have shown that customised divergent-thinking tests improve the capacity to identify creative talent (Lee, Therriault, & Linderholm, 2012). In order to construct the test using divergent-thinking tasks, a search for existing divergent-thinking creativity measures was conducted. Two questionnaires were identified that contained materials

[10] The OCT is designed as a pre-post test for the purposes of the first author's PhD project. Given that the items on the two forms tap into a set of similar divergent tasks, one concern relates to participation fatigue as a result of completing two creativity forms and a questionnaire. To overcome this challenge, students were given the second form to complete a few days later.

of potential use as an adaptable source for generation of a new scale. These were the Cultural Creativity Task (Lee et al., 2012) and culture-specific creativity measures (Leung & Chiu, 2010; Leung, Maddux, Galinsky, & Chiu, 2008). When adapting these questionnaires, we constructed ten open-ended items (see Appendix D) that required participants to generate as many solutions as possible.

These ten items consisted of both general and nature-related tasks requiring divergent thinking. Some tasks, for instance, required participants to find unusual uses or improvements for common items; some called for creation of new ideas or inventions; and others tapped into participants' ability to generate solutions to a problem. There was no stipulation that individuals needed to create nature-related ideas when solving the problems. Preliminary results showed similar correlational patterns for both types of tasks. Examples of the ten items include: "*Think of as many possible improvements as you can to a regular backpack, making it more interesting, more useful, and more presentable*", "*Think of as many possible improvements as you can to a climbing helmet, making it more interesting, more useful, and more presentable*", "*Design a fun and interesting survival tool for use in the outdoors. A survival tool is a physical item that you would like to have in order to survive in the outdoors (in a forest, for example). Provide as many examples as you can*", and "*Many tourists are visiting our nature reserves but are unaware of the dos and don'ts to observe in nature. What steps can you suggest to communicate the necessary guidelines to our tourists?*"

The OCT comprised two forms, Form A and Form B, because the test was designed for pre-post-test comparison in future studies. The two forms consisted therefore of similar tasks. A participant might be required, for example, to think of as many possible uses as he/she can for different elements, e.g., a rock in Form A and a

tree log in Form B. Each form consisted of five three-minute divergent-thinking activities.

The test was scored by using a subjective scoring method based on the widely used and validated Consensual Assessment Technique (Amabile, 1983a). Two coders were involved. The first author briefed them regarding the scoring method and supplied them with Silvia et al.'s (2008) guidelines regarding when ideas might be viewed as unusual, original, and clever (i.e., creative). This process aimed to standardise the coders' general understanding of creativity when judging. In accordance with the Consensual Assessment Technique (Amabile, 1983a), the coding work was independent so the coders did not influence each other's rating in any way. They rated the creativity of the product in relation to other products within the pool of completed tests, with no comparison to external standards. Most importantly, the coders were blind to the order effects of pre- and post-test.

Consistent with the creativity scoring procedure in Lee et al. (2012), there were two key steps. First, coders determined the number of ideas generated for each activity. Any redundant or repeated items were counted once only. Next, the originality score for each counted response was coded on a five-point Likert scale, ranging from 1 (not at all) to 5 (very much). Although the OCT has not been extensively validated, it has face validity, as it is similar to current creativity tests such as the Unusual Uses Test (Guilford et al., 1958) and the Cultural Creativity Task (Lee et al., 2012). In addition, the reliability and validity of the originality measure has been assessed in a wide variety of ways, as indicated in Guilford, Christensen, Merrifield, and Wilson (1978) and in Amabile (1983b). The originality scores showed good inter-class reliability (intraclass correlation coefficient [ICC] = .72). According to Amabile (1996), this is an adequate level of inter-rater reliability, and is similar to the range of .70 to .89 for previous inter-

rater reliability correlations. Runco (1986) argues that the originality scores typically relate closely to the number of ideas generated, and our results are consistent with this ($r = .97$, $p < .01$).

For the purposes of this paper, the originality scores are used as an indicator of divergent-thinking creative performance. The originality scores for all creative ideas produced for each task were combined to measure that task's overall creative strength: A high score suggests a greater capability to produce more creative ideas. All ten items were combined as a single creativity scale, and the Cronbach's alpha for the originality scores of the ten OCT items was .86.

Independent variable: Connectedness to nature. The Connectedness to Nature Scale (CNS) measures the level of one's general connectedness with nature (Mayer & Frantz, 2004). There are 14 items, which include statements such as "*I think of the natural world as a community to which I feel belong to*" and "*I often feel disconnected from nature*" (reverse scored). Participants indicated how strongly they agreed or disagreed with each item on a five-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's alpha was .76.

Control variable: Adaptive-innovative thinking. The Kirton Adaption-Innovation Inventory (KAI) assesses whether participants' preferred thinking style is more innovative or adaptive oriented (Kirton, 1976). There are 32 items: An example item from the innovative end is "*always full of ideas*" while an adaptive item example is "*is organised and efficient*". Participants rated how well each item described them using a five-point Likert-type scale. This ranged from 1 (not at all like me) to 5 (just like me), which gave a possible range of 32 to 160 KAI scores. A lower KAI score suggests a more adaptive preference, and a higher score a more innovative one. The KAI scale was found to be reliable ($\alpha = .93$).

Control variable: Creative self-efficacy. The Creative Self-Efficacy scale (CSE) assesses an individual's belief in his/her own creative ability to generate novel and useful ideas or products (Tierney & Farmer, 2002). The three items were adapted from Beghetto (2006) and included "*I am good at coming up with new ideas*", "*I have a lot of good ideas*", and "*I have a good imagination*". Participants rated on a five-point Likert-type scale ranging from 1 (not true) to 5 (very true) how accurately each item/statement conveyed their view. A higher CSE score indicates a greater level of self-belief regarding one's own creative ability. The scale was reliable ($\alpha = .83$).

Control variable: Physical self-efficacy. The Perceived Physical Ability Scale for Children (PAS) assesses an individual's physical self-efficacy, i.e., belief in such physical abilities on his/her part as strength and speed (Colella, Morano, Bortoli, & Robazza, 2008). We included this measurement of physical self-efficacy because one reviewer suggested that physical fitness might be an underlying effect driving the effect between creativity performance and connectedness with nature. To partial out any activity-related effects of outdoor experience on creativity, we controlled, therefore, for the participants' physical self-efficacy while examining the effects of connectedness with nature and creativity. In this scale, the six items were adapted from Ryckman, Robbins, Thornton, and Cantrell (1982). Participants rated how accurately each item/statement conveyed their own views of their physical ability on a four-point Likert-type scale ranging from 1 to 4. An example item included scores of 1 (*I run very slowly*), 2 (*I run slowly*), 3 (*I run fast*), and 4 (*I run very fast*). This scale gave a possible range of 6 to 24 PAS scores. A lower PAS score suggests a perception of having less physical ability, and a higher score a stronger sense of physical self-efficacy. The PAS scale was reliable ($\alpha = .73$).

4.3.3. Statistical analysis

There were some considerations regarding demographics that might influence our results. The first issue links to educational status. Although creativity studies have shown a negligible link between intelligence and creativity (K. H. Kim, 2005), the educational status of express and normal streams[11] for different year groups was used as a control variable in this study. The second issue relates to the participants' contact with nature. Given the green city policy and the landscape in Singapore, all participants would have had frequent exposure to urban nature (e.g., to neighbourhood parks and roadside trees) and nature-related stimuli (e.g., potted plants). All participants lived in urban parts of Singapore, in close proximity to their schools. The neighbourhoods of participating students are categorised as 'non-mature estates', and typically include high-rise apartments as well as human-made parks with plants and small trees. The level of familiarity with nature would therefore be largely homogenous for this sample. Another possible confound would be their outdoor exposure through school-organised camps. Given the educational context in Singapore,[12] a way of differentiating students' contact with nature is through their attendance in outdoor camps.[13] 16.1% of the participants reported that they had never before attended an outdoor camp, 21.7% had attended only one, 25.2% two, 13.3%

[11] As Singaporean secondary students are streamed according to their scores for the national primary school leaving examinations, the proportion of participants studying in the express stream was 80.4%, whereas 19.6% were in the normal stream. Generally, the normal stream students who study for five years are viewed as low achieving: the majority will spend four years in the express stream during their secondary school education.

[12] Generally, a typical Singaporean student has little outdoor experience, as most of his or her time outside formal school hours is spent on activities intended to help him/her achieve good academic results; home tuition, for example, or after-school remedial lessons. Most formal physical activities are conducted within school compounds, either on a football field or in an indoor sports hall.

[13] A standard outdoor school camp in Singapore managed by the Ministry of Education often includes a residential area for campers and a human-made challenge course. Most camp programmes, then, have revolved around challenge course activities such as artificial rock-climbing, abseiling, and high-rope elements. Some campsites may overlook or be immediately beside a natural setting (a coastal area, for example), but will usually be no more than a minute's walk from public transportation, industrial parks or housing areas. Given their camping experience, most participants would have been exposed to some human-made materials included in our test (e.g., a climbing helmet).

three, and the remaining 23.7%, more than three. As there may be a possible link between their outdoor experience and creativity, we include this as a control variable in our analysis.

To better understand the role of nature in creativity, a hierarchical multiple regression analysis was performed to explore the predictive validity of connectedness with nature for creativity, by controlling for demographics, physical self-efficacy (to partial out any activity-related effects of outdoor experience on creativity), and creativity-related variables.

4.4. Results

Table 14 shows all the statistically significant correlations between the overall Outdoor Creativity Task (OCT) scores for originality and variables such as connectedness to nature (CNS), innovative thinking (Kirton's Adaption-Innovation Inventory: KAI), creative self-efficacy (CSE), and physical self-efficacy (PAS). As expected, originality scores correlated significantly with the Connectedness to Nature Scale, innovative thinking style, and creative and physical self-efficacy. In other words, creative students are more likely to (a) be connected to nature, (b) prefer to think "outside the box" when solving problems, and (c) believe that they are creative and physically fit. The Cohen's (1992) effect size values for originality scores suggested low to medium practical significance.

Table 14

Correlations of Outdoor Creativity Task Scores and Other Psychological Variables.

Variable	*M*	*SD*	Originality	CNS	KAI	CSE
Originality	11.19	4.67	-			
CNS	3.37	.44	.28**	-		
KAI	113.29	16.69	.18*	.56**	-	
CSE	3.39	.89	.26**	.35**	.48**	-
PAS	15.84	2.83	.18*	.18*	.21**	.24**

Note. CNS: Connectedness to Nature Scale; KAI: Kirton's Adaption-Innovation Inventory; CSE: Creative Self-Efficacy Scale; PAS: Perceived Physical Ability Scale for Children.
* $p < .05$, ** $p < .01$

A hierarchical multiple regression analysis was used for originality scores (see Table 15). There were no multicollinearity problems (VIF = 1.12 for PAS, 1.74 for KAI, 1.44 for CSE and 1.52 for CNS), and other assumptions were met. To investigate the role of connectedness with nature in the prediction of creativity scores, originality was regressed on CNS, after controlling for alternative explanations (i.e., demographics, physical self-efficacy, and creative personality). At Step 1, we added age, gender, educational status, outdoor experience, and physical self-efficacy. At Step 2, we entered two creativity-related indicators (KAI and CSE); and at Step 3, CNS was entered.

Supporting our hypothesis, connectedness with nature emerged as a significant predictor for originality scores, beyond alternative explanations such as demographics, physical and creative self-efficacy, and innovative thinking. The combined predictors accounted for 19.7% of the variance ($R^2 = .20$, $F(8, 132) = 4.05$, $p < .01$) at Step 3 of the regression. Creativity-related variables explained 5.5%, and the Connectedness to Nature Scale explained an additional 4.7% of the variance in originality scores. CNS (standardised $\beta = .27$, $p < .01$) significantly predicted creativity scores, $\Delta F (1, 132) = 7.77$, $p < .01$. In this model, for every increase of 1 in

the connectedness score, there was an increase of 2.87 in the number of original ideas created, 95% CI [.83, 4.91].

Table 15

Hierarchical Multiple Regression Analyses Predicting Creative Scores

Variables	Originality		
	Model 1	Model 2	Model 3
	B 95% CI	*B* 95% CI	*B* 95% CI
Age	.01 [-1.04, 1.06]	.16 [-.87, 1.18]	.03 [-.97, 1.04]
Gender	-1.85 [-3.40, -.29]	-2.14 [-3.68, -.60]	-2.25 [-3.75, -.75]
Educational Status	-1.76 [-3.50, -.02]	-1.49 [-3.20, .23]	-1.44 [-3.11, .24]
Outdoor Experience	.11 [-.16, .39]	.07 [-.20, .34]	.10 [-.17, .36]
PAS	.33 [.06, .60]	.24 [-.03, .52]	.22 [-.05, .49]
KAI		.01 [-.04, .06]	-.03 [-.09, .02]
CSE		1.23 [.25, 2.22]	1.10 [.14, 2.06]
CNS			2.87 [.83, 4.91]
R^2	.10	.15	.20
ΔR^2	.10	.06	.06
Adjusted R^2	.06	.11	.15
F for ΔR^2	2.83*	4.30*	7.77**

Note. PAS: Perceived Physical Ability Scale for Children; KAI: Kirton's Adaption-Innovation Inventory; CSE: Creative Self-Efficacy Scale; CNS: Connectedness to Nature Scale.
* p <.05, ** p <.01

4.5. Discussion

This is the first study to establish a relationship between connectedness with nature and divergent-thinking creative performance. Two significant findings emerged. First, divergent-thinking creative performance showed significant

associations with two conceptually related variables of creativity (creative self-efficacy and Kirton's (1976) adaptive-innovative thinking), physical self-efficacy, and the Connectedness to Nature Scale. Importantly, divergent-thinking creative performance is positively associated with connectedness to nature. This finding extends previous creativity research that focussed strictly on the link between the physical natural environment and creativity (Atchley et al., 2012; Ferraro, 2015; Shibata & Suzuki, 2002; Shibata & Suzuki, 2004). This supports our earlier speculations that connectedness with nature predicts divergent-thinking creative performance. Our results also converge with related research reporting a relationship between creative performance and creativity-related variables (Beghetto, 2006; Ee et al., 2007; Ma, 2009; Tierney & Farmer, 2002), such as efficacy and innovative thinking style. Overall, people who generate more creative ideas are more likely to have a close connection with nature, strong creative self-efficacy, and an innovative thinking style.

Second, and more importantly, after including demographics, physical self-efficacy, and creativity correlates as control variables, connectedness with nature was a significant predictor of originality scores. This establishes a relationship between connectedness with nature and divergent-thinking creative performance. Our data also supports the idea that this relationship is not related to another third variable such as innovative thinking, for example. Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) have previously demonstrated that people who are more connected with nature also prefer innovative thinking. Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) argue that people who are connected with nature are likely to engage in adventurous activities in nature, and, to do so, they need to embrace an openness to new experiences. This openness is likely to influence their preference for

innovative thinking. Similarly, it has been observed that creative people prefer innovative thinking styles (Ee et al., 2007). Given that connectedness with nature remains a significant predictor for creative performance, our findings suggest that alternative explanations, e.g., innovative thinking and self-efficacy, may not explain the link between connectedness with nature and creativity. In other words, the ability to create as many novel ideas as possible is associated with our subjective connectedness with nature.

This relationship between connectedness with nature and creative performance may be plausibly explained by a process of perspective taking. Mayer and Frantz (2004) found a link between connectedness with nature and perspective-taking ability, and this ability may allow people to create useful ideas when solving problems (Grant & Berry, 2011). This suggests that perspective-taking ability appears to be shared by both creative people and people who are connected with nature. People who have a strong sense of connectedness with nature seek such connections in a variety of ways: by identifying with nature, for example, and/or by taking a perspective that considers the impact of human beings on the natural world (their own impact, or that of others) (Mayer & Frantz, 2004). Such a perspective requires consideration of diverse viewpoints during decision-making. Additionally, people with a greater sense of connectedness are possibly more likely to appreciate the interconnectedness within the natural world and to understand how, in its complexity, nature solves problems (e.g., relationships within ecosystems, food webs, and life cycles). This knowledge of nature may provide different perspectives as to how things work and possibly broaden cognitive resources. With the new perspectives as additional resources, individuals may be able to solve complex problems and put things together in novel ways. The

mechanisms underlying this connectedness with nature and a creativity link such as perspective thinking are worth researching.

4.5.1. Limitations and future research

This study has three limitations. First, the research design did not control for potential order effects. These findings might be confounded as a result of presenting (a) the OCT before the questionnaires and (b) two versions of the OCT to all participants in the same order. All participants completed the OCT before the questionnaire. Future studies could adopt a counterbalanced design (e.g., with participants randomly assigned to completing the questionnaires before the OCT and vice versa) to restrict any possibility of order treatment, demand characteristics, or other factors that may adversely influence results. Because of the administration requirements in classrooms, we were unable to counterbalance the order in the current study.

Second, the use of a newly designed creativity test combined with the subjectivity of the scoring method may influence the validity and reliability of the test. To address this concern, we referred to the creativity research and adopted the widely used and validated scoring method, Consensual Assessment Technique by Amabile (1983a). This allowed us to align our scores with current scoring standards in creativity research. To improve validity, we had the test reviewed by educators for feedback and then involved a focus group of students to look over the assessment for difficulties. We also compared our creativity scores with other creativity-related criteria such as innovative thinking and creative self-efficacy. The significant positive associations in our current study provide some testimony to the validity of the creativity test we designed. However, as the test is still new, it requires extensive validity and reliability testing. Future research may examine the test and retest

reliability of the OCT scores to support the validity of adopting Amabile's scoring method for this test.

The last limitation of the current study lies in the inability to determine if the effects of connectedness to nature are due to increased creativity levels, or if the effects of creativity are due to an increased exposure to nature, to increased connectedness with nature, or to other factors associated with connectedness with nature or nature-related experiences. These factors are often closely interconnected, however, so it may be challenging to separate their effects. Exposure to nature, for example, has been found to increase connectedness with nature (Mayer et al., 2009). It may be theoretically important to design future experimental studies in order to understand the unique influences of exposure to nature and connectedness with nature on creative problem solving. Nonetheless, this study provides a foundation for further investigation of connectedness with nature as a potential mediator between nature experiences and creativity.

As this study could only establish correlation between connectedness with nature and divergent-thinking creative performance, future research should consider investigating the causal relationships that might hold between connectedness with nature and creativity. In accordance with evidence linking connectedness with nature with increased nature exposures (Nisbet et al., 2009), we suggest that a potential avenue for promotion of creativity may lie in experience of the outdoors. This also reflects other findings (Atchley et al., 2012; Ferraro, 2015) reporting that participants generated ideas of a more creative sort after prolonged exposure to nature through outdoor programmes. This thus, implies that it is worthwhile to design truly engaging and enriching nature experiences that go beyond occasional one-off nature exposures. It seems unrealistic, in any case, to expect young people to develop a strong

connection with nature when both the frequency and the quality of their experience of it is limited. If gaining a strong connection with nature is similar to developing a close relationship with a good friend (Mayer & Frantz, 2004), it may take time, effort, and authentic interactions for this sense of affinity to grow. Future research might include investigation of ways to nurture connectedness with nature through nature experiences, by having different levels of engagement with nature or different repetitions of exposures, for instance. Such projects investigating this pathway may provide educational insights for schools.

4.5.2. Practical implications and conclusion

The present study highlights potential practical implications for both educators and parents who wish to promote creativity and connectedness with nature. Generally, school curricula of the kind found in Singapore are dependent on the teaching of academic subjects which emphasise adaptive thinking or efficiency by working within rules and regulations (Chua, 2014; Zhang, 2002). While these thinking styles provide opportunities for sound problem-solving strategies, they tend to "box" ideas up and produce efficient, as well as normative and "safe" solutions. In contrast to these thinking styles, nature lovers when outdoors often need to think innovatively, especially when responding to the diverse challenges that arise during experiences of nature (Leong et al., 2014, see previous Studies 2 and 3 in Chapter Three). Young people may need to acquire a sense of connectedness with nature, as they may gain diverse creative-thinking strategies associated with this connection and develop their creative cognition holistically, thereby enhancing their capacity to generate creative ideas.

In conclusion, this study supports the idea that there is a connection between connectedness with nature and divergent-thinking creative performance, and builds on

previous research into nature and conceptually related variables of creativity. As our findings provide only initial insights, future researchers could endeavour to arrive at a more complete understanding of how both the physical environment and a psychological attachment to nature may influence divergent-thinking creative performance. Meanwhile, it is our hope that people will adopt the idea that taking a walk in the forest and enjoying an outdoor experience can lead to the generation of diverse creative ideas.

CHAPTER 5. STUDY 4

"Look deep into nature and then you will understand everything better."

Albert Einstein

Engaging with nature: Nurturing nature connectedness and creativity through nature observations

The following manuscript has been submitted for review. The version shown here includes minor formatting changes for consistency with the rest of this thesis. The Outdoor Creativity Task and questionnaires used in Study 4 are provided in Appendices D and F respectively. The materials used during the experimental study (i.e., activity sheets for each condition, and the experimenter observation sheet) are provided in Appendix F. References for this article are found within the consolidated list in the *References* section. A low risk ethical approval was given by Massey University's Human Ethics Committee.

The manuscript is shown as: Leong, L. Y. C., Hill, S., & Fischer, R. (2016). *Engaging with nature: Nurturing nature connectedness and creativity through nature observations*. Manuscript submitted for review.

5.1. Abstract

Previous research indicates that contact with the natural world enhances people's creativity. It remains unclear, however, whether different ways in which people have contact with nature increase or decrease creativity, and how the particular effect is achieved. This mixed measures experiment ($N = 93$) is rigorously controlled for potential confounds. It examines the impact of different nature engagements on creativity and the mediating role of a psychological connectedness with nature. Our

marginally significant results indicated the trend of a small creativity increase over time for those who had focussed nature engagement; and a small decrease for those with unfocussed engagement. We also reported a mediating effect of connectedness with nature. This suggests that focussed nature engagement may facilitate a stronger sense of connectedness with nature, which will, in turn, enhance creativity. It is hoped that our findings will not only increase people's motivation to engage more often and more effectively with nature, but will also provide an impetus for educational efforts to promote outdoor activities.

5.2. Introduction

With more than half the global population living in urban areas (United Nations Population Division, 2014), people generally spend less time in the outdoors (Evans & McCoy, 1998; MacKerron & Mourato, 2013). According to theorists (Leopold, 1949; E. O. Wilson, 1984), however, the natural environment is important for our well-being and survival. Across a variety of academic disciplines, the function of the natural environment in such psychosocial variables as stress, mood, memory, and creativity has received considerable attention (Bowler et al., 2010; Bratman et al., 2015; Grinde & Patil, 2009). Evidence has shown that people gain psychological benefits from being in pleasant, tranquil natural landscapes (with limited man-made influence), and from exposure to non-threatening aspects of the natural environment (e.g., living things and processes related to life) (Dadvand et al., 2015; Grinde & Patil, 2009). This suggests that the natural world influences people's physical and mental health, as well as their cognitive performance.

Environmental psychologists argue that in addition to the benefits provided by exposure to the physical environment, a psychological connection between people and nature can play an important role in human development. Mayer and Frantz (2004)

have introduced the term 'connectedness with nature', describing the extent to which an individual feels and experiences a psychological attachment to the natural world. Various researchers (Mayer et al., 2009; Nisbet et al., 2009) found that this connectedness may increase with more exposure to nature. Having a sense of connectedness with nature has obvious implications for the improvement of individual well-being and for individual actions to conserve the natural environment (Markowitz, Goldberg, Ashton, & Lee, 2012; Mayer et al., 2009; Weinstein, Przybylski, & Ryan, 2009); connectedness with nature plays a role in promoting better physical and mental health, pro-environmental attitudes and behaviour, and in enhancing our cognition (Capaldi et al., 2014; Mayer & Frantz, 2004; Mayer et al., 2009; Tam, 2013).

Recent studies have extended nature-related research beyond well-being and pro-environmental behaviours to examine creativity variables linked to both exposure to the physical environment and to a psychological connectedness with nature. Some researchers (Atchley et al., 2012; Ferraro, 2015) have found that immersion in nature increases our convergent-thinking creative performance, i.e., our ability to produce a correct creative solution (Guilford, 1956; Mednick, 1962). In comparison with a control group, people who engaged in outdoor activities performed about 50% better in coming up with the correct solution when doing convergent-thinking tasks. Another group of researchers found that people who feel a close connection with nature have greater perspective-taking ability (Herzog, Black, Fountaine, & Knotts, 1997; Mayer & Frantz, 2004) and prefer more innovative thinking (Leong et al., 2014, see previous Studies 2 and 3 in Chapter Three). Such evidence suggests that both physical and psychological contact with the natural environment improves our creative performance.

5.2.1. Research gaps

While research has provided insights into the relationship between nature and our creative performance, it has also identified several areas of uncertainty. First, while previous studies suggested that nature exposure might increase creativity (Atchley et al., 2012; Ferraro, 2015), the robustness of such findings is unclear since no comparable control conditions were used. The lack of adequate control conditions constitutes a barrier to effective investigation because the effects of nature exposure on creativity have traditionally been tested against a waitlist control group (limited physical activity or nature exposure) in an urban environmental exposure condition (e.g., Atchley et al., 2012; Ferraro, 2015). Therefore, significant confounding factors such as walking, which can influence creativity (Oppezzo & Schwartz, 2014), or cognitive stressors associated with navigating in a busy city environment, might explain the previously noted effects.

Next, it is unclear whether exposure to the natural environment will facilitate divergent-thinking creative performance, i.e., the capability to generate as many creative ideas as possible (Guilford, 1950, 1956). To date, research from the creativity literature has focussed purely on convergent-thinking creative performance. Earlier studies have reported links between a) exposure to specific characteristics of the natural environment such as indoor plants and convergent-thinking creative performance (Shibata & Suzuki, 2002; Shibata & Suzuki, 2004), and b) immersion in nature and convergent-thinking creative performance (Atchley et al., 2012; Ferraro, 2015). Divergent thinking, however, is the more widely known aspect of creativity and thus of more relevance in the current global context requiring innovation and new ideas. It remains unclear whether divergent-thinking creativity scores can be increased by physical immersion in natural environments. Further to this, if, as we hypothesise,

immersion in nature has beneficial effects on divergent-thinking creative performance, do different kinds of immersion facilitate the production of diverse creative ideas? In other words, we do not know if different engagements with nature influence divergent-thinking creative output. To complicate the question further, we do not know either whether different engagements with nature influence our connectedness with nature, or if this connectedness would help to explain the nature-creativity relationship. To answer these questions, robust empirical evidence is required to determine whether nature experience enhances creative performance. It is also important to investigate possible mechanisms that might explain nature effects on creativity.

5.2.2. Nature engagement, connectedness with nature and divergent-thinking creative performance

In the present study, we investigate whether connectedness with nature plays a role in explaining the relationship between engagement with nature and divergent-thinking creative performance. First, we argue that active engagement with nature is necessary for production of positive connectedness with nature effects. Nature experiences appear to depend on how people engage with their environment and how deep their connection with nature is. While some studies have reported that exposure to or immersion in nature results in greater connectedness with nature (Mayer & Frantz, 2004; Mayer et al., 2009; Weinstein et al., 2009), Vining, Merrick, and Price (2008) argue that this sense of connectedness may vary depending on one's experiences with nature. A sense of connectedness will perhaps depend not just on immersion in nature, but also on the way we engage with nature. How we engage with nature may influence how strongly connected we feel to it (Vining et al., 2008). For

all that, we propose that active engagement with nature is a key step in enhancing the individual's connectedness with nature.

Second, we posit that engagement with nature may influence connectedness with nature and, in turn, facilitate divergent-thinking creative performance. Mayer et al. (2009) investigated the mediating role of connectedness with nature on the relationship between exposure to nature and our cognition. They reported that a creativity-related cognitive outcome (the ability to reflect) was improved after a walk in a nature reserve (as opposed to a walk in an urban setting) and that this effect was partially mediated by connectedness with nature. When comparing highly controlled nature conditions (virtual versus actual nature), they also reported that connectedness with nature marginally mediated the effects of condition on the ability to reflect. This indicates that connectedness with nature may play a role in influencing cognitive outcomes after exposure to nature.

There are several possible explanations for this plausible nature-creativity link. Some studies seem to suggest, for example, that connectedness with nature may influence creativity due to affective and well-being processes (Leong et al., 2014, see previous Studies 2 and 3 in Chapter Three). Yet the findings of Leong et al. (2014, see previous Studies 2 and 3 in Chapter Three) indicate that connectedness with nature constitutes an important link to creative cognitive style beyond alternative explanations of positive affect and well-being. Another possible explanation relates to perspective taking. Mayer and Frantz (2004) suggest that developing connectedness with nature expands people's knowledge of the ecological diversity of nature. An individual who feels connected to nature pays closer attention to the dynamics of the natural environment. He/she will also increase his or her knowledge of the natural world, which will lead to wide-ranging changes in individual perception of the natural

environment and its rich interdependencies. The skill involved in taking a different perspective appears similar to creative thinkers' perspective-taking ability, which may help in generating more creative ideas (Grant & Berry, 2011; Hoever et al., 2012). The ability to adopt diverse perspectives appears important for understanding how connectedness with nature relates to creativity. Connectedness with nature may therefore explain the relationship between engagement with nature and divergent-thinking creative performance.

5.2.3. Research goal

In summary, this study aims to test whether individuals need to engage purposefully with nature to produce positive effects on creativity, or whether nature exposure (without active attention being given to nature) is in itself sufficient to promote creativity. We tested whether a short nature walking intervention, where participants were instructed to consciously pay attention to the natural environment, was more effective in improving creative performance than a similar exposure in which participants' attention was not centrally focussed on that natural environment. We predicted that focussed engagement with nature would improve creative performance. In other words, after a focussed engagement with nature, the creative performance of the focussed engagement group would improve compared to the performance of a non-focussed engagement group. We also predicted that the effect on creativity scores of engaging with nature would be mediated by a person's feeling of connectedness with nature. This study aims to add to our understanding of the ways in which the natural environment plays an important role in increasing our creative impetus. The findings will have potentially significant implications for promotion of conservation efforts, and may thereby translate into opportunities for further nature engagement and connection.

5.3. Method

5.3.1. Participants

Ninety-three volunteers (M = 25.93 years; 73.6% female) participated in the study. Power analysis using the average meta-analytic effect size of nature exposure across all outcomes (Hattie et al., 1997) and an alpha level of .80 suggested a sample of 70 for the required total number of participants. This means that our study was sufficiently powered (Faul et al., 2007).

5.3.2. Materials

Creative Outdoor Adventure Task. We used two five-item versions of the Creative Outdoor Adventure Task (adapted from various divergent thinking creativity measures (Lee et al., 2012; Leung & Chiu, 2010; Leung et al., 2008)) to measure creativity (divergent thinking). Participants were required to generate as many ideas as possible for each item within a span of three minutes. A sample item includes "*Think of as many possible improvements as you can to a regular backpack, making it more interesting, more useful and more presentable*". Two coders, blind to the experimental conditions and hypotheses of the study, were asked to evaluate on a 5-point scale (from 1 = very uncreative, to 5 = extremely creative) the originality of each idea produced. A high score suggests a stronger capacity to produce creative ideas (for more information on the validity, see Amabile (1983a), Silvia et al., (2008)). The originality ratings showed good intraclass reliabilities (intraclass correlation coefficient [ICC] = .82 & .73, for time 1 and time 2 respectively). The average scores across the two coders were used to measure creativity.

Connectedness to Nature Scale. We measured the more stable dispositional aspect of connectedness with nature at time 1, using the Connectedness to Nature

scale (e.g., "*I think of the natural world as a community to which I feel belong to*" and "*I often feel disconnected from nature*" (reverse scored))(Mayer & Frantz, 2004). At time 2, we measured the state level or spontaneous feeling of connectedness with nature with an adapted version of the Connectedness to Nature Scale (e.g., "*Right now, I feel a sense of togetherness with the natural world around me*") (Mayer et al., 2009; Weinstein et al., 2009). A higher score indicated greater levels of connectedness with nature (rated on a 5-point Likert scale, from 1 = strongly disagree, to 5 = strongly agree). The reliability was .74 at time 1 and .79 at time 2.

5.3.3. Procedure

The study used a 2 (Engagement in nature: Nature focussed versus unfocussed) x 2 (time: before versus after) mixed measures design. It took place within the world's first fully fenced eco-sanctuary, situated in a valley on the outskirts of Wellington, New Zealand. Upon arrival at the eco-sanctuary, participants completed a version of the creativity test, a connectedness with nature survey, and demographics-related information (time 1). They were then randomly assigned to a treatment condition specified on a personal activity sheet (see Appendix F). This activity sheet (collected at the end of the walk) required participants to record either their observations, or their tally of footsteps and reflections, at various checkpoints. In the unfocussed attention condition, participants were instructed to count their footsteps during the walk and to reflect, at seven checkpoints along the way, on personal experiences unrelated to nature (they were asked, for example, to write a sentence about a recent university paper or about a meal eaten last week). In the focussed attention condition, participants were instructed to pay attention to specific aspects of the natural environment while walking (e.g., the sounds of nature heard and the birds seen), and to reflect on nature-related experiences at the checkpoints. Questions about the procedure were answered on an

individual basis and participants were instructed not to communicate with one another while walking. Post-experimental debriefs suggested that our manipulations were successful and that individuals were unaware of the different activities given to other participants. Having received their individual tasks, people walked in groups of four to seven. The joint walking of people assigned to the two different conditions allowed us to control for weather and for environmental and social conditions, with the major difference being the experimental condition assigned to each individual during the walk. All groups were led by the same researcher along the same walking track, which followed a sealed road beside a lake in the valley (approximately 500m), then a well-graded dirt road through some undergrowth (approximately 800m). Participants then walked beside a stream (approximately 600m) and came back to the sealed road for the return to the Visitor Centre. After the walk, which lasted approximately 40 minutes, participants completed the second set of the creativity test and the connectedness with nature survey (time 2 measures), both in the same location. Each participant was given a movie voucher to compensate him/her for the time given to the study.

5.4. Results

There were no pre-existing differences between the two conditions in terms of trait connectedness with nature $F(1,91) = .23$, $p = .63$, and creativity scores, $F(1,91) = .11$, $p = .74$. Table 16 shows all the statistically significant correlations between the scores for originality at both times, and connectedness with nature at time 2. Originality scores after walking in nature correlate significantly with connectedness with nature scores at time 2. These significant correlations establish a link between connectedness with nature and creativity scores such as originality after nature experiences.

Table 16

Descriptive Statistics and Correlations between Connectedness with Nature and Originality Scores.

Variable	*M*	*SD*	CNS	Originality time 1
CNS	3.69	.68	-	
Originality time one	14.65	4.64	.12	-
Originality time two	14.71	4.52	.25*	.80**

Note. CNS: Connectedness to Nature Scale at time 2.
* $p < .05$, ** $p < .01$

To test our main hypothesis, we conducted a mixed measures ANOVA to examine the effects of condition on creativity scores. The main effect for time was not significant: $F(1,91) = .04$, $p = .85$, $\eta_p^2 = .00$; nor the main effect for nature engagement manipulation: $F(1,91) = .78$, $p = .38$, $\eta_p^2 = .01$. There was a marginally significant trend (one-tailed) for an interaction between time and nature engagement manipulation: $F(1,91) = 2.53$, $p = .06$, $\eta_p^2 = .03$ (see Figure 2 for a visual display of the overall findings). We further explored the simple effects by conducting two dependent *t*-tests. Although non-significant, our results indicated the trend of a small decrease in creativity scores from time 1 to time 2 for the control group: $t(46) = 1.01$, $p = .32$, 95% CI [-.42, 1.24], Cohen's $d = .30$; and a small creativity increase over time for the focussed group: $t(47) = -1.24$, $p = .22$, 95% CI [-1.39, .33], Cohen's $d = -.37$. These effect sizes are comparable to a previous meta-analytical effect size of .34 (Hattie et al., 1997) and to the effect size (.41) of Study 1 for the effectiveness of outdoor programmes in pre-post-test studies. Furthermore, an independent *t*-test analysis revealed that the focussed engagement group had higher creativity scores at time 2, compared to the non-focussed engagement group: $t(91) = 1.36$, $p = .18$, 95% CI [-.58, 3.12], Cohen's $d = .28$. This effect size is comparable to the effect size of .26 reported in Study 1 for the effectiveness of outdoor programmes in experimental studies.

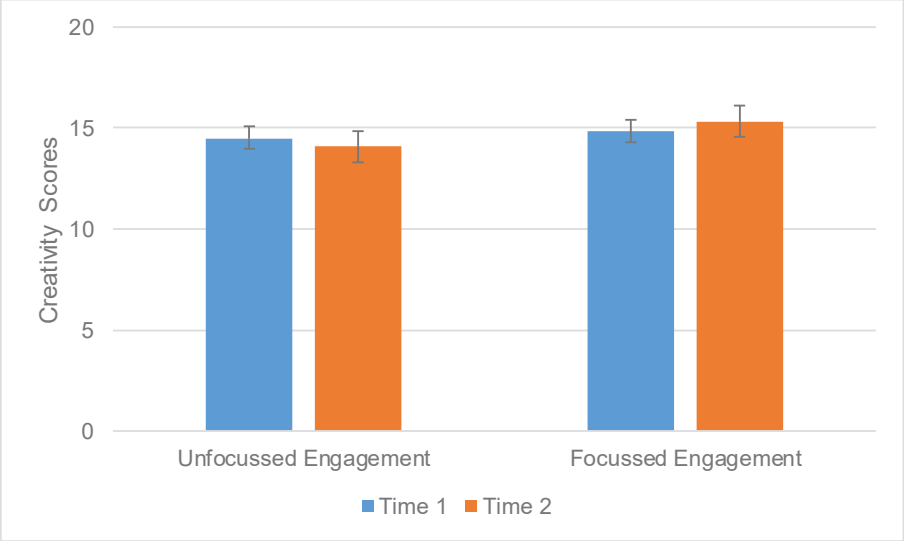

Figure 2. Creativity scores for the unfocussed and focussed engagement with nature conditions.Standard errors are represented in the figure by the error bars attached in each column.

Next, to test whether our manipulation of engagement in nature indeed had an influence on creativity performance through subjective feelings of connectedness with nature, we performed a mediation analysis, using 5000 bootstrapping resamples and bias-corrected 95% confidence intervals (Hayes, 2012). Figure 3 displays the results. The experimental manipulation was marginally significant for connectedness with nature ($B = .27$, $t(91) = 1.93$, $p = .06$), whereas the experimental manipulation effect on creativity ($B = 1.27$, $t(91) = 1.36$, $p = .18$) was non-significant. The path from subjectively rated connectedness with nature to creativity ($B = 1.52$, $t(90) = 2.20$, $p < .05$) was significant. Importantly, the indirect effect of engagement with nature on creativity through connectedness with nature was significant ($B = .41$; CI = .03 to 1.15). In other words, connectedness with nature mediated the association between the engagement with nature manipulation and originality scores.

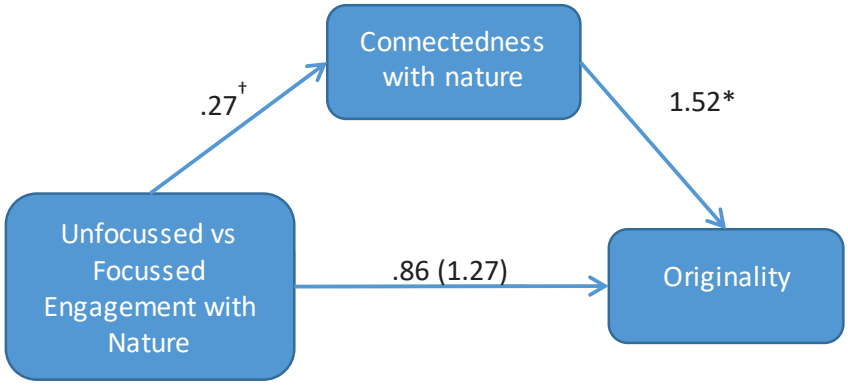

Figure 3. Indirect effect of engagement with nature on originality scores through connectedness with nature.

* $p < .05$ † $p < .06$

We also tested the homogeneity of regression slopes to rule out possible interactions between the engagement with nature manipulation (IV) and connectedness with nature (mediator). No significant interaction was found: $F(1,89) = 3.20$, $p > .05$, $R^2 = .03$. In other words, the relationship between connectedness with nature and originality scores did not change as a result of the engagement with nature manipulation, and, inversely, connectedness with nature did not affect the association between our manipulation and originality scores.

5.5. Discussion

This study presents a rigorous examination of the nature-creativity argument and suggests a general trend of higher creativity after a focussed engagement with nature manipulation. Although the effects were insignificant, we reported a small to moderate effect size of .37 for an increase in creativity over time, which was comparable to the benchmark of Study 1 and previous meta-analyses for outdoor programmes (Cason & Gillis, 1994; Hans, 2000; Hattie et al., 1997). Instead of using a prolonged nature experience as earlier studies have done (Atchley et al., 2012; Ferraro, 2015), this study examined a more practical and cost-effective approach,

which could be achieved in other contexts by taking a short nature walk during lunch breaks, classroom activities, etc.

Our findings point to the mediating effect of connectedness with nature on nature engagement and creativity. This study breaks new ground in that by having participants follow the same walking route for both conditions (focussed and unfocussed engagement with nature), it controlled confounding variables such as physical and cognitive demands. It also compared effects on creative performance by using the same natural environment, but changing the focus of attention. These advances allow us to better estimate the effect of engagement with the natural world than may have been achievable in previous research where important factors were not controlled (Atchley et al., 2012; Ferraro, 2015). Experiments conducted in the natural environment allow us to study participants in a more authentic setting than is possible within a laboratory. This offsets, to some extent, the limitations resulting from limited experimental control over extraneous situational factors.

Given the constraints of our tightly controlled study (i.e., a number of confounds in previous studies were ruled out to compare a nature-focussed versus nature-unfocussed engagement manipulation in real world settings), it is not surprising that our results are small and only marginally significant. Previous studies used weak controls and found relatively strong effects. In our more stringent test, connectedness with nature was found to mediate the relationship between creativity and focussed engagement with nature, even though the direct effects were only marginally significant. Our findings overall are consistent with those of Mayer et al. (2009), who for natural versus urban conditions found a mediating effect of connectedness with nature on the relationship between nature and the ability to reflect, and a marginal mediating effect when comparing highly controlled nature

conditions (virtual versus actual nature). Even though our effects in this study are only marginally significant, our data converges with the conclusions reached in earlier studies (e.g., Atchley et al., 2012; Ferraro, 2015): outdoor activities may facilitate our creative performance. Moreover, the diversity of samples that have been examined (in the United States, Singapore and–in this study–New Zealand (Atchley et al., 2012; Ferraro, 2015; Leong et al., 2014, see previous Studies 2 and 3 in Chapter Three) points to the potential universality of these phenomena.

5.5.1. Limitations and future research

A number of factors may explain the limitations of our findings. First, unlike classical laboratory experiments, running experiments in the natural environment might present certain levels of bias. Each experimental session comprised two conditions concurrently in that participants from both conditions engaged with and walked in nature in combined groups each numbering four to seven people. Had this not been part of the process, however, the effects of unpredictable weather or other external influences might have adversely affected the nature experience and impacted on the ability for certain conditions to be inspired by or to connect with nature. Using the traditional design of one condition within a session would have prevented us from studying the participants in a more authentic environment for group nature walks, and may fail to replicate normal situations for nature walk groups in which members engage with nature differently. To manage the issues of independence, participants were instructed to concentrate on their assigned task and not to communicate with others during the experiment. It is likely therefore that these compromised sessions would attenuate the effects of the study, but would also lessen the risk of dependencies.

It is also unclear whether the tasks in the two conditions were equivalent in terms of cognitive demands. No quantitative measure was taken of how carefully those allocated to the focussed attention condition paid attention to nature. In this current study, the intention in having one group count their footsteps and recount an experience was to inhibit their senses and their ability to attend to the environment. To achieve this, qualitative data was collected using the activity sheet, which provided some evidence that the participants were engaged in their specific tasks during the walk.

Next, even with randomised assignment there is a possible assignment bias, as the state measure of connectedness with nature was collected at post-test but not at pre-test. Our estimate of individual differences between conditions was based solely on the trait measure of connectedness with nature collected at pre-test. For a more robust comparison, future research might consider measuring both states of connectedness with nature at both pre- and post-test.

Despite its small effects, our study has raised some future research directions for investigation. The first of these relates to the importance of further research to investigate the optimal dosage of nature exposure. It is plausible that longer periods of exposure may result in increased improvements in divergent thinking. We suggest two ways of investigating the dose response of nature exposure. First, future research needs to investigate the dose effects of such exposure. In principle, a between subject design with duration as the independent variable may shed light on this issue of exploring the effect of an optimal dosage of nature exposure on creativity and other cognitive measures. Second, researchers may wish to study the impact of repeated exposure to nature over time, so as to examine whether repeated nature experiences are more efficient in achieving optimal cognitive effects. Another future research

direction would be to extend this study and compare the pre- and post-test effects of focussed versus unfocussed engagement conditions in both natural and urban environments. Although the comparison of nature and urban conditions may seem somewhat biased given their opposite environmental characteristics, such a study might test whether effects of contact with nature are due to the natural environment or attention levels. There is a possibility that it would reveal information regarding the process of focussed and unfocussed attention in different environments.

5.5.2. Implications

This study has stimulated us to consider how we can enrich people's engagement with nature. In the long term, it would be prudent to cultivate people's sense of connectedness with nature and promote the socio-emotional and cognitive benefits resulting from nature experiences. While some researchers suggest that spending more time in the natural world and having direct contact with it would increase connectedness with nature (Geng et al., 2015), others argue that the way we engage with nature influences the strength of our connection to it (Vining et al., 2008). The consequences of nature experiences appear to depend on how people engage with what is around them and on the depth of their psychological connection with nature. Focussed engagement with nature may play an important role in developing a stronger sense of connectedness with it, and this may in turn influence related variables such as creativity.

Judging from an educational perspective, practitioners may need to think of ways to stimulate people to feel more connected with nature. One method of focussing engagement with nature links to a current outdoor education approach, 'slow pedagogy of place' (Payne & Wattchow, 2010). Such an approach involves slowing down and interacting with the natural world, perhaps observing the natural

surroundings more closely, or interacting with the environment (e.g., planting a seedling and nurturing it over time as it grows into a plant or tree). Those who receive exposure to new nature experiences may form thereby an emotional and cognitive bond with nature, and may in turn increase any potential benefits to be reaped from such natural experiences and connectedness.

5.6. Conclusion

In sum, the findings of this study suggest that connectedness with nature is a potential variable for understanding how engagement with nature can increase creative performance. This indicates that an appreciation of the ways nature affects humans may be important for improving human well-being and performance. Previous research has highlighted that people who have a stronger sense of connectedness with nature are more likely to exhibit creative behaviour (Leong et al., 2014, see previous Studies 2 and 3 in Chapter Three). Given the importance of developing a creative society for economic progress (APEC Human Resources Development Working Group, 2011; Trilling & Fadel, 2009), the creative benefits unleashed by exposure to the natural environment will hopefully provide further motivation for people to support an active outdoor lifestyle and relevant policy in promotion of this.

5.7. Acknowledgments

This study was supported by Massey University and Karori Sanctuary Trust (who kindly waived the participants' entrance fees to Zealandia). We gratefully acknowledge Associate Professor John Spicer's constructive feedback, the assistance of Dr Xiaodan Gao, whose feedback was so helpful to us, and the valuable contribution of the university students who participated in the experiments.

CHAPTER 6. GENERAL DISCUSSION

"I have always believed that a blighted urban landscape, a concrete jungle destroys the human spirit. We need the greenery of nature to lift our spirits."

Lee Kuan Yew

6.1. Introduction

This thesis builds on existing research evidence relevant to the effects of contact with nature and critically examines these effects on psychological abilities. This thesis has used a multi-method approach (i.e., comprising different quantitative methods) across four studies to investigate: first, the effectiveness of outdoor experiences on associated outcomes and the ways to enhance any reported positive effects; second, whether creative people have similar characteristics to nature lovers; and third, whether different types of engagement with nature impact on creativity.

In this chapter, I will begin by summarising the main findings from the four studies. Next, I will engage in a theoretical discussion based on my research and suggest some avenues for future investigation. I will finally outline my methodological critique and contribution before concluding with a review of the practical implications of this thesis.

6.2. Summary of main findings

The first part of the thesis evaluates the overall effectiveness of contact with nature in the form of outdoor experiences on various psychological outcomes studied. Study 1 summarised the studies of outdoor interventions and evaluated some potential factors that may be manipulated in order to enhance the effectiveness of such programmes. The fifteen outcomes studied included variables relating to self-concept, life effectiveness, affect, well-being, and group processes. Overall, the review of the

studies showed statistically significant, but relatively modest, improvement in personal and social outcomes due to outdoor interventions. It was found that outdoor experiences were more effective for primary school students than for students at secondary or university level. Moreover, school-organised programmes and programmes conducted in Asian countries reported greater effect sizes than similar programmes conducted in non-Asian countries. Furthermore, with regard to the effects of outdoor interventions, no differences were reported in terms of the respective impact of short and long programmes. Finally, Study 1 showed there is a paucity of studies investigating the effects of contact with nature on cognitive outcomes.

Studies 2 and 3 examined the association between a psychological connectedness with nature and different creativity measures. The studies were designed to address the above research gap identified in Study 1 by investigating the cognitive effects of contact with nature. These studies were inspired by research (Atchley et al., 2012; Ferraro, 2015) that demonstrates positive effects of prolonged exposure to nature on creativity requiring convergent thinking. Study 2 found that students who are more closely connected with nature are more likely to prefer creative cognitive styles such as innovative and holistic thinking.

Study 3 tried to replicate the finding that students who have a closer connection with nature are more likely to prefer creative cognitive styles such as innovative and holistic thinking. The aim of the study was to rule out alternative affective explanations. Additionally, the study found that people who are more connected with nature are more likely to generate creative ideas by controlling for alternative creativity-related explanations. It, therefore, reported a positive association

between nature connectedness and divergent thinking, a key creative process. Findings of Studies 2 and 3 support the nature-creativity relationship.

Finally, Study 4 further investigated this nature-creativity relationship using an experimental design that included connectedness with nature as a mediator. The findings of Study 4 showed that the average creativity scores for the sample improved after focussed engagement with nature, but these did not reach statistical significance. First, after engaging with nature, there was a small decrease in the creativity level for participants in the unfocussed condition and a small increase for those in the focussed condition, as compared to their pre-test creativity scores. Second, participants in the 'focussed engagement with nature' condition scored higher in creativity than those in the unfocussed condition. The reported effect sizes were similar to those of Study 1 and Hattie et al. (1997), which both reported the effectiveness of outdoor experiences on personal and social outcomes. More importantly, this final study of the thesis reported a statistically significant, but relatively modest, mediation effect of connectedness with nature on the relationship between nature engagement and creative performance.

In short, a common feature of all the studies is that they assessed the effects of contact with nature, either physical exposure to or psychological connectedness with it (or both). Their findings are consistent with the idea that contact with nature is beneficial for us, particularly in terms of influencing our creativity.

6.3. Theoretical discussion

Working from a cross-disciplinary perspective, this thesis has expanded current understanding of the nature-creativity relationship by exploring the contributions connectedness with nature may make to the creativity research. Ulrich (1993) has argued that exposure to natural surroundings may improve creative

thinking, though previous research (Atchley et al., 2012; Ferraro, 2015) has focussed on physical exposure to natural stimuli and spaces. In addition to these previous findings of positive creative effects associated with physical interaction with nature, findings from this thesis have revealed several ideas that may inform our understanding of the effects of contact with nature, mainly in terms of creativity outcomes.

6.3.1. Understanding the effects of contact with nature on our cognition

This thesis suggests three main points regarding the understanding of the impact of contact with nature. First, there are many and varied benefits to be derived from contact with nature, through outdoor experiences. The effect sizes reported in Study 1 were consistent with those of previous meta-analyses regarding the effectiveness of outdoor experiences: The findings of Study 1 generally support previous meta-analytical evidence (Bowen & Neill, 2013; Gillis & Speelman, 2008; Hans, 2000; Hattie et al., 1997; Staunton, 2003; S. J. Wilson & Lipsey, 2000) which points to the effectiveness of outdoor interventions for improving various psychological outcomes. Study 1 has found relatively modest improvement in various psychological outcomes (such as self-concept, life effectiveness, affect, well-being, and group processes) due to outdoor interventions. These findings are consistent with the biophilia hypothesis perspective (E. O. Wilson, 1984), whereby immersion in the non-threatening natural world plays a beneficial role for most humans.

Second, the intensity of feeling one might have of a psychological connection with nature is positively correlated with creativity. Based on the correlational evidence between an open personality and creativity (Ee et al., 2007; McCrae, 1987) and openness and connectedness with nature (Nisbet et al., 2009), past research has suggested that people who are more connected with nature are more creative. Studies

2 and 3 ruled out alternative explanations and reported that connectedness with nature is a significant predictor for three creativity outcomes: innovative thinking, creative self-efficacy, and divergent thinking. Such findings demonstrate significant positive associations between connectedness with nature and different processes of creativity.

Several explanations can be provided for the positive associations between connectedness with nature and creativity. A number of earlier studies suggest that connecting with non-threatening nature fosters positive affect, which in turn influences our thoughts and actions. For example, Ulrich (1993) postulates that restorative natural environments support positive affective states such as reduced stress and fatigue, and that physical exposure to natural environments may facilitate creativity. Similarly, Isen (1999) argues that positive affect encourages creative thinking, as happy people are more likely to make links between ideas and see a variety of connections between stimuli. Despite the need for further evidence to clarify why restorative environments support positive affect, these studies are in line with suggestions from two theories. The Broaden-and-Build Theory of positive emotions (Fredrickson, 2001) suggests that positive emotions encourage novel, varied, and exploratory thoughts and actions, all of which will enable creative thinking. Overall, these studies and theories are consistent with the idea that positive emotions evoked by connecting with nature, which in turn foster creativity.

However, although several more recent studies have confirmed that connectedness with nature increases levels of happiness, other kinds of positive affect, and vitality (Capaldi et al., 2014; Cervinka et al., 2012; Nisbet & Zelenski, 2011; Nisbet et al., 2011), the positive emotions and well-being status evoked by connectedness with nature do not completely account for the nature-creativity link. Study 3 showed that connectedness with nature continues to be significantly related to

innovative thinking when well-being is controlled. This finding indicates that the explanation of positive shifts in emotional states alone is unlikely to explain the observed correlation between connectedness with nature and creativity. There are three possible explanations. First, the correlation may have something to do with whether the people are already creative. In other words, it is possible that creative people are more connected with nature than those who are not creative. Second, it is also possible that other variables such as openness to experiences or perspective taking may explain this relationship. It has been shown that openness to new experiences is a crucial factor in generating innovative ideas (Ee et al., 2007), while perspective taking is considered to provide accessibility to new ideas (Galinsky et al., 2008) and has been found to enhance creativity (Hoever et al., 2012). Unfortunately, current correlational evidence is unable to provide any causal explanation of these associations.

Another third possible explanation of the positive association between connectedness with nature and creativity is that increased connectedness with nature might foster creativity performance. Study 4 has demonstrated that connectedness with nature mediates the effects of focussed nature engagement (acute rather than long exposure to nature) on creativity. Previously, Mayer et al. (2009) reported that exposure to nature increased connectedness with nature, and that this led to a heightened ability to reflect on a life problem (identified by the authors as a complex cognitive-emotional process). Consistent with Mayer et al. (2009), the current research suggests that exposure to nature affects people's thinking because they are focussed during their engagement with nature. When focussed during engagement with nature, people are mindful of and interested in their natural surroundings. They may, for instance, listen to the different birdsongs, observe the kingfisher hunting for

food, or wonder about the existence of an algal bloom in the lake. Being focussed may increase their sense of connectedness with the natural world and, in turn, their creativity. Possibly, deeper engagement with the natural world when we are in it triggers a more complex cognitive process, which allows us to generate diverse creative ideas. This means that in addition to other factors associated with physical exposure to the natural environment that may affect our creativity, greater engagement with that environment promotes creative thinking.

Third, the amount of time spent in nature may affect associated outcomes related to contact with it. Previous researchers (Hattie et al., 1997) have shown the effectiveness of longer (e.g., more than twenty days) outdoor programmes for a wide variety of learning outcomes associated with self, interpersonal skills, well-being, and other competencies. Research in environmental psychology (Barton, Griffin, & Pretty, 2012; Barton & Pretty, 2010; Pretty et al., 2007) reported positive effects of acute exposure (e.g., five minutes) to natural environments on well-being indicators such as self-esteem and mood. Mayer et al. (2009) have reported significant effects of short nature exposure lasting ten minutes for other cognitive-emotional outcomes such as the ability to reflect. In contrast, Atchley et al. (2012) and Ferraro (2015) have reported the creative benefits of prolonged outdoor participation (three days).

However, some researchers (Laidlaw, 2000) have found no differences in the impact between short and long outdoor programmes. Consistent with the findings of Laidlaw (2000), my analyses in Study 1 reported no differences, so both short and long exposures to natural surroundings were equally beneficial for our affect and behaviour. Study 1 has also shown similar effects of outdoor experiences between short and long exposure. These findings are consistent with the idea that short exposures might affect our cognition. On the basis of the non-significant trends of

increased creativity levels after greater engagement with nature reported in Study 4, these findings might not have much relevance for real world application. It remains unclear whether short contact with nature may be sufficient to accrue associated benefits for creativity. For pragmatic reasons, it is important to clarify whether short exposures to nature are as effective for creative benefits because for many people taking three days away from work or study is a luxury in today's society.

6.3.2. Benefits of contact with nature may not be universal

This thesis indicates that contact with nature has differential impacts for different groups of people. First, adults benefit more from outdoor experiences than some other groups of people. The meta-analyses in Study 1 revealed that working adults and school students benefitted most from outdoor interventions. This finding is consistent with findings of previous studies. Some reported that outdoor programmes were more beneficial for adults than for other participant groups (Gillis & Speelman, 2008; Hattie et al., 1997) while others found that outdoor programmes were good for younger children and adolescents (Cason & Gillis, 1994; Marsh, 1999b). Generally speaking, working adults appeared to benefit more from outdoor programmes than most school and university students did. Hattie et al. (1997) suggest the difference may be because the adults had usually taken leave from work to attend such programmes, so were more goal-orientated and motivated to gain maximum learning outcomes. Alternatively, the adults may well have regarded participation in these outdoor programmes as equivalent to a vacation. Some researchers (de Bloom et al., 2009) suggest that adults benefit from vacation in terms of their health and well-being, so the restorative effects of vacation might explain any reported beneficial effects.

Second, the impact of outdoor experiences differs according to different student profile groups. Focussing on the effect sizes for educational groups, Study 1 also revealed that primary school students benefitted most from outdoor interventions, as compared to before participation. This is followed by secondary, and, lastly, university students who also benefitted from such interventions. One possible explanation could be that some groups of students (e.g., university level) already engage with nature in a more 'substantial' way than others. In contrast, primary school students who received fewer opportunities for outdoor exposure may have experienced a more intensive physical and psychological interaction with the natural environment in a pre-post-test comparison. In other words, they may have received a higher 'out of their comfort zone' challenge, as compared to their older and more experienced counterparts, and hence benefitted more from such interventions.

Alternatively, from an educational perspective, these differential effects might be explained by the specific developmental stage of a given student group. According to many developmental psychology theorists (e.g., Piaget, 1970; Vygotsky, 1978), a child passes through a number of developmental stages. It is possible therefore that contact with nature might be more effective for learners at certain stages of development. During the concrete operational stage (Piaget, 1970) for example, children are becoming less egocentric in thinking and more observant of their surroundings. The activities during outdoor interventions are often designed as experiential and team-oriented. If participating children are at the concrete operational stage and become more aware of others' unique thoughts and feelings, they may be more curious and feel greater motivation to participate and may learn more about social skills during such interventions. Similarly, from a Vygotskyian perspective (Vygotsky, 1978), outdoor experiences might provide children with unique social

opportunities to engage in activities in their 'zone of proximal development'–the 'space' where they can be 'scaffolded' by parents, teachers, or older siblings to do things (cognitively) that they are not able to do alone. This 'zone' is where key developmental changes occur. Practitioners might ask themselves therefore how they can encourage students to engage more with nature at different stages in order to reap optimal benefits from being in nature.

The effects of contact with nature also appear to differ across cultures. Previous research (Hattie et al., 1997; Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010; Pretty et al., 2007) has shown the benefits of contact with nature among participants living in a number of countries such as Australia, Japan, the United Kingdom, and the United States, and this evidence supports the evolutionary perspectives of the biophilia hypothesis. Such perspectives notwithstanding, Study 1 reported significant differences between Asian and non-Asian samples in terms of the effectiveness of outdoor programmes. It appears that the effects of contact with nature may differ as a result of socio-cultural factors (e.g., cross-cultural differences, family backgrounds) or perhaps biogeographical differences. Study 1 suggests that cross-cultural variability exists in the context of outdoor programmes. Anthropomorphism of nature–attributing human characteristics to nonhuman–for instance, is common in different cultures (Epley et al., 2007). This suggests that people from different cultures may view elements of the natural world differently and some may be more connected with nature than others. Such cross-cultural differences might influence effects of outdoor experiences. In addition, Collado et al. (2016) reported fewer restorative benefits in leisure contact with nature for children from agricultural family backgrounds than for children who had spent only free time in the same natural environments. Such evidence suggests that socio-cultural factors (e.g., cross-cultural

differences, family backgrounds) or biogeographical differences may influence the effects of contact with nature.

6.4. Potential avenues for future research

The hypothesis that contact with nature has psychological benefits, especially relating to an understanding of the nature-creativity relationship, is still in its infancy. Research on this topic has revealed a number of important areas that require further investigation. To further develop this understanding of the relationship, three directions for future research are discussed below.

6.4.1. Deriving new propositions

Most studies of the effects of outdoor interventions have been criticised for their limited exploration of the potential underlying mechanisms explaining the effects of outdoor programmes (Ewert, 1987; Hattie et al., 1997). While it is important to clarify the psychological impact of contact with nature, an understanding of causal pathways involved is of more importance. Having established the relationship between connectedness with nature and creativity, Study 4 of this thesis experimentally manipulated the independent variable (engagement with nature) and controlled some of the other related variables in order to study the causal relationship between contact with nature and creativity. Although this thesis identifies the construct of connectedness with nature as a possible mechanism in the nature-creativity relationship, little is known about how nature might affect our creativity. This section therefore outlines two possible explanations to further develop the contact with nature/creativity effects observed here: perspective taking and analogical thinking.

Perspective Taking Hypothesis. One possibility is that connectedness with nature is associated with perspective taking that allows people to see things differently and perhaps solve problems in a novel fashion. According to Epley and Caruso (2009), perspective taking refers to a mental capacity to embrace someone else's views and consider their emotions, thoughts, and states of mind. It has been argued that perspective taking promotes creativity (Galinsky et al., 2008; Grant & Berry, 2011; Hoever et al., 2012). Hoever et al. (2012) have demonstrated, for instance, that instructing people to take other team members' perspectives enabled teams that included people of different backgrounds to perform more creatively than homogeneous teams. Although our relationship with nature might not possess the reciprocity that relationships with other people do, having a stronger sense of connection with nature might also encourage us to consider non-egocentric perspectives. This suggests that people who are more connected with nature may see things from a perspective more closely linked to the natural world.

Connectedness with nature may foster perspective taking. This idea is consistent with the findings of Tam (2013), who has demonstrated that people who feel more connected with nature show stronger dispositional empathy with nature, which involves the ability to adopt the perspective of nature. They may, for example, observe specific features (such as plants, insects, or animals) of the natural environment, wonder about a certain behavioural feature, and try to understand the reasons behind it. If insects are observed at home, they might often be regarded as pests and perhaps be exterminated. In home gardens, someone less connected to nature might also prune the 'damaged' leaves with holes left by insects such as caterpillars in them. By contrast, people who are connected with nature might perhaps understand the interdependence between the plant and the caterpillars. Their

connection with nature will allow them to adopt the perspective of nature, and to consider the ecological importance of caterpillars: the plant may provide a food source for the caterpillars, but it will also depend on their adult form, i.e., as butterflies, for pollination. As a result, people who are connected with nature might not think in terms of killing the caterpillars, and will even appreciate their existence. An example such as this one suggests that being connected with nature may encourage us to widen our perspectives so as to adopt some concept of the existence of other living things. Such perspective-taking skills may be translated into creative problem solving.

Thus, future research may consider investigating perspective taking as a mechanism to explain how creative ideas are generated when someone is more connected with nature. Experiments may test if creativity is higher among participants who are more connected with nature and who adopt a perspective of nature, for instance. Such studies certainly enable a more intricate theoretical understanding of how contact with nature affects our creativity.

Analogical Thinking Hypothesis Contact with nature might also engage analogical thinking; in other words, the cognitive process whereby information is used from one domain (i.e., the first analogy, termed the *source*) to assist in problem solving in another domain (i.e., the second analogy, termed the *target*) (Gick & Holyoak, 1980). Typically, someone who is more familiar with and who has a deeper understanding of the source (i.e., the expert) can use it to draw inferences regarding the target, and this allows analogical transfer, i.e., the transfer of information from one domain to solve problem in another domain (Holyoak, 2005). Analogical thinking is a complex cognitive process which involves retrieving information from long-term memory, and mapping systematic connections between analogues in working memory

so as to generate new inferences about target, and thus form new abstract schemas. By contrast, a novice might not be able to engage easily in analogical thinking.

Extending this to the nature-creativity relationship, analogical thinking may possibly explain how our thinking is affected by immersion in and connection to the natural world. Nature and the natural systems in the natural world provide a variety of potential analogues as inspirational sources. As indicated above, experts 'see' the things in their domain of expertise at a deeper level–that is, they understand how two, superficially different 'objects' may be the same (and vice versa) because they understand the deeper causal and functional aspects of the objects within their area of expertise. Perhaps someone who is more connected with nature also 'sees' these deeper aspects of natural 'objects'. They may identify flora and fauna species, or notice the biodiversity and the natural systems, and as a result feel more connected with nature. These natural observations may serve as potential sources for analogical transfer. With in-depth knowledge of the natural world, people who are more connected with nature can possibly map systematic connections between the natural world source and the targeted analogue, thus drawing new inferences in order to form new abstract schemas for creative problem solving.

Thus, analogical thinking may explain how some creative works, such as biomimicry inventions (see below), are generated after the immersion in nature of those who have created them. There have been many famous works of art, music, and literature created as a result of the inspiration provided by nature. The 'Water Lilies' art series by Claude Monet, 'Symphony No. 6' by Beethoven, and 'Grasses' by the Chinese poet Bai Juyi count among these. Besides artworks, examples of biomimicry have demonstrated that nature and natural systems serve as inspirations for creative thinking and innovation. Some researchers, for instance, created a biomimetic solar

cell design after being inspired by the morphology of leaves; and this now serves as a light harvesting system in nature (J. B. Kim et al., 2012). This design has achieved significant gains in light absorption of solar cells and has increased the efficiency of human-made solar energy harvesting systems. Such anecdotal evidence suggests that the natural world may provide inspirational analogues for cognition, which may in turn be translated into creative problem solving. Future studies may test if people who are more connected with nature generate more creative ideas because of increased analogical thinking when exposed to nature.

Using both perspective taking and analogical thinking to explain the nature-creativity relationship, these ideas appear to suggest the importance of being focussed during our engagement with nature. This is consistent with our finding that creativity levels are enhanced by the increased connectedness that we experience when we are focussed during engagement with our natural surroundings. This proposal of increased focus during contact with nature includes two distinct ideas.

Firstly, the variety of living things in the environment may keep us more focussed when engaging with the surroundings. Some researchers (Cracknell, White, Pahl, Nichols, & Depledge, 2016) have demonstrated that people spend more time viewing an aquarium exhibit with the highest stocking level of marine life; this suggests a heightened interest generated by increased marine biota levels. The implication is that higher biota levels might increase our focus when we are observing a very 'busy' natural environment full of visible insects, animals, plants, and natural phenomena. This may in turn provide more opportunities to be inspired by more natural items and the associations between them.

Secondly, connectedness with nature may influence our ability to focus during nature engagements. Similar to the 'experts' versus 'novices' explanation in the

analogical thinking process, someone who is more connected with nature (like an expert) might be more interested and able to 'see' more varied/diverse things and associations in nature (e.g., can identify different epiphytes in a tree) than others who feel no connection, or who are less connected. Although the 'busy-ness' of an environment may be dependent on our observational ability to make discriminations, this ability is, in turn, driven by our expertise about the natural environment. This suggests that our focus during engagement with nature might increase with a stronger connection to it. In any event, it is also possible that different natural environments inspire different kinds of thinking, and that some are more inspirational than others. In other words, the advantages that accrue from the environment may depend on the variety of things in in a particular environment, and different natural environments might have different cognitive implications. When in such environments, the ability to stay focussed in our engagement seems to play a crucial role in enhancing our chances of perspective taking and analogical thinking. This proposition lays the groundwork for further research in this area, as increased creativity benefits may be associated with a stronger sense of connection to nature when we are focussed during engagement with our natural surroundings.

6.4.2. Potential dose-response patterns of physical contact with nature

Future research could further investigate the dose-response relationship to clarify the cognitive effects of contact with nature. Some studies have demonstrated that the duration of outdoor experiences may influence their effects. Study 1 revealed that both long and short outdoor experiences were equally effective for personal and social outcomes. Little is known about how different cognitive abilities are affected by the duration of interactions with natural environments. Study 4 suggested that short nature experiences might possibly influence our creativity. By manipulating the

duration of nature exposure, a repeated measures study, for example, would provide valuable insight into the optimised dose of duration in terms of its effects on creativity.

Alternatively, future studies could examine the impact of repeated exposures (either long or short exposures), because one-off exposure to nature may not be sensitive enough to influence associated variables such as connectedness with nature and creativity. Study 1 showed that the beneficial effects of outdoor experiences did not last. This implies that one-off exposures might gain temporary effects, while lasting effects could perhaps require repeated exposures over time. Some studies have suggested that more contact with nature may enhance our sense of connectedness with it (Mayer & Frantz, 2004; Mayer et al., 2009; Nisbet et al., 2009; Weinstein et al., 2009). It may take some time to develop a relationship, but more time and effort will certainly be required to sustain a close relationship. This being the case, repeated exposures to nature might be necessary for us to connect with it, as time is required to cultivate such connectedness. In the previous illustration of the analogical thinking process (see section 6.4.1), for instance, repeated exposures could help to develop familiarity with and deeper understanding of the natural world in order to become an expert able to draw inferences to solve problems. By manipulating the number of repeated exposures to nature (varying between long and short duration), a repeated measures study, for example, would provide valuable insight into how repeated exposures might affect our connectedness or creativity.

6.4.3. Differential effects of contact with nature

This thesis has demonstrated differential effects of outdoor experiences (reported in Study 1), and this highlights the need for future research to better clarify these effects. As discussed earlier, the benefits of such interventions varies for

different groups of students, and this may be due to their prior experiences regarding contact with nature, developmental stages, or other factors associated with the various group profiles. To better understand the effects of contact with nature, future researchers could consider clarifying the impact of the above-mentioned factors on such effects. A pragmatic consideration is that such investigations could also better inform policies and allow practitioners to provide a developmentally appropriate learning experience in nature.

Future studies might also investigate the interaction between culture and familiarity with types of natural environment, in order to develop a culturally appropriate programme design and evaluative measures for such contact. The findings of Study 1 showed that outdoor experiences can have different impacts for Asian and non-Asian participants. Given the variety of socio-cultural factors or biogeographical differences associated with different groups of human beings, some people might be more familiar with being in nature. If this proposition holds, it will challenge previous studies implying that certain environments are more beneficial for people because of their natural properties (e.g., forest/greenery versus water). If some cultures are more exposed to certain types of nature than others (Arabs, for example, are more familiar with desert than with green landscapes), would contact with unfamiliar types of natural environment have the same psychological impact on them?

The familiarity one has with a certain environment might perhaps affect the effects of contact with nature. It has been argued that blue spaces (i.e., areas with lakes, oceans, rivers) may have a greater positive impact on psychological health than green spaces. This notion is supported by Nutsford, Pearson, Kingham, and Reitsma (2016) who found that after controlling for covariates such as personal income, housing quality, population density, and crime rate, increased visibility of oceanic

views was significantly associated with lower psychological distress for New Zealanders, but that there were no significant effects reported for green space visibility. People unfamiliar with blue spaces, however (e.g., those living in desert terrain, or inland) might not experience similar effects to New Zealanders, for whom typical landscapes consist significantly of blue spaces. Future researchers could investigate whether beneficial effects of contact with nature are due to certain characteristics of the natural environment or to other factors such as familiarity with particular surroundings.

6.5. Methodological considerations and recommendations

This section discusses the suitability of current research strategies used to investigate the impact of contact with nature, and suggests plausible ways of enhancing future research strategies. Both published literature and the current research are used to illustrate some of the key issues.

First, there is a need to employ more sophisticated experimental designs when studying contact with nature. Based on the meta-analytical review in Chapter Two, pre-post-test design seems to be a common way to study the impact of outdoor interventions. A problem with this design, however, is that the post-test results may be influenced by pre-test experiences resulting from practice effects on creativity tests. The between-group design is another common method used, but in this there is a possibility of selection bias. In Ferraro (2015), for example, random assignment is not possible when participants are self-selected to participate in an outdoor intervention as compared to participants of the control group, who have taken part in no such intervention. To address some of these concerns, future researchers can consider other research methods such as the Solomon four group design (to avoid the associated issues with the pre-post-test design); or waitlist controls to account for selection bias.

Second, some innovative changes are needed to the usual ways of investigating the impact of contact with nature. Within the field of environmental psychology, most studies have used the design of comparing natural environment and urban conditions. Such comparison is problematic, given the number of potential confounding variables that exist in two very different environments.

One possible approach is to control for extraneous variables. Study 4 develops and designs a tighter research protocol in the study of contact with nature than had previously existed. The strengths of this protocol boil down to three main aspects. Firstly, in order to obtain a clearer idea of the way in which engagement influences creativity, Study 4 compares two active conditions during exposure to nature but varies the level of engagement with nature. The comparison of two active nature conditions aims to control for other factors that may differ between nature and urban environments. The fact, for example, that one needs to be vigilant for traffic in urban areas may skew the comparison between the two environments, as such factors are unlikely to exist in the non-threatening natural settings frequently used in experiments. Secondly, there are often high levels of statistical noise when conducting an experiment in the field. Given that better cognitive functioning and well-being are typically associated with higher levels of physical activity (Scully, Kremer, Meade, Graham, & Dudgeon, 1998; Sibley & Etnier, 2003; Weuve et al., 2004), physical activity levels may explain the positive effects of exposure to nature. By having the two conditions occurring simultaneously and in the same place, participants from both conditions were exposed to almost identical environmental experiences (e.g., weather, natural events, nature exposure), social interactions (no communication was allowed), and levels of physical activity (similar walking speed and distance). This allows us to make better causal inferences when such confounding variables are controlled for.

Thirdly, this experiment allows for random assignment so that the effect of the experiment is not confounded as a result of selection biases (e.g., Ferraro, 2015).

The design of the protocol can also include strategies to control for research biases. For example, Study 4 had certain limitations as well. Firstly, the participants were aware when they volunteered that they had to take part in a nature walk for about forty-five minutes. This may have created a selection bias for those who enjoyed walking in nature. Although this bias should have applied to both conditions, I tested to see whether any systematic differences for connectedness with nature existed in the pre-test. Secondly, a pre-post-test design may lead to testing bias, especially when responding to similar questions twice after a short intervention, so the order of surveys was counterbalanced. There were also two creativity tests with different items used. To avoid fatigue effects, the number of items measuring the underlying constructs was kept to a minimum. Lastly, it is possible that some participants did not adhere to our instructions and were tempted either to communicate with others or, in the case of the control group, to observe the natural surroundings.

To manage these potential problems, we: a) stressed the importance of observing the research protocol, b) provided participants with an activity sheet to complete throughout the walk (the aims of this being to keep them focussed on their assigned task and to check for anyone who was distracted from their task), and c) intervened when certain participants tried to communicate with others or deviated from their task. The experimenter will intervene when necessary in order to maintain tighter control and complete an observation form (see Appendix F) at the end of each session to note environmental situations (e.g., weather conditions) and any experimental concerns that have arisen. Another important problem is experimenter

bias, as the experimenter would know what condition each participant was in and was not therefore blind to condition. To minimise this bias, the experimenter was provided with a set of standardised protocols to give the same instructions for every experimental session comprising both conditions occurring concurrently. In addition, the coders for the creativity tests were not involved during the experimental stages and were therefore blind to the conditions.

Lastly, the process of conducting the research for this thesis has highlighted two further methodological recommendations that are relevant to the study of contact with nature. Firstly, there is a need for unpublished studies to be registered in an open access depository. This would allow all reports of contact with nature, including insignificant evidence, to be more readily accessible for research purposes. Although conducting a meta-analysis is one possible approach that may inform policy and future research directions, the availability of this depository would enable researchers to gain insight into various research protocols used previously, and to design more effective protocols for future investigations. Given the demanding resources required for outdoor research, this may prevent researchers from reinventing the wheel, and would perhaps avoid pitfalls of one kind or another in such research. With the possible presence of statistical noise when studying the impact of contact with natural environments, future studies would require stronger designs and larger sample sizes than previous studies have had, in order to better examine any effects. Researchers could perhaps also consider replicating the effects of previous statistically significant studies in order to validate such effects.

Secondly, there is a need for effective and useful research that would help to bridge the gap between laboratory and quasi-experiments. Laboratory studies are likely to be reliable and have a high internal validity, as they allow us to control

statistical noise, examine specific relationships, and increase precision, but may prevent our understanding of the complexity of the phenomena (i.e., a lack of external validity). Quasi-experiments, on the other hand, can be very challenging to conduct in a robust scientific manner, as they lack the control of confounding variables when studying real world phenomena, but may have high ecological validity because of their natural setting. It is therefore possible to generalise their findings to a real-life setting. Randomised controlled experiments in the field may therefore be one possible bridge between laboratory and quasi-experiments. The design of Study 4 provides such an example, in which participants were randomly assigned to different conditions in the natural environment and minor interventions were made to control possible statistical noise. It is no easy task to create a bridge of the sort indicated, but such designs may accrue combined benefits that neither laboratory experiments nor quasi-experiments could provide alone. Therefore, future research directions could build on the success and failure of previous research and adapt more effective and useful methodologies to explore further the complex understanding of the nature-creativity phenomenon.

6.6. Practical implications

"If we want children to flourish, to become truly empowered, then let us allow them to love the earth before we ask them to save it. Perhaps this is what Thoreau had in mind when he said, 'the more slowly trees grow at first, the sounder they are at the core, and I think the same is true of human beings'."

David Sobel

This thesis suggests that students could benefit from contact with the natural environment (outdoor education) and from cultivating a sense of connection with

nature. Study 1 showed the effectiveness of outdoor programmes for different outcomes (relating to self, interpersonal skills, well-being, and other competencies) among different levels of students, especially at primary level. The findings reported in the remaining studies are consistent with the idea that contact with nature may be beneficial to students. Regular learning trips to a natural environment may engender a shift in thinking after connecting with nature. Such outdoor activities might include a collection of factors (physical activity, natural surroundings, and possible deep engagement with nature) that will be likely to have positive effects on our cognition. Students who prefer to stay in their familiar urban/suburban environments so as to engage with 'technological interactions' may, by contrast, lack the opportunities to learn to connect with nature and to have a deeper engagement with it. It is important for students to be exposed to different environments (both outdoors and indoors) in order to reap combined benefits that neither natural nor indoor environments could provide alone.

One challenge, however, is to consider ways to deepen students' sense of connectedness with nature. Studies 2 and 3 showed that students who are more connected with nature are more likely to be creative. Study 4 suggested, moreover, that in addition to other factors associated with physical exposure to the natural environment, greater engagement with that environment promotes creative thinking due to increased connectedness with it. One possibility is to encourage students to have deeper engagement (i.e., pay more attention to, observe, explore, and learn about natural details) during nature experiences in order to effect a connection. Mere instructions, however, may not easily accomplish the mission of deeper engagement with nature. Educators may need to encourage interesting activities that tap students' intrinsic motivations and that, in turn, require them to pay close attention to their

surroundings, and 'use' the natural environment to achieve these intrinsically motivating goals. Students who are used to watching TV or to playing on PlayStations may not find it easy, given their lack of connectedness with nature, to come up with activities that accomplish this objective of a deeper engagement. It might take time for these students to become used to outdoor experiences before they can develop a sense of connectedness with nature and enjoy (or benefit) from such experiences.

It is recommended that schools do not view outdoor education programmes as a 'one size fits all' solution. According to our meta-analytical findings in Study 1, primary students tend to benefit more from outdoor intervention than students do at secondary or university levels. In other words, a 'one size fits all' intervention might not be effective, given the differential impacts for different cohorts of students. We do not know, for instance, whether the thinking of students at different developmental levels is affected similarly by contact with nature. Alternatively, the different effects could be a result of the way different cohorts of students are treated at school or the experiences they tend to have in a certain culture/educational system. We need a much more comprehensive understanding of the ways individual participant factors (e.g., age, personality, cultural background, and gender) as well as situational factors (e.g., dose, type of environment, and types of activities in that environment) might impact on the nature-cognition relationship.

Given the benefits associated with nature experiences, my findings suggest that it is a good idea to start introducing students to natural environments at a young age. Some schools, for example, have introduced nature-inspired education in their early childhood curriculum (O'Brien, 2009; Schäffer & Kistemann, 2012), while other school systems have introduced outdoor education in primary schools (Ministry of Education Singapore, 2016; Zink & Boyes, 2006). Perhaps children could be exposed

to outdoor learning and start cultivating connectedness with nature at a young age, such as those in the forest kindergartens (see Schäffer & Kistemann, 2012), in order to accrue benefits and skills associated with outdoor experiences.

6.7. Final conclusion

Although common sense and a few scientific studies on prolonged outdoor participation suggest that contact with nature may be beneficial for creativity, most research has limited its focus to the effects of direct, 'acute' exposure to natural environments. This thesis has summarised the effectiveness of contact with nature (including connection and engagement with nature) on creativity. A number of the studies in this thesis have included research that uses data from Asian samples, notably Singapore. More importantly, this is the first research project to investigate the relationship between a psychological connectedness with nature and elements of creativity, and to examine the mediating role of this connectedness with regard to changes in creativity before and after focussed versus unfocussed engagements in nature. Students who feel a closer connection with nature are more likely to exhibit creative traits and behaviour. Additionally, focussed engagement with nature can boost our creative thinking for divergent creativity tasks by strengthening a sense of connectedness with nature. Given the novelty of this nature-creativity research, there is a need to develop a comprehensive theoretical framework to investigate the mechanisms that underpin the relationships between these factors. More research using larger samples is needed to replicate the findings and to further examine the underlying processes that explain how contact with nature facilitates creativity. It would be of great value to see more environmental psychology studies focussing on investigation of the nature-creativity effects. Given our hectic urban lifestyles, answers to these questions may do more than provide evidence of an outdoor avenue

for the fostering of creativity in educational settings. It is also my hope that our increasingly urbanised society can adopt a more outdoor lifestyle and avoid a 'nature-deficit' society divorced from nature.

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Appendix B: Online Materials for Study 2

Letter of Information

What is the purpose of this research?

This research will allow us to gain a better understanding of how outdoor adventure activities affect educational outcomes in an educational setting.

Who is conducting the research?

This research is conducted by Carmen Leong, a PhD student of the School of Psychology at Victoria University of Wellington. The project is supervised by Dr Ron Fischer and Prof John McClure.

To participate in this research, you must be between 13-18 years of age

What is involved if you agree to participate?

If you agree to participate in this study, you will complete a confidential survey where you will respond to questions such as "I found the activity very interesting." We anticipate that the survey will take you no more than 30 minutes to complete. During the research, you are free to withdraw at any point before submitting the surveys.

Privacy and Confidentiality

Your responses, as well as your personal identity will remain completely anonymous. You and your school will never be identified in this research project or in any other presentation or publication. The information you provide will be coded by number only. Please do not write your name or any identifying information on the questionnaire itself. In accordance with the requirements of some scientific journals and organisations, your coded data may be shared with other competent researchers. A copy of the coded data will remain in the custody of Ms Leong, Dr Fischer and Prof McClure.

What happens to the information that you provide?

The data you provide may be used for one or more of the following purposes:
- The overall findings may be submitted for publication in a scientific journal, or presented at scientific conferences.
- The overall findings may form part of a PhD thesis that will be submitted for assessment and a summary of the findings may be shared with governmental and non-government agencies aiming to improve outdoor education programmes.

Consent of participation

Please note that by completing and returning the questionnaire to the researcher online you agree that your survey responses will be used and analysed.

If you would like to know the results of this study, they will be posted as a downloadable PDF by April 2013 on the Centre for Applied Cross-Cultural Research website: http://cacr.victoria.ac.nz/.

If you need any clarifications, please contact Ms Leong at Carmen.Leong@vuw.ac.nz

Thank you very much for your help and cooperation.

Warmest Regards

Carmen Leong, Dr Ron Fischer, and Prof John McClure

Online Questionnaire

- ❍ I would like to participate in this research. (1)
- ❍ I do not want to participate in this research. (2)

If I do not want to participat... Is Selected, Then Skip To End of Survey

Section 1: Information about You

Q1 My height is _____ cm (1)

My weight is _____ kg (1)

Q2 Are you…?

- ❍ Male (1)
- ❍ Female (2)

Q3 In which year were you born?

- ❍ 1994 (1) _____
- ❍ 1995 (2)
- ❍ 1996 (3)
- ❍ 1997 (4)
- ❍ 1998 (5)
- ❍ 1999 (6)
- ❍ 2000 (7)

Q4 What is the first name of your mother/ caretaker?

Q5 Where are you born?

Q6 Are you…?

- ❍ a Singapore citizen (1)
- ❍ a Singapore permanent resident (2)
- ❍ a foreign student (3)

Q7 Are you studying at… ?

- ❍ Secondary One (1)
- ❍ Secondary Two (2)
- ❍ Secondary Three (3)
- ❍ Secondary Four (4)
- ❍ Secondary Five (5)

Q8 What is your ethnic background?

- ❑ Singaporean Chinese (1)
- ❑ Singaporean Malay (2)
- ❑ Singaporean Indian (3)
- ❑ Singaporean Eurasian (4)
- ❑ Singaporean mixed ethnicity (5)
- ❑ Others (please specify below) (6) _____

Q9 What is your mother tongue/ native language?

- ❍ Mandarin (1)
- ❍ Malay (2)
- ❍ Tamil (3)
- ❍ Other languages (please specify below) (4) _____

Q10 Have you participated in an outdoor adventure camp before?

- ❍ Yes (1)
- ❍ No (2)

Answer If Have you participated in an outdoor adventure camp before? Yes Is Selected

Q11 If you have participated in an outdoor adventure camp before, write down the number of outdoor adventure camps you have attended so far:

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ more than 8 (10)

Section 2: Your Views

A Listed below are a number of statements about your thoughts, feelings, and behaviours. Select the option that best matches your agreement or disagreement with each statement. Use the following scale, which ranges from "strongly disagree" to "strongly agree". There is no right or wrong answer.

Everything in the universe is somehow related to each other. (1)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
Nothing is unrelated. (2)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
Everything in the world is connected and influences each other. (3)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
Any small changes at one place may have great effects on others. (4)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
There are many causes to everything, even though you may not know them all. (5)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
An event can have many different consequences, even though you may not know them all. (6)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
It is better to stay in the middle than going to extremes. (7)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)

Where there is a disagreement, it is best to find a solution that makes everyone happy. (8)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
It is more important to find a solution than to argue who is right or wrong when people disagree. (9)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
It is best to be in harmony, rather than conflict, when people disagree. (10)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
Choosing a middle ground in an argument should be avoided. (11)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
We should avoid having extreme opinions. (12)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
Everything that happens in the world is predictable. (13)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
A person who is currently living a successful life will continue to stay successful. (14)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
An individual who is currently honest will stay honest in the future. (15)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
If an event is moving toward a certain direction, it will continue to move toward that direction. (16)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
Current situations can change at any time. (17)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
Future events are predictable based on present situations. (18)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
The whole event, rather than the details, should be considered in order to fully understand it. (19)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
It is more important to pay attention to the whole than its parts. (20)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
The whole is greater than the sum of its parts. (21)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)

It is more important to pay attention to the whole context rather than the details. (22)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
It is not possible to understand the parts without considering the whole picture. (23)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)
We should consider the situation a person is faced with, as well as his/her personality, in order to understand one's behaviour. (24)	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agre e (6)	Strongly Agree (7)

Section 3: Your Views about the Environment

This section looks at what you think about the environment.

Q23 Please answer each of these questions in terms of the way you feel generally. There is no right or wrong answer. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

I often feel a sense of oneness with the natural world around me. (1)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I think of the natural world as a community to which I belong. (2)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I recognise and appreciate the intelligence of other living organisms. (3)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I often feel disconnected from nature. (4)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
When I think of my life, I imagine myself to be part of a larger repeated process of living. (5)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I often feel a relationship with animals and plants. (6)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I feel as though I belong to the Earth as equally as it belongs to me. (7)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I have a deep understanding of how my actions affect the natural world. (8)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I often feel part of the web of life. (9)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)

I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'. (10)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Like a tree can be part of a forest, I feel surrounded within the broader natural world. (11)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. (12)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees. (13)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
My personal welfare is independent of the welfare of the natural world. (14)	Strongly disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)

Below are more statements about how you feel about the environment.

Q24 For each of the following, please rate the extent to which you agree with each statement, using the scale from 'strongly disagree' to 'strongly agree' as shown below. Please respond as you really feel, rather than how you think "most people" feel.

I enjoy being outdoors, even in unpleasant weather. (1)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Some species are just meant to die out or become extinct. (2)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Humans have the right to use natural resources any way we want. (3)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
My ideal vacation spot would be a remote, wilderness area. (4)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I always think about how my actions affect the environment. (5)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I enjoy digging in the earth and getting dirt on my hands. (6)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)

My connection to nature and the environment is a part of my spirituality. (7)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I am very aware of environmental issues. (8)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I take notice of wildlife wherever I am. (9)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I do not often go out in nature. (10)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Nothing I do will change problems in other places on the planet. (11)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I am not separate from nature, but a part of nature. (12)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
The thought of being deep in the forest, away from modern society, is frightening. (13)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
My feelings about nature do not affect how I live my life. (14)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Animals, birds and plants should have fewer rights than humans. (15)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Even in the middle of the city, I notice nature around me. (16)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
My relationship to nature is an important part of who I am. (17)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Conservation is unnecessary because nature is strong enough to recover from any human impact. (18)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
The state of animals, birds and plants may tell us about the future for humans. (19)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I think a lot about the suffering of animals. (20)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I feel very connected to all living things and the earth. (21)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)

For each of the following item, please circle a number that best describes you.

There is no right or wrong answer, and your first responses are usually the most accurate.

Has original ideas (1)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is always full of ideas (2)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is encouraging (3)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Copes with several new ideas at the same time (4)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Will always think of something when stuck (5)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Would rather create something new than improve something old (6)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Has fresh views on old problems (7)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Often risks doing things differently (8)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Likes to vary set routines at a moment's notice (9)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Prefers to work on one problem at a time (10)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Can stand out in disagreement against group (11)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Needs the stimulation of frequent change (12)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Prefers changes to occur gradually (13)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is thorough (14)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Takes great care in every detail (15)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is organised and efficient (16)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Enjoys detailed work (17)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is always hardworking (18)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is consistent (19)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Keeps a good order of things that I can control (20)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)

Can easily understand and work within the rules and regulations (21)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Conforms (22)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Readily agrees with the team at work (23)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Never seeks to bend or break the rules (24)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is not doing things without teachers' permission (25)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is careful when dealing with teachers (26)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Feel comfortable with precise instructions (27)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Is predictable (28)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Prefers friends who follow the rules (29)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Like teachers and study patterns which are consistent (30)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Works according to instructions (31)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)
Holds back ideas until obviously needed (32)	Not at all like me (1)	Not much like me (2)	Somewhat like me (3)	Quite a lot like me (4)	Just like me (5)

Section 6: Your General Feelings

This last section is about your general feelings over the past few weeks. Below are a series of statements with which you may either agree or disagree. Please select an option which best represents your views over the past few weeks (WHAT YOU THINK), using the scale below. There is no right or wrong answer, and your first responses are usually the most accurate.

	Never (1)	Sometimes (2)	Often (3)	Almost Always (4)
I like the way things are going for me. (1)				
My life is going well. (2)				
My life is just right. (3)				
I would like to change many things in my life. (4)				
I wish I had a different kind of life. (5)				
I have a good life. (6)				
I feel good about what's happening to me. (7)				
I have what I want in life. (8)				
My life is better than most of my peers. (9)				

Below are a series of statements with which you may either agree or disagree.

Please select an option which best represents your feelings over the past few weeks, using the scale below. There is no right or wrong answer, and your first responses are usually the most accurate.

	Strongly Agree (1)	Agree (2)	Disagree (3)	Strongly Disagree (4)
On the whole, I am satisfied with myself. (1)				
At times, I think I am no good at all. (2)				
I feel that I have a number of good qualities. (3)				
I am able to do things as well as most other people. (4)				
I feel I do not have much to be proud of. (5)				
I certainly feel useless at times. (6)				
I feel that I'm a person of worth, at least on an equal plane with others. (7)				
I wish I could have more respect for myself. (8)				
All in all, I am inclined to feel that I am a failure. (9)				
I take a positive attitude toward myself. (10)				

Please select an option which best represents your feelings over the past few weeks, using the scale below. There is no right or wrong answer, and your first responses are usually the most accurate.

	None of the time (1)	Rarely (2)	Some of the time (3)	Often (4)	All of the Time (5)
I've been feeling optimistic about the future. (1)					
I've been feeling useful. (2)					
I've been feeling relaxed. (3)					
I've been feeling interested in other people. (4)					
I've had energy to spare. (5)					
I've been dealing with problems well. (6)					
I've been thinking clearly. (7)					
I've been feeling good about myself. (8)					
I've been feeling close to other people. (9)					
I've been feeling confident. (10)					
I've been able to make up my own mind about things. (11)					
I've been feeling loved. (12)					
I've been interested in new things. (13)					
I've been feeling cheerful. (14)					

Below are some characteristics that may be used to describe different feelings and emotions.

In this section we are interested in your feelings over the past few weeks (HOW YOU FEEL). There is no right or wrong answer, and your first responses are usually the most accurate.

	Very slightly or not at all (1)	A little (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
Interested (1)					
Sad (2)					
Frightened (3)					
Alert (4)					
Excited (5)					
Ashamed (6)					
Upset (7)					
Happy (8)					
Strong (9)					

Nervous (10)					
Guilty (11)					
Energetic (12)					
Scared (13)					
Calm (14)					
Miserable (15)					
Jittery (16)					
Cheerful (17)					
Active (18)					
Proud (19)					
Afraid (20)					
Joyful (21)					
Lonely (22)					
Mad (23)					
Fearless (24)					
Disgusted (25)					
Delighted (26)					
Blue (27)					
Daring (28)					
Gloomy (29)					
Lively (30)					

The following questions relate to how you have been feeling over the past weeks. Please choose the option which best applies to you.

Have you recently…

Been able to concentrate on whatever you are doing? (1)	Better than usual (1)	Same as usual (2)	Less than usual (3)	Much less than usual (4)
Been losing confidence in yourself? (2)	Not at all (1)	No more than usual (2)	Rather more than usual (3)	Much more than usual (4)
Felt that you were playing a useful part in things? (3)	More so than usual (1)	Same as usual (2)	Less useful than usual (3)	Much less useful (4)
Lost much sleep over worry? (4)	Not at all (1)	No more than usual (2)	Rather more than usual (3)	Much more than usual (4)
Felt capable of making decisions about things? (5)	More so than usual (1)	Same as usual (2)	Less so than usual (3)	Much less capable (4)
Felt constantly under strain? (6)	Not at all (1)	No more than usual (2)	Rather more than usual (3)	Much more than usual (4)
Been able to face up to your problems? (7)	More so than usual (1)	Same as usual (2)	Less able than usual (3)	Much less able (4)
Felt that you couldn't overcome your difficulties? (8)	Not at all (1)	No more than usual (2)	Rather more than usual (3)	Much more than usual (4)
Been able to enjoy your normal day-to-day activities? (9)	More so than usual (1)	Same as usual (2)	Less so than usual (3)	Much less than usual (4)

Been feeling unhappy and depressed? (10)	Not at all (1)	No more than usual (2)	Rather more than usual (3)	Much more than usual (4)
Been feeling reasonably happy all things considered? (11)	More so than usual (1)	About same as usual (2)	Less so than usual (3)	Much less than usual (4)
Been thinking of yourself as a worthless person? (12)	Not at all (1)	No more than usual (2)	Rather more than usual (3)	Much more than usual (4)

Debriefing Form

Thank you very much for participating in our study. The research is part of a larger project that involves the understanding of how outdoor adventure activities in schools will affect educational outcomes with students.

Outdoor adventure activities have been integral to Singapore secondary school curriculum. Today, it is very common for students to attend outdoor adventure camps in Singapore and overseas. Previous research has shown that outdoor adventure activities are associated with educational benefits but little is known about the processes underlying the programme and outcome relationship. As these activities are very resource demanding, it is important for us to understand its role in education and the underlying psychological processes during the activities.

When psychology researchers design a research study with a specific group, it is important to ensure that the research design is accurate and valid. One way of doing this is to pilot the study and test the relationship between the concepts. Therefore, in this study we use a variety of tests, including measures of creativity, well-being, intrinsic motivation, self-efficacy, personality traits, environmental attitudes and fear of heights. We expect that the introduction of outdoor adventure activities will show a specific pattern and relationship with the abovementioned criterion measures.

If the results of this pilot study meet our assumptions, we can be confident that the modified version of the research design is reliable for outdoor adventure activities research participants, including adolescents.

The research is important because it gives us the necessary tools to understand the processes affecting people in outdoor adventure educational contexts. The results of the study will be posted as a downloadable PDF by April 2013 on the CACR website: http://cacr.victoria.ac.nz/.

Thank you again for participating in the research.

Warmest Regards

Carmen Leong, Dr Ron Fischer, and Prof John McClure

Appendix C: Materials for Study 3

Letter of Research Request to Schools (Sample)

Date: 10 September 2012

Principal

School

RESEARCH ON OUTDOOR ADVENTURE ACTIVITIES IN SINGAPORE SCHOOLS

1. I am a MOE education officer who is currently on overseas leave, doing my PhD with School of Psychology, Victoria University of Wellington, New Zealand. I am working with my supervisors, Prof John McClure and Dr Ronald Fischer to examine the effects of Outdoor Adventure Education programmes on educational outcomes like creativity and well-being.

2. We are seeking your school's participation by sending **one hundred and twenty students** to take part in this research. This research is open to all **secondary one - three students,** aged 13-15 years old.

3. More information can be found in Research Information Sheet and more details can be discussed and co-designed with your teacher in-charge via e-mail once your school's participation is confirmed.

4. I would appreciate it if you could confirm your school's participation in the research by emailing the School Approval Form (Annex A) to Carmen.Leong@vuw.ac.nz by 30 September 2012.

5. Upon your approval, I will contact Data Administration Centre, Ministry of Education, for their approval. Finally, I will also be submitting an ethics approval application to School of Psychology Ethics Committee, Victoria University of Wellington, New Zealand.

6. For clarifications, please contact the undersigned via email Carmen.Leong@vuw.ac.nz .

7. I would be grateful for the opportunity to work with your school to support my contribution for the OE field. The information collected will be part of my academic work which I look forward to share with your school so we can work together to plan future OE programmes more effectively.

8. Thank you.

Warmest Regards,

Carmen Leong,Dr Ron Fischer, and Prof John McClure

RESEARCH INFORMATION SHEET

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Due to research protocols, the information in this document should not be released to participants to avoid any potential biases in the data collected. (Note: The final proposal is subjected to changes depending on the pilot study data.)

Title of Research: The psychology of outdoor adventure education in a modern society

Purpose of Research: This research will allow us to gain a better understanding of how outdoor adventure activities may enhance adolescents' creativity and well-being more than other types of activities in an educational setting.

Researcher(s) involved: This research is conducted by Carmen Leong, a PhD student of the School of Psychology at Victoria University of Wellington. The project is supervised by Dr Ron Fischer and Prof John McClure. Upon approval by the school Principal and Ministry of Education, Singapore, this research will be approved by the School of Psychology Human Ethics Committee under delegated authority of Victoria University of Wellington's Human Ethics Committee.

Participants: We are seeking your school's participation by sending at least **one teacher-in-charge** as the coordinator and **one hundred and twenty students** to take part in this research. This research is open to secondary one to three students, **aged 13-15 years old,** as of 1st January 2012.

Time Frame: Before 23 November 2012. During the research, your school is free to withdraw at any point before the studies have been completed.

Survey details: The survey will include a cover letter, a debriefing sheet, and the measures on the following concepts: creativity, self-efficacy, environmental attitudes, personality, and well-being. Additionally, participants will be asked to provide a wide range of demographic data (e.g. gender, year of birth, immigrant status, education status, ethnicity, native language status, and participation information on outdoor adventure activity).

Data Usage: The data your school provides may be used for one or more of the following purposes:

- The overall findings may be submitted for publication in a scientific journal, or presented at scientific conferences; and
- The overall findings may form part of a PhD thesis that will be submitted for assessment.

Privacy and Confidentiality

- The survey is completely anonymous.
- We will keep your school data for at least five years after publication.

- Your school will never be identified in the research project or in any other presentation or publication. All information your students provide will be identifiable by number only.
- In accordance with the requirements of some scientific journals and organizations, your school's anonymous data may be shared with other competent researchers.
- Your school's data may be used in other, related studies.
- A copy of data without identifying names will remain in the custody of Carmen Leong, Dr. Ron Fischer and Prof John McClure.

If you would like to know the results of the study, we will prepare a report for your school upon request via email.

If you have any further question regarding the research, please feel free to contact the investigator listed below.

Thank you for considering participation in this research.

Warmest Regards

Carmen Leong,
Dr Ron Fischer, and
Prof John McClure

Annex A

RESEARCH IN SINGAPORE SCHOOLS
APPROVAL FORM

Email Contact for Completed Forms: Carmen.Leong@vuw.ac.nz

Attention: Carmen Leong

Name of Teacher i/c	:*Dr/Mr/Mrs/Mdm/Miss_____
School teaching in	: _____
Designation / Department	: _____
Contact no(s)	:_____
E-mail address (for us to contact you with regards to research)	:_____
Number of Students Participating	:_____
Number of Teachers Participating	:_____

_____ _____
Date / Signature Principal's Signature

_____
School Stamp

Letter of Information (Participants)

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RESEARCH INFORMATION SHEET

What is the purpose of this research?
This research will allow us to gain a better understanding of how outdoor adventure activities affect educational outcomes in an educational setting.

Who is conducting the research?
This research is conducted by Carmen Leong, a PhD student of the School of Psychology at Victoria University of Wellington. The project is supervised by Dr Ron Fischer and Prof John McClure. This research has been approved by the school principal, Ministry of Education, Singapore, and the School of Psychology Human Ethics Committee under delegated authority of Victoria University of Wellington's Human Ethics Committee.

To participate in this research, you must be
- between 13-18 years of age; and
- a current student of the participating school.

What is involved if you agree to participate?
If you agree to participate in this study, you will complete a confidential survey before and after your school activity where you will respond to questions such as "I found the activity very interesting." We anticipate that the survey will take you no more than 60 minutes to complete. During the research, you are free to withdraw at any point before submitting the surveys.

Privacy and Confidentiality
Your responses, as well as your personal identity will remain completely anonymous. You and your school will never be identified in this research project or in any other presentation or publication. The information you provide will be coded by number only. Please do not write your name or any identifying information on the questionnaire itself. In accordance with the requirements of some scientific journals and organisations, your coded data may be shared with other competent researchers. A copy of the coded data will remain in the custody of Ms Leong, Dr Fischer and Prof McClure.

What happens to the information that you provide?
The data you provide may be used for one or more of the following purposes:
- The overall findings may be submitted for publication in a scientific journal, or presented at scientific conferences.
- The overall findings may form part of a PhD thesis that will be submitted for assessment and a summary of the findings may be shared with governmental and non-government agencies aiming to improve outdoor education programmes.

If you would like to know the results of this study, they will be posted as a downloadable PDF by April 2013 on the Centre for Applied Cross-Cultural Research website: http://cacr.victoria.ac.nz/.

Thank you very much for your help and cooperation.

Warmest Regards

Carmen Leong,
Dr Ron Fischer, and
Prof John McClure

Questionnaire at Time 1

The data collected was used for analysis in Chapter 3.

Section 1: Information about You

1) Height: _____cm Weight: _____kg

2) Are you a… (tick one)? ___ Girl ___ Boy

3) When is your date of birth? ____/ _____/ _____
DD MM YYYY

4) What is the first name of your mother/ caretaker? _____ (e.g. Meilin)

5) Where were you born? _____(e.g. Singapore)

6) Are you…(tick one)?
___ a Singapore citizen ___ a Singapore permanent resident
___ a foreign student

7) Are you studying at… (tick one)?
___ Secondary One ___ Secondary Two
___ Secondary Three ___ Secondary Four
___ Secondary Five

8) What is your ethnic background (tick one)?
____ Singaporean Chinese ____ Singaporean Malay
____ Singaporean Indian ____ Singaporean Eurasian
____ Singaporean mixed ethnicity
____ Others (please specify): _____

9) What is your mother tongue/ native language (tick one)?
____ Mandarin ____ Malay
____ Tamil
____ Other languages (please specify):
_____

10) Have you participated in an outdoor adventure camp before (tick one)?
____ Yes ____ No

11) If you have participated in an outdoor adventure camp before, write down the number of outdoor adventure camps you have attended so far: _____

Section 2: Your Views

A. Below are a series of statements with which you may either agree or disagree. Please circle a number which best represents your views (**WHAT YOU THINK**), using the scale below. There is no right or wrong answers.

1 2 3 4 5

Not true *Very true*

1.	I am good at coming up with new ideas.	1	2	3	4	5
2.	I have a lot of good ideas.	1	2	3	4	5
3.	I have a good imagination	1	2	3	4	5

B. The following questions relate to how you have been feeling. **over the past few weeks** Please CIRCLE the option which best applies to you.

	Have you recently…	Please **CIRCLE** your answer			
1	Been able to concentrate on whatever you are doing?	Better than usual	Same as usual	Less than usual	Much less than usual
2	Been losing confidence in yourself?	Not at all	No more than usual	Rather more than usual	Much more than usual
3	Felt that you were playing a useful part in things?	More so than usual	Same as usual	Less useful than usual	Much less useful
4	Lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
5	Felt capable of making decisions about things?	More so than usual	Same as usual	Less so than usual	Much less capable
6	Felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
7	Been able to face up to your problems?	More so than usual	Same as usual	Less able than usual	Much less able
8	Felt that you couldn't overcome your difficulties?	Not at all	No more than usual	Rather more than usual	Much more than usual
9	Been able to enjoy your normal day-to-day activities?	More so than usual	Same as usual	Less so than usual	Much less than usual
10	Been feeling unhappy and depressed?	Not at all	No more than usual	Rather more than usual	Much more than usual
11	Been feeling reasonably happy all things considered?	More so than usual	About same as usual	Less so than usual	Much less than usual
12	Been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual

C. Below is a list of statements dealing with your general feelings about **over the past few weeks**. If you strongly agree, circle **SA**. If you agree with the statement, circle **A**. If you disagree, circle **D**. If you strongly disagree, circle **SD**.

1.	On the whole, I am satisfied with myself.	SA	A	D	SD
2.	At times, I think I am no good at all.	SA	A	D	SD
3.	I feel that I have a number of good qualities.	SA	A	D	SD
4.	I am able to do things as well as most other people.	SA	A	D	SD
5.	I feel I do not have much to be proud of.	SA	A	D	SD
6.	I certainly feel useless at times.	SA	A	D	SD
7.	I feel that I'm a person of worth, at least on an equal plane with others.	SA	A	D	SD
8.	I wish I could have more respect for myself.	SA	A	D	SD
9.	All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10.	I take a positive attitude toward myself.	SA	A	D	SD

D. For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think "most people" feel.

1	2	3	4	5
strongly disagree	disagree	neutral/neither agree nor disagree	agree	strongly agree

1.	I enjoy being outdoors, even in unpleasant weather.	1	2	3	4	5
2.	Some species are just meant to die out or become extinct.	1	2	3	4	5
3.	Humans have the right to use natural resources any way we want.	1	2	3	4	5
4.	My ideal vacation spot would be a remote, wilderness area.	1	2	3	4	5
5.	I always think about how my actions affect the environment.	1	2	3	4	5
6.	I enjoy digging in the earth and getting dirt on my hands.	1	2	3	4	5
7.	My connection to nature and the environment is a part of my spirituality.	1	2	3	4	5
8.	I am very aware of environmental issues.	1	2	3	4	5
9.	I take notice of wildlife wherever I am.	1	2	3	4	5
10.	I do not often go out in nature.	1	2	3	4	5
11.	Nothing I do will change problems in other places on the planet.	1	2	3	4	5
12.	I am not separate from nature, but a part of nature.	1	2	3	4	5
13.	The thought of being deep in the forest, away from modern society, is frightening.	1	2	3	4	5
14.	My feelings about nature do not affect how I live my life.	1	2	3	4	5
15.	Animals, birds and plants should have fewer rights than humans.	1	2	3	4	5
16.	Even in the middle of the city, I notice nature around me.	1	2	3	4	5

17. My relationship to nature is an important part of who I am.	1	2	3	4	5
18. Conservation is unnecessary because nature is strong enough to recover from any human impact.	1	2	3	4	5
19. The state of animals, birds and plants may tell us about the future for humans.	1	2	3	4	5
20. I think a lot about the suffering of animals.	1	2	3	4	5
21. I feel very connected to all living things and the earth.	1	2	3	4	5

E. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

1 Not at all true **2** Hardly true **3** Moderately true **4** Exactly true

1. I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2. If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3. It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4. I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6. I can solve most problems if I invest the necessary effort.	1	2	3	4
7. I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4
8. When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9. If I am in trouble, I can usually think of a solution.	1	2	3	4
10. I can usually handle whatever comes my way.	1	2	3	4

1 strongly disagree **2** disagree **3** neutral/ neither agree nor disagree **4** agree **5** strongly agree

1. I often feel a sense of togetherness with the natural world around me.	1	2	3	4	5
2. I think of the natural world as a community to which I belong.	1	2	3	4	5
3. I recognise and appreciate the intelligence of other living organisms.	1	2	3	4	5
4. I often feel disconnected from nature.	1	2	3	4	5
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.	1	2	3	4	5
6. I often feel a relationship with animals and plants.	1	2	3	4	5
7. I feel as though I belong to the Earth as equally as it belongs to me.	1	2	3	4	5
8. I have a deep understanding of how my actions affect the natural world.	1	2	3	4	5
9. I often feel part of the web of life.	1	2	3	4	5

10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.	1	2	3	4	5
11. Like a tree can be part of a forest, I feel surrounded within the broader natural world.	1	2	3	4	5
12. When I think of my place on Earth, I consider myself to be a top member of a pyramid that exists in nature.	1	2	3	4	5
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.	1	2	3	4	5
14. My personal welfare is independent of the welfare of the natural world.	1	2	3	4	5

F. Below are some statements about feelings and thoughts **over the past few weeks**. Please circle a number that best describes your experience of each **over the past few weeks**.

	Statements	**None of the time**	**Rarely**	**Some of the time**	**Often**	**All of the time**
1	I've been feeling optimistic about the future.	1	2	3	4	5
2	I've been feeling useful.	1	2	3	4	5
3	I've been feeling relaxed.	1	2	3	4	5
4	I've been feeling interested in other people.	1	2	3	4	5
5	I've had energy to spare.	1	2	3	4	5
6	I've been dealing with problems well.	1	2	3	4	5
7	I've been thinking clearly.	1	2	3	4	5
8	I've been feeling good about myself.	1	2	3	4	5
9	I've been feeling close to other people.	1	2	3	4	5
10	I've been feeling confident.	1	2	3	4	5
11	I've been able to make up my own mind about things.	1	2	3	4	5
12	I've been feeling loved.	1	2	3	4	5
13	I've been interested in new things.	1	2	3	4	5
14	I've been feeling cheerful.	1	2	3	4	5

G. Thinking about ***how you feel over the past few weeks,*** please circle the number (1-5) that best describes your feelings. There is no right or wrong answer, and your first responses are usually the most accurate.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	1	2	3	4	5
Frightened	1	2	3	4	5
Alert	1	2	3	4	5
Ashamed	1	2	3	4	5
Upset	1	2	3	4	5
Happy	1	2	3	4	5
Nervous	1	2	3	4	5
Energetic	1	2	3	4	5
Scared	1	2	3	4	5
Calm	1	2	3	4	5
Active	1	2	3	4	5
Afraid	1	2	3	4	5

H. For each of the following item, choose one of the four sentences that best represents your personal choice.

	1	2	3	4	My Choice
1.	I run very slowly.	I run slowly.	I run fast.	I run very fast.	1 2 3 4
2.	I am able to do very difficult exercise.	I am able to do difficult exercise.	I am able to do only easy exercise.	I am able to do only very easy exercise.	1 2 3 4
3.	My muscles are very weak.	My muscles are weak.	My muscles are strong.	My muscles are very strong.	1 2 3 4
4.	I move very rapidly.	I move rapidly.	I move slowly.	I move very slowly.	1 2 3 4
5.	I feel very insecure when I move.	I feel somewhat insecure when I move.	I feel sure when I move.	I feel very sure when I move.	1 2 3 4
6.	I do not feel tired at all when I move.	I do not feel tired when I move.	I feel tired when I move.	I feel very tired when I move.	1 2 3 4

I. For each of the following item, please circle a number that best describes you. There is no right or wrong answer, and your first responses are usually the most accurate.

1 2 3 4 5

Item does not describe me well ***Item describes me well***

1. Has original ideas	1 2 3 4 5
2. Is always full of ideas	1 2 3 4 5
3. Is encouraging	1 2 3 4 5
4. Copes with several new ideas at the same time	1 2 3 4 5
5. Will always think of something when stuck	1 2 3 4 5
6. Would rather create something new than improve something old	1 2 3 4 5
7. Has fresh views on old problems	1 2 3 4 5

8. Often risks doing things differently	1	2	3	4	5
9. Likes to vary set routines at a moment's notice	1	2	3	4	5
10. Prefers to work on one problem at a time	1	2	3	4	5
11. Can stand out in disagreement against group	1	2	3	4	5
12. Needs the stimulation of frequent change	1	2	3	4	5
13. Prefers changes to occur gradually	1	2	3	4	5
14. Completes the work carefully	1	2	3	4	5
15. Takes great care in every detail	1	2	3	4	5
16. Is organised and efficient	1	2	3	4	5
17. Enjoys detailed work	1	2	3	4	5
18. Is always hardworking	1	2	3	4	5
19. Is consistent	1	2	3	4	5
20. Keeps a good order of things that I can control	1	2	3	4	5
21. Can easily understand and work within the rules and regulations	1	2	3	4	5
22. Follows the majority	1	2	3	4	5
23. Readily agrees with the team in school	1	2	3	4	5
24. Never seeks to bend or break the rules	1	2	3	4	5
25. Is not doing things without teachers' permission	1	2	3	4	5
26. Is careful when dealing with teachers	1	2	3	4	5
27. Feel comfortable with precise instructions	1	2	3	4	5
28. Is predictable	1	2	3	4	5
29. Prefers friends who follow the rules	1	2	3	4	5
30. Like teachers and study patterns which are consistent	1	2	3	4	5
31. Works according to instructions	1	2	3	4	5
32. Holds back ideas until obviously needed	1	2	3	4	5

K. Listed below are a number of statements about your thoughts, feelings, and behaviours. Select the number that best matches your agreement or disagreement with each statement. Use the following scale, which ranges from 1 (strongly disagree) to 7 (strongly agree). There is no right or wrong answer.

1	2	3	4	5	6	7
strongly agree			neutral/ neither agree nor disagree			strongly disagree

1. Everything in the universe is somehow related to each other.	1	2	3	4	5	6	7
2. It is better to stay in the middle than going to extremes.	1	2	3	4	5	6	7
3. Everything that happens in the world is predictable.	1	2	3	4	5	6	7
4. The whole event, rather than the details, should be considered in order to fully understand it.	1	2	3	4	5	6	7
5. There are many causes to everything, even though you may not know them all.	1	2	3	4	5	6	7
6. We should avoid having extreme opinions.	1	2	3	4	5	6	7
7. An individual who is currently honest will stay honest in the future.	1	2	3	4	5	6	7
8. Any small changes at one place may have great effects on others.	1	2	3	4	5	6	7
9. Where there is a disagreement, it is best to find a solution that makes everyone happy.	1	2	3	4	5	6	7
10. An event can have many different consequences, even though you may not know them all.	1	2	3	4	5	6	7
11. Current situations can change at any time.	1	2	3	4	5	6	7
12. It is more important to pay attention to the whole context rather than the details.	1	2	3	4	5	6	7
13. It is more important to find a solution than to argue who is right or wrong when people disagree.	1	2	3	4	5	6	7
14. It is more important to pay attention to the whole than its parts.	1	2	3	4	5	6	7
15. A person who is currently living a successful life will continue to stay successful.	1	2	3	4	5	6	7
16. Nothing is unrelated.	1	2	3	4	5	6	7
17. It is not possible to understand the parts without considering the whole picture.	1	2	3	4	5	6	7
18. Everything in the world is connected and influences each other.	1	2	3	4	5	6	7
19. If an event is moving toward a certain direction, it will continue to move toward that direction.	1	2	3	4	5	6	7
20. It is best to be in harmony, rather than conflict, when people disagree.	1	2	3	4	5	6	7
21. Future events are predictable based on present situations.	1	2	3	4	5	6	7

22. The whole is greater than the sum of its parts.	1	2	3	4	5	6	7
23. We should consider the situation a person is faced with, as well as his/her personality, in order to understand one's behaviour.	1	2	3	4	5	6	7

Questionnaire at Time 2

The data collected was used for analysis in Chapter 4.

Section 1: Information about You

1) Height: _____cm Weight: _____kg

2) Are you a… (tick one)? ___ Girl ___ Boy

3) When is your date of birth? ____/ _____/ _____
DD MM YYYY

4) What is the first name of your mother/ caretaker? _____ (e.g. Meilin)

5) Where were you born? _____(e.g. Singapore)

6) Are you…(tick one)?
___ a Singapore citizen ___ a Singapore permanent resident
___ a foreign student

7) Are you studying at… (tick one)?
___ Secondary One ___ Secondary Two
___ Secondary Three ___ Secondary Four
___ Secondary Five

8) What is your ethnic background (tick one)?
____ Singaporean Chinese ____ Singaporean Malay
____ Singaporean Indian ____ Singaporean Eurasian
____ Singaporean mixed ethnicity
____ Others (please specify): _____

9) What is your mother tongue/ native language (tick one)?
____ Mandarin ____ Malay
____ Tamil
____ Other languages (please specify):
_____

10) Have you participated in an outdoor adventure camp before (tick one)?
____ Yes ____ No

11) If you have participated in an outdoor adventure camp before, write down the number of outdoor adventure camps you have attended so far: _____

Section 2: Your Views

A. Below are a series of statements with which you may either agree or disagree. Please circle a number which best represents your views (**WHAT YOU THINK**), using the scale below.

1 2 3 4 5

Not true *Very true*

1.	I am good at coming up with new ideas.	1	2	3	4	5
2.	I have a lot of good ideas.	1	2	3	4	5
3.	I have a good imagination	1	2	3	4	5

B. The following questions relate to how you have been feeling. Please CIRCLE the option which best applies to you.

	Have you recently…	Please **CIRCLE** your answer			
1	Been able to concentrate on whatever you are doing?	Better than usual	Same as usual	Less than usual	Much less than usual
2	Been losing confidence in yourself?	Not at all	No more than usual	Rather more than usual	Much more than usual
3	Felt that you were playing a useful part in things?	More so than usual	Same as usual	Less useful than usual	Much less useful
4	Lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
5	Felt capable of making decisions about things?	More so than usual	Same as usual	Less so than usual	Much less capable
6	Felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
7	Been able to face up to your problems?	More so than usual	Same as usual	Less able than usual	Much less able
8	Felt that you couldn't overcome your difficulties?	Not at all	No more than usual	Rather more than usual	Much more than usual
9	Been able to enjoy your normal day-to-day activities?	More so than usual	Same as usual	Less so than usual	Much less than usual
10	Been feeling unhappy and depressed?	Not at all	No more than usual	Rather more than usual	Much more than usual
11	Been feeling reasonably happy all things considered?	More so than usual	About same as usual	Less so than usual	Much less than usual
12	Been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual

C. Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle **SA**. If you agree with the statement, circle **A**. If you disagree, circle **D**. If you strongly disagree, circle **SD**.

1.	On the whole, I am satisfied with myself.	SA	A	D	SD
2.	At times, I think I am no good at all.	SA	A	D	SD
3.	I feel that I have a number of good qualities.	SA	A	D	SD
4.	I am able to do things as well as most other people.	SA	A	D	SD
5.	I feel I do not have much to be proud of.	SA	A	D	SD
6.	I certainly feel useless at times.	SA	A	D	SD
7.	I feel that I'm a person of worth, at least on an equal plane with others.	SA	A	D	SD
8.	I wish I could have more respect for myself.	SA	A	D	SD
9.	All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10.	I take a positive attitude toward myself.	SA	A	D	SD

D. For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think "most people" feel.

1 strongly disagree	**2** disagree	**3** neutral/ neither agree nor disagree	**4** agree	**5** strongly agree

1.	I enjoy being outdoors, even in unpleasant weather.	1	2	3	4	5
2.	Some species are just meant to die out or become extinct.	1	2	3	4	5
3.	Humans have the right to use natural resources any way we want.	1	2	3	4	5
4.	My ideal vacation spot would be a remote, wilderness area.	1	2	3	4	5
5.	I always think about how my actions affect the environment.	1	2	3	4	5
6.	I enjoy digging in the earth and getting dirt on my hands.	1	2	3	4	5
7.	My connection to nature and the environment is a part of my spirituality.	1	2	3	4	5
8.	I am very aware of environmental issues.	1	2	3	4	5
9.	I take notice of wildlife wherever I am.	1	2	3	4	5
10.	I do not often go out in nature.	1	2	3	4	5
11.	Nothing I do will change problems in other places on the planet.	1	2	3	4	5
12.	I am not separate from nature, but a part of nature.	1	2	3	4	5
13.	The thought of being deep in the forest, away from modern society, is frightening.	1	2	3	4	5
14.	My feelings about nature do not affect how I live my life.	1	2	3	4	5
15.	Animals, birds and plants should have fewer rights than humans.	1	2	3	4	5
16.	Even in the middle of the city, I notice nature around me.	1	2	3	4	5
17.	My relationship to nature is an important part of who I am.	1	2	3	4	5

18. Conservation is unnecessary because nature is strong enough to recover from any human impact.	1	2	3	4	5
19. The state of animals, birds and plants may tell us about the future for humans.	1	2	3	4	5
20. I think a lot about the suffering of animals.	1	2	3	4	5
21. I feel very connected to all living things and the earth.	1	2	3	4	5

E. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

1 Not at all true **2** Hardly true **3** Moderately true **4** Exactly true

1. I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2. If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3. It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4. I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6. I can solve most problems if I invest the necessary effort.	1	2	3	4
7. I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4
8. When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9. If I am in trouble, I can usually think of a solution.	1	2	3	4
10. I can usually handle whatever comes my way.	1	2	3	4

1 strongly disagree **2** disagree **3** neutral/ neither agree nor disagree **4** agree **5** strongly agree

1. I often feel a sense of togetherness with the natural world around me.	1	2	3	4	5
2. I think of the natural world as a community to which I belong.	1	2	3	4	5
3. I recognise and appreciate the intelligence of other living organisms.	1	2	3	4	5
4. I often feel disconnected from nature.	1	2	3	4	5
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.	1	2	3	4	5
6. I often feel a relationship with animals and plants.	1	2	3	4	5
7. I feel as though I belong to the Earth as equally as it belongs to me.	1	2	3	4	5
8. I have a deep understanding of how my actions affect the natural world.	1	2	3	4	5
9. I often feel part of the web of life.	1	2	3	4	5

10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.	1	2	3	4	5
11. Like a tree can be part of a forest, I feel surrounded within the broader natural world.	1	2	3	4	5
12. When I think of my place on Earth, I consider myself to be a top member of a pyramid that exists in nature.	1	2	3	4	5
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.	1	2	3	4	5
14. My personal welfare is independent of the welfare of the natural world.	1	2	3	4	5

F. Below are some statements about feelings and thoughts. Please circle a number that best describes your experience of each over the activity.

	Statements	**None of the time**	**Rarely**	**Some of the time**	**Often**	**All of the time**
1	I've been feeling optimistic about the future.	1	2	3	4	5
2	I've been feeling useful.	1	2	3	4	5
3	I've been feeling relaxed.	1	2	3	4	5
4	I've been feeling interested in other people.	1	2	3	4	5
5	I've had energy to spare.	1	2	3	4	5
6	I've been dealing with problems well.	1	2	3	4	5
7	I've been thinking clearly.	1	2	3	4	5
8	I've been feeling good about myself.	1	2	3	4	5
9	I've been feeling close to other people.	1	2	3	4	5
10	I've been feeling confident.	1	2	3	4	5
11	I've been able to make up my own mind about things.	1	2	3	4	5
12	I've been feeling loved.	1	2	3	4	5
13	I've been interested in new things.	1	2	3	4	5
14	I've been feeling cheerful.	1	2	3	4	5

G. Thinking about ***how you feel right now,*** please circle the number (1-5) that best describes your feelings. There is no right or wrong answer, and your first responses are usually the most accurate.

	Very slightly or not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**
Interested	1	2	3	4	5
Frightened	1	2	3	4	5
Alert	1	2	3	4	5
Ashamed	1	2	3	4	5
Upset	1	2	3	4	5
Happy	1	2	3	4	5
Nervous	1	2	3	4	5
Energetic	1	2	3	4	5
Scared	1	2	3	4	5

Calm	1	2	3	4	5
Active	1	2	3	4	5
Afraid	1	2	3	4	5

H. For each of the following item, choose one of the four sentences that best represents your personal choice.

	1	2	3	4	My Choice
1.	I run very slowly.	I run slowly.	I run fast.	I run very fast.	1 2 3 4
2.	I am able to do very difficult exercise.	I am able to do difficult exercise.	I am able to do only easy exercise.	I am able to do only very easy exercise.	1 2 3 4
3.	My muscles are very weak.	My muscles are weak.	My muscles are strong.	My muscles are very strong.	1 2 3 4
4.	I move very rapidly.	I move rapidly.	I move slowly.	I move very slowly.	1 2 3 4
	1	**2**	**3**	**4**	**My Choice**
5.	I feel very insecure when I move.	I feel somewhat insecure when I move.	I feel sure when I move.	I feel very sure when I move.	1 2 3 4
6.	I do not feel tired at all when I move.	I do not feel tired when I move.	I feel tired when I move.	I feel very tired when I move.	1 2 3 4

I. For each of the following item, please circle a number that best describes you. There is no right or wrong answer, and your first responses are usually the most accurate.

1 **2** **3** **4** **5**

Item does not describe me well ***Item describes me well***

1. Has original ideas	1 2 3 4 5
2. Is always full of ideas	1 2 3 4 5
3. Is encouraging	1 2 3 4 5
4. Copes with several new ideas at the same time	1 2 3 4 5
5. Will always think of something when stuck	1 2 3 4 5
6. Would rather create something new than improve something old	1 2 3 4 5
7. Has fresh views on old problems	1 2 3 4 5
8. Often risks doing things differently	1 2 3 4 5
9. Likes to vary set routines at a moment's notice	1 2 3 4 5
10. Prefers to work on one problem at a time	1 2 3 4 5
11. Can stand out in disagreement against group	1 2 3 4 5
12. Needs the stimulation of frequent change	1 2 3 4 5
13. Prefers changes to occur gradually	1 2 3 4 5
14. Completes the work carefully	1 2 3 4 5
15. Takes great care in every detail	1 2 3 4 5
16. Is organised and efficient	1 2 3 4 5
17. Enjoys detailed work	1 2 3 4 5
18. Is always hardworking	1 2 3 4 5
19. Is consistent	1 2 3 4 5
20. Keeps a good order of things that I can control	1 2 3 4 5
21. Can easily understand and work within the rules and regulations	1 2 3 4 5

22. Follows the majority	1	2	3	4	5	
23. Readily agrees with the team in school	1	2	3	4	5	
24. Never seeks to bend or break the rules	1	2	3	4	5	
25. Is not doing things without teachers' permission	1	2	3	4	5	
26. Is careful when dealing with teachers	1	2	3	4	5	
27. Feel comfortable with precise instructions	1	2	3	4	5	
28. Is predictable	1	2	3	4	5	
29. Prefers friends who follow the rules	1	2	3	4	5	
30. Like teachers and study patterns which are consistent	1	2	3	4	5	
31. Works according to instructions	1	2	3	4	5	
32. Holds back ideas until obviously needed	1	2	3	4	5	

J. Listed below are a number of statements about your thoughts, feelings, and behaviours. Select the number that best matches your agreement or disagreement with each statement. Use the following scale, which ranges from 1 (strongly disagree) to 7 (strongly agree). There is no right or wrong answer.

1 strongly disagree 2 3 4 neutral/ neither agree nor disagree 5 6 7 strongly agree

1. Everything in the universe is somehow related to each other.	1	2	3	4	5	6	7
2. It is better to stay in the middle than going to extremes.	1	2	3	4	5	6	7
3. Everything that happens in the world is predictable.	1	2	3	4	5	6	7
4. The whole event, rather than the details, should be considered in order to fully understand it.	1	2	3	4	5	6	7
5. There are many causes to everything, even though you may not know them all.	1	2	3	4	5	6	7
6. We should avoid having extreme opinions.	1	2	3	4	5	6	7
7. An individual who is currently honest will stay honest in the future.	1	2	3	4	5	6	7
8. Any small changes at one place may have great effects on others.	1	2	3	4	5	6	7
9. Where there is a disagreement, it is best to find a solution that makes everyone happy.	1	2	3	4	5	6	7
10. An event can have many different consequences, even though you may not know them all.	1	2	3	4	5	6	7
11. Current situations can change at any time.	1	2	3	4	5	6	7
12. It is more important to pay attention to the whole context rather than the details.	1	2	3	4	5	6	7
13. It is more important to find a solution than to argue who is right or wrong when people disagree.	1	2	3	4	5	6	7
14. It is more important to pay attention to the whole than its parts.	1	2	3	4	5	6	7
15. A person who is currently living a successful life will continue to stay successful.	1	2	3	4	5	6	7
16. Nothing is unrelated.	1	2	3	4	5	6	7

17. It is not possible to understand the parts without considering the whole picture.	1	2	3	4	5	6	7
18. Everything in the world is connected and influences each other.	1	2	3	4	5	6	7
19. If an event is moving toward a certain direction, it will continue to move toward that direction.	1	2	3	4	5	6	7
20. It is best to be in harmony, rather than conflict, when people disagree.	1	2	3	4	5	6	7
21. Future events are predictable based on present situations.	1	2	3	4	5	6	7
22. The whole is greater than the sum of its parts.	1	2	3	4	5	6	7
23. We should consider the situation a person is faced with, as well as his/her personality, in order to understand one's behaviour.	1	2	3	4	5	6	7

Debriefing Form

Thank you very much for participating in our study. The research is part of a larger project that involves the understanding of how outdoor adventure activities in schools will affect you, e.g. does it make you happier?

Outdoor adventure activities have been integral to Singapore secondary school curriculum. Today, it is very common for students to attend outdoor adventure camps in Singapore and overseas. Previous research has shown that outdoor adventure activities are associated with educational benefits but little is known about the processes underlying the programme and outcome relationship. As these activities are very resource demanding, it is important for us to understand its role in education and the underlying psychological processes during the activities.

When psychology researchers design a research study with a specific group, it is important to ensure that the research design is accurate and valid. One way of doing this is to pilot the study and test the relationship between the concepts. Therefore, in this study we use a variety of tests, including measures of creativity, well-being, intrinsic motivation, self-efficacy, attraction to nature, thinking styles and personality traits. We expect that the introduction of outdoor adventure activities will show a specific pattern and relationship with the abovementioned criterion measures.

If the results of this pilot study meet our assumptions, we can be confident that the modified version of the research design is reliable for outdoor adventure activities research participants, including adolescents.

The research is important because it gives us the necessary tools to understand the processes affecting people in outdoor adventure educational contexts. The results of the study will be posted as a downloadable PDF by April 2013 on the CACR website: http://cacr.victoria.ac.nz/.

Thank you again for participating in the research.

Warmest Regards

Carmen Leong,

Dr Ron Fischer, and

Prof John McClure

Appendix D: Outdoor Creativity Task

Form A

The task you are about to take involves five activities. The activities will give you a chance to see **how good you are at thinking up new ideas and solving problems**. They will call for all of the **imagination** and thinking ability you have.
For each of the prompts, **list as many ideas as you can**.
You will be given **3 minutes** to respond for each prompt.

s/n	Item	Code*
1.	Think of as many possible improvements as you can to a regular climbing helmet, making it more interesting, more useful and more presentable. 	Helmet
2.	Write down as many possible uses as you can think of for a rock.	Rock
3.	Design a fun and interesting survival tool (a physical item) for use in the outdoors. A survival tool is a physical item that you would like to have in order to survive in an outdoor setting like the forest. Provide as many examples as you can.	Tool
4.	Imagine you woke up tomorrow and found yourself alone on a desert island. What would you do to get home? Provide as many examples as you can.	Island
5.	Many students are staying indoors to spend their time with technology (the Internet, computer games, etc.). But now suppose that we wanted to get many more students to go outdoors to play. What steps can you suggest that would get many more students to play outdoors?	Play

*These codes are used to refer to their respective items for the purposes of this thesis.

Form B

The task you are about to take involves five activities. The activities will give you a chance to see **how good you are at thinking up new ideas and solving problems**. They will call for all of the **imagination** and thinking ability you have.
For each of the prompts, **list as many ideas as you can**.
You will be given **3 minutes** to respond for each prompt.

s/n	Item	Code*
1.	Think of as many possible improvements as you can to a regular backpack, making it more interesting, more useful and more presentable.	Backpack
2.	Write down as many possible uses as you can think of for a tree log (tree trunk).	Log
3.	Design a fun and interesting game for the outdoors. Provide as many examples as you can.	Game
4.	Imagine you were lost while trekking with your teammates in the rainforest and found yourself alone. What would you do to get home? Provide as many examples as you can.	Rainforest
5.	Many tourists are visiting our nature reserves but are unaware of the dos and don'ts in nature. What steps can you suggest to communicate the guidelines to our tourists?	Nature

*These codes are used to refer to their respective items for the purposes of this thesis.

Appendix E: Additional Analyses for the Outdoor Creativity Task

Inter-rater Reliability: To calculate the inter-rater reliability for each item, the two coders' scores were correlated as in Table 17 (see Amabile (1996) for similar approaches). We also calculated two overall inter-rater reliabilities through correlating the mean originality scores given by each coder for Form A and Form B respectively. The overall inter-rater reliability for the originality scores for Form A was r = .80; for Form B, r = .90. According to Amabile (1996), this is an adequate level of inter-rater reliability, as the results are similar to the previous range of .70 to .89 for inter-rater reliability correlations

Table 17

Inter-Rater Reliability Scores for Forms A and B.

Item	*N*	Inter-rater correlation
Form A		
Improvements to a helmet (Helmet)	185	.75**
Uses of a rock (Rock)	185	.81**
Design of a survival tool (Tool)	185	.75**
Solution to get off a desert island (Island)	185	.58**
Suggestion to encourage more outdoor play (Play)	185	.72**
Form B		
Improvements to a backpack (Backpack)	147	.78**
Uses of a tree log (Log)	147	.96**
Design of an outdoor game (Game)	147	.86**
Solution to get out of the rainforest (Rainforest)	147	.76**
Suggestion to communicate appropriate behaviour in nature (Nature)	147	.76**

* $p < .05$, ** $p < .01$

Exploratory Factor Analyses: We used the mean originality scores for both coders and examined the factorability of all ten Outdoor Creativity Task (OCT) items.

Table 18 displayed the inter-item correlations of the ten abbreviated items (see Table 17), which suggests reasonable factorability.

Table 18

Inter-Correlations between All Ten Mean Originality Scores for the Outdoor Creativity Task.

Item	1	2	3	4	5	6	7	8	9
Helmet	-								
Rock	.492**	-							
Tool	.162*	.174*	-						
Island	.418**	.573**	.270**	-					
Play	.441**	.422**	.387**	.590**	-				
Backpack	.497**	.385**	.298**	.430**	.435**	-			
Log	.339**	.417**	.128	.588**	.362**	.563**	-		
Game	.234**	.160*	.365**	.288**	.468**	.370**	.249**	-	
Rainforest	.387**	.449**	.285**	.633**	.495**	.477**	.742**	.361**	-
Nature	.347**	.496**	.262**	.561**	.510**	.509**	.490**	.398**	.662**

* p <.05, ** p <.01

An exploratory factor analysis (n = 185) was undertaken for the mean originality scores to establish the factor structure of the OCT items. One factor was extracted with an eigenvalue of 4.83, accounting for 48.25% of the total variance. The scree plot method suggested a single factor model, which was confirmed by a parallel analysis. According to the parallel analysis, one factor model was found to be significant: the two factor model's eigenvalue was 1.17, which is less than the eigenvalue of 1.33, p < .05, for the parallel analysis. Table 19 presents the unrotated principal components' loading sizes. In sum, these ten items provide a measure of overall creativity performance.

Table 19

Factor Loadings for All Ten Outdoor Creativity Task Originality Scores.

Order	Item	Loading	Communalities
9	Solution to get out of the rainforest (Rainforest)	.82	.69
4	Solution to get off a desert island (Island)	.80	.66
10	Suggestion to communicate appropriate behaviour in nature (Nature)	.78	.60
5	Suggestion to encourage more outdoor play (Play)	.74	.62
7	Uses of a tree log (Log)	.73	.65
6	Improvements to a backpack (Backpack)	.72	.52
2	Uses of a rock (Rock)	.67	.55
1	Improvements to a helmet (Helmet)	.62	.41
8	Design of an outdoor game (Game)	.53	.64
3	Design of a survival tool (Tool)	.43	.64

Reliability: For the purposes of this paper all ten items were combined as a single creativity scale and the Cronbach's alpha for the originality scores of the ten OCT items was .86. Our results were similar to those reported in the recent work of Lee et al. (2012), who found a reliability result of .69 for other specific creativity measures.

Appendix F: Materials for Study 4

Letter of Confirmation for Participants

Dear all,

Thank you for volunteering to participate in my research! Your registration has been confirmed. Just a gentle reminder: *In order to participate in this study, you will have to be a current University student who is proficient in English language. At the end of your participation, you will receive a free movie voucher as a compensation for your time.*

The details regarding the study session you have signed up for are as follows:

Date: **17 November 2014, Monday**

Reporting Time: **1.50pm**

End Time: **4pm** (estimated)

Meeting venue: **Zealandia entrance** (foyer downstairs)

Contact person: Carmen 0210496596

We will start once everyone arrives so it would be greatly appreciated if you arrive on time. In the event if you are unable to come, please contact me at 0210496596 before 16 November at 12pm or as soon as possible.

Points to take note:

As we will be going for a walk in the outdoors (45mins to 1 hour), please make sure you:

1. Have taken your meal before your trip to Zealandia;
2. Wear (comfortable and warm) outdoor clothes and walking shoes;
3. Bring your rain jacket (in the event of rain, it's Wellington after all!);
4. Bring a pen for writing;
5. Bring sunscreen and water-bottle (optional); and
6. Bring any other personal items.

To travel to Zealandia, you can either drive, take the public bus or free shuttle (see below):

http://www.visitzealandia.com/plan-your-visit/how-to-find-us/public-bus/
http://www.visitzealandia.com/plan-your-visit/how-to-find-us/free-shuttle/

Do contact me if you need any clarifications. I look forward to seeing you on Monday, 17 November.

Please feel free to invite your other university friends to sign up for the research! I would greatly appreciate your help.

Kind regards,

Carmen

Letter of Information

The effects of walking in nature

INFORMATION SHEET

Researchers' Introduction
This research is conducted by Carmen Leong, a PhD candidate in the School of Psychology at Massey University. The project is supervised by Dr Stephen Hill, A/P Ronald Fischer and A/P John Spicer. The Karori Sanctuary Trust has kindly given me permission to conduct a research study to investigate the effects of walking in nature. Completion of this exercise will constitute a partial fulfilment of the requirements for a PhD in Psychology.

Project Description and Invitation
This research will allow us to gain a better understanding of the effects of walking in nature. We are inviting you to participate because we want to learn how far walking in nature may benefit or inhibit the personal development of university students in New Zealand. We intend using the findings to inform educational policies, conference presentations and peer-reviewed journal articles. Your agreement to take part would be greatly appreciated.

Participant Identification and Recruitment
We are asking for your participation because you are a current university student. You must be in a position to participate in an outdoor activity such as a walk in the natural environment.

If you wish to volunteer, please email: Carmen.Leong.1@uni.massey.ac.nz. All volunteers will need to submit an online registration form which will be sent to them following their indication of availability. We aim to notify you of the confirmation for the allocated research session within 48 hours of your submission. You will be asked to read and sign the Consent Form and then return it to the researcher. Volunteers who choose to participate in the study will receive a movie voucher on completion of the second survey as a token of our appreciation. They will also have had the benefit of a visit to Zealandia.

Project Procedures
If you agree to participate in this study, you will meet the researcher at Zealandia at least ten minutes before the start time of the activity. The whole session is expected to last about two hours, and involves engaging in a simple cognitive task while walking in nature for about 45 minutes. You will also complete a confidential survey before and after the walk, in which you will respond to statements such as "I found the activity very interesting". We anticipate that each survey will take you about 30 minutes to complete. During the research, you are free to withdraw at any point before submitting the surveys. Completion and return of the questionnaire implies consent to use being made of such information collected during the study (see Data Management below). You have the right to decline to answer any particular question.

Data Management
Your responses, as well as your personal identity, will remain completely anonymous. You will never be identified in this research project, nor in any other presentation or publication. The information you provide will be represented by number only. Please do not write your name or any identifying information on the questionnaire itself. In accordance with the requirements of some scientific journals and organisations, your coded data may be shared with other competent researchers. A copy of the coded data will remain in the custody of the research team members.

The data you provide may be used for one or more of the following purposes:

- The overall findings may be submitted for publication in a scientific journal, or presented at scientific conferences.

- The overall findings may form part of a PhD thesis that will be submitted for assessment, and a summary of the findings may be shared with governmental and non-government agencies aiming to improve outdoor education programmes.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- *decline to answer any particular question;*
- *withdraw from the study at any point;*
- *ask any questions about the study at any time during participation;*
- *provide information on the understanding that your name will not be used unless you give permission to the researcher;*
- *be given access to a summary of the project findings when it is concluded.*

Compensation for Injury

If physical injury results from your participation in this study, you should visit a treatment provider to make a claim to ACC as soon as possible. ACC cover and entitlements are not automatic and your claim will be assessed by ACC in accordance with the Accident Compensation Act 2001. If your claim is accepted, ACC must inform you of your entitlements, and must help you access those entitlements. Entitlements may include, but not be limited to, treatment costs, travel costs for rehabilitation, loss of earnings, and/or lump sum for permanent impairment. Compensation for mental trauma may also be included, but only if this is incurred as a result of physical injury.

If your ACC claim is not accepted, you should immediately contact the researcher, who will initiate processes to ensure you receive compensation equivalent to that to which you would have been entitled had ACC accepted your claim.

Research Team Contacts

Please feel free to contact the researcher and/or supervisors with any queries you may have about the research.

Researcher:

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This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 5249, email humanethics@massey.ac.nz.

The effects of walking in nature

PARTICIPANT CONSENT FORM

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

Experimenter Observation Sheets

Research Protocols

1. There are 2 parts to the questionnaire. First we will have to do the activity task where you will be timed for each activity. You will be asked to turn over to the next activity at the end of 3 minutes. The second part is a questionnaire.

Creativity Activity

2. Your task is to be creative and think of as many creative and interesting ideas as possible. We want to know how creative you can be within 3 minutes for each task. Remember the key is to generate as many creative ideas as possible within 3 minutes.
3. This is another creative task. Try your best to complete all the questions within 5minutes.

Questionnaire

4. Be honest when answering the questions as there is no right or wrong answer. We need your honest opinion so we can understand the mindset of the students today.
5. You do not need to think too much into each item. The first answer that comes to your mind is usually the most appropriate response.
6. Debrief and thank you for your cooperation.

Date: _____ Time: _____

Weather: Sun/ Rain/ Cloudy/ Windy/ Others:

_____

Temp: _____

Start Time of the Walk: _____

End Time of the Walk: _____

Order of surveys: _____+ _____ +

_____

Pre-test start time: _____ End Time:

_____+_____+_____

Post-test start time: _____ End Time:

_____+_____+_____

Total Number of participants: _____(M) _____(F)

Attrition: _____(M) _____(F)

Communications during walk: Y / N

Comments:

Pre-test:

_____

_____

Walk:

_____

_____

Post-test:

_____

Species sighted:

( ) Takahe ( ) Kaka ( ) Tuatara ( ) Kakariki ( ) Ducks

( ) Shags ( ) Tui ( ) Robins ( ) Blackbird ( ) Kereru

( ) Others: _____

Bird song:

_____

Any other comments:

_____

_____

_____

_____

Pre-test Questionnaire

Section 1: Your Views

A. Thinking about ***how you feel over the past few weeks,*** please rate your feelings.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Upset	1	2	3	4	5
Hostile	1	2	3	4	5
Alert	1	2	3	4	5
Ashamed	1	2	3	4	5
Inspired	1	2	3	4	5
Nervous	1	2	3	4	5
Determined	1	2	3	4	5
Attentive	1	2	3	4	5
Afraid	1	2	3	4	5
Happy	1	2	3	4	5
Scared	1	2	3	4	5
Active	1	2	3	4	5

	Have you recently…	Please **CIRCLE** your answer			
1	Been able to concentrate on whatever you are doing?	Better than usual	Same as usual	Less than usual	Much less than usual
2	Been losing confidence in yourself?	Not at all	No more than usual	Rather more than usual	Much more than usual
3	Felt that you were playing a useful part in things?	More so than usual	Same as usual	Less useful than usual	Much less useful
4	Lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
5	Felt capable of making decisions about things?	More so than usual	Same as usual	Less so than usual	Much less capable
6	Felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
7	Been able to face up to your problems?	More so than usual	Same as usual	Less able than usual	Much less able
8	Felt that you couldn't overcome your difficulties?	Not at all	No more than usual	Rather more than usual	Much more than usual
9	Been able to enjoy your normal day-to-day activities?	More so than usual	Same as usual	Less so than usual	Much less than usual
10	Been feeling unhappy and depressed?	Not at all	No more than usual	Rather more than usual	Much more than usual
11	Been feeling reasonably happy all things considered?	More so than usual	About same as usual	Less so than usual	Much less than usual
12	Been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual

	Statements	None of the time	Rarely	Some of the time	Often	All of the time
1	I've been feeling optimistic about the future.	1	2	3	4	5
2	I've been feeling useful.	1	2	3	4	5
3	I've been feeling relaxed.	1	2	3	4	5
4	I've been feeling interested in other people.	1	2	3	4	5
5	I've had energy to spare.	1	2	3	4	5
6	I've been dealing with problems well.	1	2	3	4	5
7	I've been thinking clearly.	1	2	3	4	5
8	I've been feeling good about myself.	1	2	3	4	5
9	I've been feeling close to other people.	1	2	3	4	5
10	I've been feeling confident.	1	2	3	4	5
11	I've been able to make up my own mind about things.	1	2	3	4	5
12	I've been feeling loved.	1	2	3	4	5
13	I've been interested in new things.	1	2	3	4	5
14	I've been feeling cheerful.	1	2	3	4	5

B. Please rate how accurately each statement describes ***you***. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence.

1 Very inaccurate	**2** Moderately inaccurate	**3** Neither inaccurate nor accurate	**4** Moderately accurate	**5** Very accurate

1	Believe in the importance of art.	1	2	3	4	5
2	Am not interested in abstract ideas.	1	2	3	4	5
3	Have a vivid imagination.	1	2	3	4	5
4	Do not like art.	1	2	3	4	5
5	Tend to vote for liberal political candidates.	1	2	3	4	5
6	Avoid philosophical discussions.	1	2	3	4	5
7	Carry the conversation to a higher level.	1	2	3	4	5
8	Do not enjoy going to art museums.	1	2	3	4	5
9	Enjoy hearing new ideas.	1	2	3	4	5
10	Tend to vote for conservative political candidates.	1	2	3	4	5

C. Please rate how strongly you agree or disagree with the following statements about your general feelings about yourself **over the past few weeks**.

1 2 3 4 5

Not true *Very true*

1.	I am good at coming up with new ideas.	1	2	3	4	5
2.	I have a lot of good ideas.	1	2	3	4	5
3.	I have a good imagination	1	2	3	4	5

1	2	3	4
Not at all true	Hardly true	Moderately true	Exactly true

1.	I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2.	If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3.	It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4.	I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5.	Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6.	I can solve most problems if I invest the necessary effort.	1	2	3	4
7.	I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4
8.	When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9.	If I am in trouble, I can usually think of a solution.	1	2	3	4
10.	I can usually handle whatever comes my way.	1	2	3	4

1	2	3	4
strongly agree	agree	disagree	strongly disagree

1.	On the whole, I am satisfied with myself.	1	2	3	4
2.	At times, I think I am no good at all.	1	2	3	4
3.	I feel that I have a number of good qualities.	1	2	3	4
4.	I am able to do things as well as most other people.	1	2	3	4
5.	I feel I do not have much to be proud of.	1	2	3	4
6.	I certainly feel useless at times.	1	2	3	4
7.	I feel that I'm a person of worth, at least on an equal plane with others.	1	2	3	4
8.	I wish I could have more respect for myself.	1	2	3	4
9.	All in all, I am inclined to feel that I am a failure.	1	2	3	4
10.	I take a positive attitude toward myself.	1	2	3	4

D. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

1	2	3	4	5
strongly disagree	disagree	neutral/ neither agree nor disagree	agree	strongly agree

1.	I often feel a sense of togetherness with the natural world around me.	1	2	3	4	5
2.	I think of the natural world as a community to which I belong.	1	2	3	4	5
3.	I recognise and appreciate the intelligence of other living organisms.	1	2	3	4	5
4.	I often feel disconnected from nature.	1	2	3	4	5
5.	When I think of my life, I imagine myself to be part of a larger cyclical process of living.	1	2	3	4	5
6.	I often feel a relationship with animals and plants.	1	2	3	4	5

7. I feel as though I belong to the Earth as equally as it belongs to me.	1 2 3 4 5
8. I have a deep understanding of how my actions affect the natural world.	1 2 3 4 5
9. I often feel part of the web of life.	1 2 3 4 5
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.	1 2 3 4 5
11. Like a tree can be part of a forest, I feel surrounded within the broader natural world.	1 2 3 4 5
12. When I think of my place on Earth, I consider myself to be a top member of a pyramid that exists in nature.	1 2 3 4 5
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.	1 2 3 4 5
14. My personal welfare is independent of the welfare of the natural world.	1 2 3 4 5

1 **strongly disagree**	**2** **disagree**	**3** **neutral/ neither agree nor disagree**	**4** **agree**	**5** **strongly agree**

1. I enjoy being outdoors, even in unpleasant weather.	1 2 3 4 5
2. Some species are just meant to die out or become extinct.	1 2 3 4 5
3. Humans have the right to use natural resources any way we want.	1 2 3 4 5
4. My ideal vacation spot would be a remote, wilderness area.	1 2 3 4 5
5. I always think about how my actions affect the environment.	1 2 3 4 5
6. I enjoy digging in the earth and getting dirt on my hands.	1 2 3 4 5
7. My connection to nature and the environment is a part of my spirituality.	1 2 3 4 5
8. I am very aware of environmental issues.	1 2 3 4 5
9. I take notice of wildlife wherever I am.	1 2 3 4 5
10. I do not often go out in nature.	1 2 3 4 5
11. Nothing I do will change problems in other places on the planet.	1 2 3 4 5
12. I am not separate from nature, but a part of nature.	1 2 3 4 5
13. The thought of being deep in the forest, away from modern society, is frightening.	1 2 3 4 5
14. My feelings about nature do not affect how I live my life.	1 2 3 4 5
15. Animals, birds and plants should have fewer rights than humans.	1 2 3 4 5
16. Even in the middle of the city, I notice nature around me.	1 2 3 4 5
17. My relationship to nature is an important part of who I am.	1 2 3 4 5
18. Conservation is unnecessary because nature is strong enough to recover from any human impact.	1 2 3 4 5

19. The state of animals, birds and plants may tell us about the future for humans.	1 2 3 4 5
20. I think a lot about the suffering of animals.	1 2 3 4 5
21. I feel very connected to all living things and the earth.	1 2 3 4 5

E. For each of the following item, please circle a number that best describes you. There is no right or wrong answer, and your first responses are usually the most accurate.

1 2 3 4 5
Item does not describe me well *Item describes me well*

1. Has original ideas	1 2 3 4 5
2. Is always full of ideas	1 2 3 4 5
3. Is encouraging	1 2 3 4 5
4. Copes with several new ideas at the same time	1 2 3 4 5
5. Will always think of something when stuck	1 2 3 4 5
6. Would rather create something new than improve something old	1 2 3 4 5
7. Has fresh views on old problems	1 2 3 4 5
8. Often risks doing things differently	1 2 3 4 5
9. Likes to vary set routines at a moment's notice	1 2 3 4 5
10. Prefers to work on one problem at a time	1 2 3 4 5
11. Can stand out in disagreement against group	1 2 3 4 5
12. Needs the stimulation of frequent change	1 2 3 4 5
13. Prefers changes to occur gradually	1 2 3 4 5
14. Completes the work carefully	1 2 3 4 5
15. Takes great care in every detail	1 2 3 4 5
16. Is organised and efficient	1 2 3 4 5
17. Enjoys detailed work	1 2 3 4 5
18. Is always hardworking	1 2 3 4 5
19. Is consistent	1 2 3 4 5
20. Keeps a good order of things that I can control	1 2 3 4 5
21. Can easily understand and work within the rules and regulations	1 2 3 4 5
22. Follows the majority	1 2 3 4 5
23. Readily agrees with the team in school	1 2 3 4 5
24. Never seeks to bend or break the rules	1 2 3 4 5
25. Is not doing things without teachers' permission	1 2 3 4 5
26. Is careful when dealing with teachers	1 2 3 4 5
27. Feel comfortable with precise instructions	1 2 3 4 5
28. Is predictable	1 2 3 4 5
29. Prefers friends who follow the rules	1 2 3 4 5
30. Like teachers and study patterns which are consistent	1 2 3 4 5
31. Works according to instructions	1 2 3 4 5
32. Holds back ideas until obviously needed	1 2 3 4 5

Section 2: Information about You

Participant Number:

1) Height: _____cm Weight: _____kg

2) Gender: ___ Female___ Male

3) When is your date of birth? ____/ _____/ _____
DD MM YYYY

4) What is your age? _____

5) What is the name of your favourite TV/ movie/ storybook?
_____

6) Are you a ___ full-time, ___ part-time, or ___distance-learning student? (Tick one option)

7) Name of your university: _____

7) Your current university qualification
___ bachelor's/ tertiary degree ___ postgraduate diploma
___ honour's degree ___ masters' degree
___ doctoral degree & above
___ Others (please specify): _____

8) University major: _____ (e.g. psychology, history, international business)

9) Citizenship/ Visa Status
___ NZ citizen ___ NZ permanent resident
___ International student ___ Exchange student
___Others (please specify): _____

10) What is your ethnic background (e.g. Maori, Chinese)?
_____

11) Where were you born?
___ New Zealand
___ Other (please specify country of birth):
_____

12) If you were not born in New Zealand, how long have you lived in New Zealand?
_____years _____months

13a) Is English your native language? ____ Yes ____ No

13b) If not, what is your native language?
_____

14) Are you a current member of Zealandia? ____ Yes ____ No

15) Do you enjoy walking in nature? ____ Yes ____ No

Activity Sheet – Unfocussed Condition

Objective: Your task is to count the number of steps you take between checkpoints. You should not be conversing with others so that you can concentrate on the task and count accurately.

Start Time: _____ **End Time: _____**

Checkpoints	**Steps count**	**Duration**	**Your general reflections: Write a sentence to describe each item.**
Between Checkpoint 1 (Gate entrance) and Checkpoint 2 (Shag lookout)			**A paper you have studied at university.**
Between Checkpoint 2 (Shag lookout) and Checkpoint 3 (Tuatara nurseries)			**A meal you had last week.**
Between Checkpoint 3 (Tuatara nurseries) and Checkpoint 4 (Bridge before Lynch Track)			**Something you read recently.**
Between Checkpoint 4 (Bridge before Lynch Track) and Checkpoint 5 (Kaka feeders)			**A place you visited last week.**

Checkpoints	**Steps count**	**Duration**	**Your general reflections: Write a sentence to describe each item.**
Between Checkpoint 5 (Kaka feeders) and Checkpoint 6 (Nest boxes)			**An incident you experienced recently.**
Between Checkpoint 6 (Nest boxes) and Checkpoint 7 (Takahe feeders)			**An outing you had recently.**
Between Checkpoint 7 (Takahe feeders) and Checkpoint 8 (Gate entrance)			**A conversation you had recently.**

Activity Sheet – Focussed Condition

Objective: Your task is to be aware of and to observe the natural surroundings between the checkpoints. Write down at least one thing relating to nature you observed between the checkpoints. You should not be conversing with others so that you can concentrate on the task and observe the natural environment.

Start Time: _____ **End Time: _____**

Checkpoints	**Pay attention to the following in the natural environment:**	**Your general reflections: Write a sentence for each observation in the nature.**
Between Checkpoint 1 (Gate entrance) and Checkpoint 2 (Shag lookout)	The natural objects you see	
Between Checkpoint 2 (Shag lookout) and Checkpoint 3 (Tuatara nurseries)	The natural sounds you hear	
Between Checkpoint 3 (Tuatara nurseries) and Checkpoint 4 (Bridge before Lynch Track)	The natural species (e.g., tuatara, weta, tui) you see	

Checkpoints	**Pay attention to the following in the natural environment:**	**Your general reflections: Write a sentence for each observation in the nature.**
Between Checkpoint 4 (Bridge before Lynch Track) and Checkpoint 5 (Kaka feeders)	The different shapes in nature you see	
Between Checkpoint 5 (Kaka feeders) and Checkpoint 6 (Nest boxes)	The birds you see or hear	
Between Checkpoint 6 (Nest boxes) and Checkpoint 7 (Takahe feeders)	The plants you see or feel	
Between Checkpoint 7 (Takahe feeders) and Checkpoint 8 (Gate entrance)	The flowers you see	

Post-test Questionnaire

Section 1: Your Experiences

A. Is this your first time walking in nature (tick one)?

____ Yes ____ No

B. How often do you go for a nature walk?

___ Never ___ Occasionally
___ Once weekly ___ Twice weekly
___ Three times or more weekly

C. How physically demanding do you think this activity is?

___ Very slightly/ Not at all ___ A little ___ Moderately
___ Quite a bit ___ Extremely

D. Please rate how strongly you agree or disagree with the following statements after ***the activity you have just done.*** There is no right or wrong answer, and your first responses are usually the most accurate.

	1 **strongly disagree**	**2** **disagree**	**3** **neutral/ neither agree nor disagree**	**4** **agree**	**5** **strongly agree**
1. Right now, I feel a sense of togetherness with the natural world around me.	1	2	3	4	5
2. At the moment, I am feeling that the natural world is a community to which I belong.	1	2	3	4	5
3. I presently recognise and appreciate the intelligence of other living organisms.	1	2	3	4	5
4. At the present moment, I don't feel connected to nature.	1	2	3	4	5
5. At the moment, I can imagine myself to be part of a larger cyclical process of living.	1	2	3	4	5
6. At this moment, I am feeling a relationship with animals and plants.	1	2	3	4	5
7. Right now, I feel as though I belong to the Earth as equally as it belongs to me.	1	2	3	4	5
8. Right now, I am deeply aware of how my actions affect the natural world.	1	2	3	4	5
9. Presently, I feel like I am part of the web of life.	1	2	3	4	5
10. Right now, I feel that all inhabitants of Earth, human, and nonhuman, share a common life force.	1	2	3	4	5
11. At the moment, I am feeling embedded within the broader natural world, like a tree in a forest.	1	2	3	4	5
12. When I think of humans' place on Earth right now, I consider them to be the most valuable species in nature.	1	2	3	4	5
13. At the moment, I am feeling like I am only a part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.	1	2	3	4	5

1	2	3	4	5	6	7
Not at all true			somewhat true			very true

1. While I was doing the activity I was thinking about how much I enjoyed it.	1	2	3	4	5	6	7
2. I think I am pretty good at this activity.	1	2	3	4	5	6	7
3. I found the activity very interesting.	1	2	3	4	5	6	7
4. I think I did pretty well at this activity, compared to other students.	1	2	3	4	5	6	7
5. Doing the activity was fun.	1	2	3	4	5	6	7
6. I enjoyed doing the activity very much.	1	2	3	4	5	6	7
7. I am satisfied with my performance at this activity.	1	2	3	4	5	6	7
8. I thought the activity was very boring.	1	2	3	4	5	6	7
9. I felt pretty skilled at this activity.	1	2	3	4	5	6	7
10. I thought the activity was very interesting.	1	2	3	4	5	6	7
11. I would describe the activity as very enjoyable.	1	2	3	4	5	6	7
12. After doing this activity for a while, I felt pretty competent.	1	2	3	4	5	6	7

E. Thinking about ***how you feel right now,*** please circle the number (1-5) that best describes your feelings now.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Upset	1	2	3	4	5
Hostile	1	2	3	4	5
Alert	1	2	3	4	5
Ashamed	1	2	3	4	5
Inspired	1	2	3	4	5
Nervous	1	2	3	4	5
Determined	1	2	3	4	5
Attentive	1	2	3	4	5
Afraid	1	2	3	4	5
Happy	1	2	3	4	5
Scared	1	2	3	4	5
Active	1	2	3	4	5

F. Please rate how strongly you agree or disagree with the following statements about your general feelings about yourself **after the activity**.

	1 strongly agree	2 agree	3 disagree	4 strongly disagree
1.	On the whole, I am satisfied with myself.	1	2	3	4
2.	At times, I think I am no good at all.	1	2	3	4
3.	I feel that I have a number of good qualities.	1	2	3	4
4.	I am able to do things as well as most other people.	1	2	3	4
5.	I feel I do not have much to be proud of.	1	2	3	4
6.	I certainly feel useless at times.	1	2	3	4
7.	I feel that I'm a person of worth, at least on an equal plane with others.	1	2	3	4
8.	I wish I could have more respect for myself.	1	2	3	4
9.	All in all, I am inclined to feel that I am a failure.	1	2	3	4
10.	I take a positive attitude toward myself.	1	2	3	4

G. The following questions relate to how you have been feeling **after the activity**. Please CIRCLE the option which best applies to you.

	Have you recently…	Please **CIRCLE** your answer			
1	Been able to concentrate on whatever you are doing?	Better than usual	Same as usual	Less than usual	Much less than usual
2	Been losing confidence in yourself?	Not at all	No more than usual	Rather more than usual	Much more than usual
3	Felt that you were playing a useful part in things?	More so than usual	Same as usual	Less useful than usual	Much less useful
4	Lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
5	Felt capable of making decisions about things?	More so than usual	Same as usual	Less so than usual	Much less capable
6	Felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
7	Been able to face up to your problems?	More so than usual	Same as usual	Less able than usual	Much less able
8	Felt that you couldn't overcome your difficulties?	Not at all	No more than usual	Rather more than usual	Much more than usual
9	Been able to enjoy your normal day-to-day activities?	More so than usual	Same as usual	Less so than usual	Much less than usual
10	Been feeling unhappy and depressed?	Not at all	No more than usual	Rather more than usual	Much more than usual
11	Been feeling reasonably happy all things considered?	More so than usual	About same as usual	Less so than usual	Much less than usual
12	Been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual

H. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

	1 Not at all true	2 Hardly true	3 Moderately true	4 Exactly true
1.	I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2.	If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3.	It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4.	I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5.	Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6.	I can solve most problems if I invest the necessary effort.	1	2	3	4
7.	I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4
8.	When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9.	If I am in trouble, I can usually think of a solution.	1	2	3	4
10.	I can usually handle whatever comes my way.	1	2	3	4

I. Below are some statements about feelings and thoughts **<u>after the activity</u>**. Please circle a number that best describes your experience of each over the activity.

	Statements	**None of the time**	**Rarely**	**Some of the time**	**Often**	**All of the time**
1	I've been feeling optimistic about the future.	1	2	3	4	5
2	I've been feeling useful.	1	2	3	4	5
3	I've been feeling relaxed.	1	2	3	4	5
4	I've been feeling interested in other people.	1	2	3	4	5
5	I've had energy to spare.	1	2	3	4	5
6	I've been dealing with problems well.	1	2	3	4	5
7	I've been thinking clearly.	1	2	3	4	5
8	I've been feeling good about myself.	1	2	3	4	5
9	I've been feeling close to other people.	1	2	3	4	5
10	I've been feeling confident.	1	2	3	4	5
11	I've been able to make up my own mind about things.	1	2	3	4	5
12	I've been feeling loved.	1	2	3	4	5
13	I've been interested in new things.	1	2	3	4	5
14	I've been feeling cheerful.	1	2	3	4	5

Section 2: Information about You

1) Height: _____cm Weight: _____kg

2) Gender: ___ Female___ Male

3) When is your date of birth? ____/ _____/ _____
DD MM YYYY

4) What is the name of your favourite TV/ movie/ storybook?
_____

Participant Number:

Debriefing Sheet

Thank you very much for participating in our study. The research is part of a larger project that involves the understanding of how outdoor activities affect you (specifically, whether such activities make you more creative).

For a long time now, outdoor activities have been integral to the curricula of schools the world over. Today, it is very common for students to engage in outdoor activities both during and outside school hours. Previous research has shown that outdoor activities are associated with educational benefits such as creativity, but little is known about the processes underlying the activity and outcome relationship. As these activities often require considerable resources, it is important for us to understand their role and the underlying psychological processes during the activities.

The present study examines the theory that exposure to nature is beneficial to human beings. When you are engaged with nature, you expand your sense of self and become more 'nature' focussed; and this may nurture creativity. Today we have tested whether walking in nature indeed leads to better creative performance. We asked you questions after your nature walk to try to establish whether walking in nature has made a difference to your level of creativity.

The research is important because it gives us the necessary tools to understand the processes affecting people within contexts involving outdoor activity. If the results of this study meet our assumptions, that will help us in our understanding of how the natural environment influences the creativity of humans. If engagement in nature is found to increase creative performance, outdoor activities could be encouraged as part of school curricula as well as in lifestyle choices.

If you have any additional questions or comments about this study, please feel free to contact Carmen Leong at Carmen.Leong.1@uni.massey.ac.nz or Dr Stephen Hill at S.R.Hill@massey.ac.nz.

Appendix G: Statements of Contributions for Publications

Massey University requires that a Statement of Contribution (form DRC 16) is included for each publication in a doctoral thesis. A copy of this form is provided below for the publication in Chapter Three.

DRC 16

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Carmen Leong Lai Yin

Name/Title of Principal Supervisor: Dr Stephen Hill

Name of Published Research Output and full reference:

Leong, L. Y. C., Fischer, R., & McClure, J. (2014). Are nature lovers more innovative? The relationship between connectedness with nature and cognitive styles. Journal of Environmental Psychology, 40, 57-63. doi: 10.1016/j.jenvp.2014.03.007

In which Chapter is the Published Work: 3

Please indicate either:

- The percentage of the Published Work that was contributed by the candidate:

  and / or

- Describe the contribution that the candidate has made to the Published Work:

  Carmen Leong designed the study, collected the data, selected and conducted data analysis, and wrote the article.

Carmen Leong — Candidate's Signature — 11/04/2017 — Date

Stephen Hill — Digitally signed by Stephen Hill Date: 2017.04.12 09:21:15 +12'00' — Principal Supervisor's signature — 12/4/2017 — Date