An examination of the effect of green exercise and nature connectedness on the psychological well-being and attentional capacity of primary school-aged children.

By

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A thesis submitted to Mary Immaculate College for the degree of PROFESSIONAL DOCTORATE OF EDUCATIONAL AND CHILD PSYCHOLOGY.

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Mary Immaculate College

August 2019

Abstract

Aim

Research into the positive impact of green exercise on the psychological well-being and attention of adults has been largely confirmatory. Early exploration into the effects of green exercise on children has produced contrasting findings. Green exercise refers to exercise which takes place in an environment with a high level of natural greenness. Connectedness denotes the level of affective connection an individual has to the natural environment. This study aimed to compare the effects of green exercise, non-green exercise, connectedness to a green environment and connectedness to a non-green environment on the psychological well-being and attentional capacity of 3rd-6th class primary school students.

Method

350 participants took part in the study. Utilising a mixed research design, 56% of participants completed green and non-green exercise and 43% of participants completed a green and non-green connectedness activity. In addition to measures of mood and attention, demographic information was gathered for each participant, as well as information regarding attitudes to exercise and to the intervention environments.

Results

Pre and post data were statistically analysed using multi-level modelling. Environmental setting showed significant effect on post-intervention positive affect; the urban environment brought greater positive impact. Participation in a nature connectedness activity did not significantly predict change to mood or attention post-intervention. Greater enjoyment and aesthetic value attached to a particular environment lead to higher levels of positive affect and lower levels of negative affect. Gender significantly impacted on post-intervention levels of affect; females reported higher levels of positive affect and lower levels of negative affect than males.

Conclusions

While the psychological effects of participation in green exercise and nature connectedness activities have been broadly lauded in adult-based research, the current research indicates that, for children, the process of gaining the benefits of green exercise and nature connection is complex. The study indicates that individual differences, including gender and personality, should be recognised during the policy-making process and in implementing well-being driven interventions for children.

Declaration

I hereby declare that this thesis represents my own work and has not been submitted, in whole or in part, by me or any other person, for the purpose of obtaining any other qualification.

Name: Alison O'Keeffe

Signature:_____

Date:_____

Dedication

Behind every young child who believes in herself is a parent who believed first.

I would like to dedicate this thesis to my Dad, Bobby, who was a strong advocate of not hiding your light under a bushel.

Wishing you were here to celebrate the end of this chapter and the beginning of the next one, Dad.

Acknowledgements

I would like to begin by thanking the four schools who took part in this research. Thank you to the principals, teachers and students who allowed for this study to take place by giving of their time. It could not have happened without you all.

A special thank you to my research supervisors, Dr. Johanna Fitzgerald and Dr. Paul Mulcahy. To Johanna, thank you for mopping up my tears and to Paul, thank you for mopping up my statistics. Truly, I could not have asked for more interested, supportive or helpful research supervisors. You have both made this research journey a lot less painful than it had potential to be!

I would like to acknowledge my fellow trainees. We began this journey together three years ago, not knowing all that was ahead of us. Having you all to share the stressful times and laugh our way through was invaluable. Special mention to Carol - classmate, fellow student-bride and friend – thank you for the help, support and advice along the way and to my 'work-wives' Charlotte and Lainey, for the much-needed chats and coffees.

I would like to thank my newly acquired family of in-laws, Patricia, John, Bríd, Joe and Elaine. Thank you all for welcoming me so fully into my new life in Limerick. Your thoughtfulness and support means so much. Special mention to Bríd for the laughs, the jellies and the odd glass of wine!

To my lovely family, Mum, Rob, Val, and Jen. Having just read back on the acknowledgements section of my Masters dissertation, I will again thank Val for tolerating my 'little lectures', sorry Val! Rob, thanks for your genuine interest in the process and the progress. And Paoleen, thank you for your support through the tougher times and for always celebrating the successes. Also, thank you for being on the end of the phone when I was going stir-crazy due to desk-life! Thank you all for fun memories and time spent together along the way.

Lastly, to my husband, David. I could write another chapter on all the ways you have helped to get me to this point. We have joked over the last few years that this is your doctorate too, really that is true; I couldn't have gotten here without you. From the practical to the emotional, your unfaltering support and faith in me continues to amaze me. I'm so thankful to have you, for always.

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Chapter One: Introduction

> Health is created and lived by people within the settings of their everyday life; where they learn, work, play and love. Health is created by caring for oneself and others, by being able to take decisions and have control over one's life circumstances, and by ensuring that the society one lives in creates conditions that allow the attainment of health by all its members.
>
> Ottawa Charter for Health Promotion, 1986, p. 4.

This chapter introduces key elements which structure the present study. Firstly, a reflexivity statement is outlined. Secondly, a brief exploration of the concept of well-being is conducted. Thirdly, the concept of 'universal intervention' is discussed, alongside its role in promoting a climate which supports positive well-being. Fourthly, an overview of the concepts of nature connectedness and green exercise will be provided. A rationale for the present study and the aims which it hopes to achieve are presented. Finally, the structure of the thesis is outlined.

1.1 Reflexivity Statement

As an educational psychologist in training, I have encountered the importance of and difficulties inherent in promoting children's well-being. Across disability settings, schools and mental health services, the value of sound emotional and psychological health for children is fully acknowledged. Equally, during my training, the challenges which come with fostering positive mental health have become apparent. Be it a question of the local context, the needs of the presenting child/children or families, the time and resources available or the capacity of stakeholders to implement intervention, supporting children's well-being is complex.

Previous to my entering this professional training programme, I worked with adolescents and young adults whom were experiencing homelessness. The cycle in which poor well-being can result in homelessness and homelessness contributes to poor well-being was evident. Also apparent was the value of early intervention, of resilience building, of *access* to supports, in determining outcomes.

In completing this research study, I bring this awareness of the impact of well-being on life outcomes, of the impact of life outcomes on well-being and of the role which society plays in building resilient, emotionally-aware children, whom have capacity to draw on necessary supports and resources, within themselves and within their communities, in order to maintain their well-being. Further, the role which the educational psychologist holds, in building knowledge and awareness and in empowering stakeholders to foster well-being, informs the motivation, design and implementation of this study.

1.2 Children's Well-Being

The National Council for Special Education (NCSE; 2006) outlines that, on the basis of International Classification of Diseases-10 and Diagnostic and Statistical Manual of Mental Disorders-IV diagnostic criteria, an estimate of 86,083 children attending Irish schools have a moderate to severe mental health difficulty (Irish College of Psychiatrists, 2005). The NCSE (2006) report further suggests that this is a conservative figure which does not account for children who experience mental health difficulties at a milder end of the spectrum. In recent years, national and educational policies have highlighted the importance of building children's positive well-being and engagement in learning (Department of Children and Youth Affairs [DCYA], 2014; Department of Health, 2013).

1.3 Conceptualising Well-Being

Well-being can be defined in terms of the extent to which an individual realises his/her own strengths, has capacity to cope positively with daily stressors and can make a contribution to his/her community (World Health Organisation [WHO], 2007). WHO (2014) defines health in terms of complete physical, mental and social well-being, going beyond the mere absence of illness. Though mental health has previously been regarded as a term synonymous with mental illness, or conceptualised only in terms of the absence of mental illness, more recently, a reconceptualisation of mental health views it as the presence of positive aspects of well-being (Cane & Oland, 2015; MacDonald, 2006). Additionally, the WHO (2004) outlines that the essential aim of mental health promoting action is to improve the well-being and functioning of individuals through a focus on strengths and resources, building levels of resilience and enhancing protective factors. Similarly,

Cane and Oland (2015) suggest that this reconceptualisation of mental health encourages the exploration of proactive means of promoting mental health, which may be preventative of mental health difficulties, rather than maintaining a reactive, treatment approach to mental ill-health. Through systematic review of return on investment of public health interventions, it has been found that such interventions are decidedly cost-saving, yielding high return on investment for both health services and the wider economy (Masters, Anwar, Collins, Cookson & Capewell, 2017).

1.4 Universal Intervention

With consideration of proactive means of promoting positive mental health in children, the potential inherent in the school setting warrants examination. Research suggests that universal school-based interventions represent a promising approach to building children's social-emotional well-being (Elias et al., 1997). Universal interventions are directed at whole school populations, rather than targeting those whom have been identified to be at risk of or whom present with a mental health difficulty (Higgins & O'Sullivan, 2015). Analysis of international research indicates that a universal intervention, in the school context, can result in improved behaviour, increased learning, higher levels of inclusion and social cohesion, and enhanced mental health (Weare & Gray, 2003). The Department of Education and Skills (DES; 2018) posits that a whole school approach to the promotion of well-being should encompass culture and environment, the curriculum, relationships and partnerships, and policy and planning. An example of a universal intervention can be found in The Daily Mile, a physical activity programme which originated in a school in Scotland and has become popular in Scotland and internationally (Chesham et al., 2018). The Daily Mile sees children running or walking outside for 15 minutes per day at a self-selected pace. Taking place on school grounds, participation in The Daily Mile has been found to increase periods of moderate to vigorous physical activity, reduce sedentary time, and increase physical fitness (Chesham et al., 2018).

1.5 Nature Connectedness and Green Exercise

The non-medical term nature-deficit disorder is used to refer to the growing gap between human beings and nature (Louv, 2011). It is suggested that, in a period of rapid environmental, economic and social change, there are indicators of a shortage of direct experience with the natural world in children's lives (Charles &

Louv, 2009). Likewise, Capaldi, Passmore, Nisbet, Selenski and Dopko (2015) argue that many individuals are not as connected to nature as they have been previously, with consequent implications for both the well-being of the environment and the well-being of individuals. The researchers suggest that exposure to nature represents a source for promoting health and well-being which is currently underutilised, offering opportunities for enhanced mood and reduced stress (Capaldi et al., 2015). Existing empirical research regarding the positive impact of nature connection points to the promise of a reconnection with nature (Richardson & Sheffield, 2017).

Green exercise refers to physical activity which takes place in a natural environment (Calogiuri, Patil & Aamodt, 2016). Research has found additional physical and mental health benefits to green exercise, beyond those benefits which result from physical activity alone (Calogiuri et al., 2016). The environment in which green exercise is conducted can be conceptualised as one which has a higher ratio of natural to artificial elements than is typically experienced by an individual in everyday life (Mackay & Neill, 2010). Though beneficial effects of green exercise have been recorded in research, the combination of factors which may be involved in determining the effect of green exercise, such as exercise variables, individual differences, cognitions, socio-cultural variables and environmental variables, is as yet ambiguous (Mackay & Neill, 2010). However, green exercise has been found to reduce anxiety, reduce low mood, reduce anger and improve attention (Berto, 2005; Bodin & Hartig, 2003; Mackay & Neill, 2010).

1.6 Rationale

Rationale for the present study arose subsequent to consideration of the following:

- The present state of children's well-being in Ireland
- The usefulness of universal interventions
- The current national and educational policy context
- The potential benefits to well-being and attention of green exercise and nature connection outlined by existing research.

1.7 Aim of Study

The research which is described and discussed in this thesis is a small-scale study which aims to explore the effectiveness of an universal intervention in promoting the emotional well-being and attention of primary school-aged children. Building on predominantly adult-based research into outcomes of green exercise and nature connectedness, the current study compares effects of exposure to a green environment and urban environment, incorporating exercise and a connectedness activity. The study's specific aims and research questions are outlined in Chapter Three.

1.8 Thesis Structure

This thesis comprises six chapters: Introduction (Chapter One), Literature Review (Chapter Two), Methodology (Chapter Three), Results (Chapter Four), Discussion (Chapter Five) and Conclusions (Chapter Six).

The Literature Review (Chapter Two) provides a systematic review of nature connectedness and green exercise research, as well as an overview of the theoretical basis of research in this area. Chapter Three provides a detailed description of the study's method including research design, pre and post-intervention measures and statistical analysis. The results of the study are outlined in Chapter Four. Results are summarised and discussed in relation to the current literature and the theoretical context in Chapter Five (Discussion). Implications for future research and educational psychology practice are also explored. Chapter Six details conclusions to be drawn from the study and a personal reflective account of the impact of the research on the researcher's professional practice.

Chapter Two: Literature Review

This chapter provides an overview of the theoretical foundations which support research on nature connectedness and green exercise. A review is conducted of national and educational policy and current curriculum provisions that aim to promote well-being in schools. Systematic reviews of nature connectedness literature and green exercise literature are carried out. Findings from these reviews are synthesised in order to provide a comprehensive account of research outcomes to date. With consideration of the policy and research context, the research questions which this study aims to answer are outlined.

2.1 Theoretical Underpinnings

Two theories, attention restoration theory and stress reduction theory, underlie a majority of research into the effects of connection with nature and exercise in natural, green spaces on aspects of well-being (Han, 2017; Mackay & Neill, 2010; Martensson et al., 2009; Olafsdottir, Cloke & Vogele, 2017; Passmore & Holder, 2017; Richardson & Sheffield, 2017; Roe & Aspinall, 2011). Attention restoration theory (ART) proposes that attention fatigue can be restored through particular environments (Kaplan & Kaplan, 1989). Attention fatigue may result from, for example, long hours of study, a period of worry or anxiety or a busy period of working to complete several tasks (Kaplan & Kaplan, 1989). The environments on which Kaplan and Kaplan (1989) focus their theory are natural; their conceptualisation of the natural environment is broad, encompassing environments where there has been little human intervention as well as places designated as 'natural areas' by a government body. Natural environments include woodland, parks, meadows, abandoned fields and domestic gardens (Kaplan & Kaplan, 1989).

The theory of attention restoration is based around the concept of mental fatigue; that is a 'worn-out state' which is generally not physical in nature, rather a lack of physical activity may be a contributor (Kaplan & Kaplan, 1989). Mental fatigue is characterised by distractibility, restlessness and forgetfulness and can have a negative impact on emotions, behaviours and performance (Han, 2017; Martensson et al., 2009). The theorists utilise the work of William James (1892 as cited in Kaplan & Kaplan, 1989) to dissect the concept of mental fatigue. Two types of attention are identified, involuntary attention (soft fascination) and directed attention.

During directed attention, the cognitive capacity to process activities and goals forces the suppression of potentially distracting factors (Martensson et al., 2009). Within directed attention, one maintains focus not by strengthening attention on a particular mental task but by inhibiting all that surrounds it (Kaplan & Kaplan, 1989). Directed attention is mentally demanding, when capacity for this is depleted, one experiences mental fatigue (Hartig, Mang & Evans, 1991). In contrast, involuntary attention is an effortless action; brought on by stimuli which are exciting or intriguing, involuntary attention describes the action of looking to discover what is happening when one encounters an interesting, strange, attractive or unusual stimulus (Kaplan & Kaplan, 1989). Restorative environments, such as those with greater natural than artificial environments, are considered to facilitate recovery from directed attention fatigue (Mackay & Neill, 2010). Through contact with nature, attention is restored due to the high level of soft fascination in natural settings; high levels of soft fascination bring sufficient interest to hold attention but to an extent where space for reflection remains (Kaplan, 1995; Roe & Aspinall, 2011).

In addition to soft fascination, an environment must possess other features in order to be considered restorative (Kaplan & Kaplan, 1989). *Escape* refers to a sense of being away from that which has caused mental fatigue; *extent* refers to the space feeling like a 'whole other world', and *compatibility* describes the good fit between the characteristics and offerings of the environment and the individual's purpose or desires (Kaplan, 1995; Roe & Aspinall, 2011). ART asserts that the natural environment, as opposed to built-up, urban environments, has a higher proportion of these four qualities (Kaplan & Kaplan, 1989). In addition, the profile of an individual, including age and status of mental health, can be understood to influence response to the restorative environment. Exploring differences in the restorative outcomes of urban and green settings on two groups with disparate mental health, Roe and Aspinall (2011) found that the group without mental health difficulties experienced positive changes to mood following a green walk but not an urban walk. In contrast, both the green and urban walks produced significant positive change to mood and mindset variables for those participants who were experiencing poorer mental health (Roe & Aspinall, 2011). The disparity in effects for those considered to have good mental health and those of poor mental health suggests that the underlying processes which produce change post-intervention are dissociated. It may

be considered that the physical activity comprised in the intervention brought positive change to mood for those experiencing poor mental health, potentially due to physiological and/or psychological factors (Fox, 1999; Peluso & Silveira Guerra de Andrade, 2005). In contrast, benefits for those who are experiencing good mental health may be explained by psychological processes specifically. This research study also found a significant age interaction effect on hedonic tone (affective state); stress and hedonic state show a negative correlation, with younger participants being more likely to demonstrate change post-rural intervention, than older participants (Roe & Aspinall, 2011). Though this study had limitations, including a small sample size and a basic categorisation between 'good' and 'poor' mental health, it demonstrates that the restorative experience of natural environments is effective for both adults experiencing mental health difficulties and adults who are of good mental health.

Stress reduction theory (SRT) adopts a psycho-evolutionary perspective (Ulrich et al., 1991). It suggests that immediate, unconsciously initiated emotional responses play a central role in how one responds to nature, and that these influences impact attention, physiological state and behaviour (Ulrich et al., 1991). In this way, Ulrich's (1983; 1991) theory diverges from ART; SRT suggests that the initial response of an individual to the environment is affective rather than cognitive (Hartig et al., 1991). The features of a natural setting and the emotional, cognitive and physiological state in which an individual encounters that setting will dictate adaptive responses; Ulrich (1983) suggests that these adaptive responses can present as stress and avoidance behaviour or restoration and approach behaviour. SRT proposes that nature has a calming effect due to non-demanding stimuli which elicit positive emotional states and suppress negative emotional states (Hartig et al., 1991). The elements of a natural setting which are believed to foster positive emotional response include moderate complexity and the presence of a focal point (Roe & Aspinall, 2011). These restorative elements are reflective of findings of research on aesthetic judgements which suggest that complex stimuli become more pleasing over time and that the interaction between visual complexity and conceptual fluency determine derived aesthetic pleasure (Ball, Threadgold, Marsh & Christensen, 2018; Berlyne, 1970). In contrast to ART, SRT states that the benefits of exposure to natural environments are feasible in any stressful situation, rather than being limited

to those in which the individual is attentionally fatigued (Han, 2017; Roe & Aspinall, 2011).

Though ART and SRT are widely conveyed in the literature as competing explanations for response to natural environments, Bratman, Daily, Levy & Gross (2015) examined effects in relation to both cognition and affect (Bodin & Hartig, 2005; Christie & Cole, 2017; Faber-Taylor & Kuo, 2009; Han, 2014; Mackay & Neill, 2010; Ohly et al., 2016). The researchers found improvements to affective functioning following a green walk, including decreases in anxiety, rumination and negative mood. Likewise, improvements to cognitive functioning following participation in the green condition were also evident, with no such effects found in the urban condition (Bratman et al., 2015). Findings related to cognitive impact were more equivocal than those related to affective impact (Bratman et al., 2015). The researchers concluded that, as yet, explanation of the influence of environmental covariates on individuals is unclear. Similarly, Berman et al. (2012) found affective and cognitive benefits to interaction with nature for individuals with a diagnosis of a major depressive disorder. However, improvements to affect and cognition were not correlated, suggesting separable mechanisms at work (Berman et al., 2012). Acknowledging theoretical viewpoints regarding the potential interaction between improved mood and improved cognitive functioning, Berman et al. (2015) propose that the findings of this study suggest that the cognitive benefits gained from interaction with a natural environment result from processes beyond increased positive mood.

As the cognitive profile and affective state of an individual impacts on their response to restorative environments, so an individual's dispositional sensitivity to engaging with environments on an aesthetic level may play a role in dictating response (Lu, Wang & Hughes, 2016; Roe & Aspinall, 2011). In exploring this potential impact, research on the topic of personality and aesthetic experience relates to the 'big 5' personality dimension of openness to experience (Lu et al., 2016; McCrae & Costa, 1997). Openness to experience refers to an ongoing state of engagement with the world whereby open individuals actively seek out new and varied experiences, are more observant and more imaginative, are more tolerant of ambiguity, are more moved by art and experience deeper and more differentiated emotional states (Costa & McCrae, 1978; McCrae & Costa, 1997). It is argued that openness should be

accounted for in research on attitude change and behaviour change, in assessing the value of teaching strategies and in investigating the value of health promotion approaches (McCrae & Costa, 1997).

Stress response has been investigated in the context of personality composition with findings that the trait of openness has an influence on an individual's stress response (Ó Súilleabháin, Howard, & Hughes, 2017; Williams, Rau, Cribbet & Gunn, 2009). Following subjection to a laboratory-based stressor, participants who were higher in openness experienced less blood pressure reactivity and a small increase in positive affect during the stressor (Williams et al., 2009). The researchers also found that life stress resulted in poor sleep quality for participants with low levels of openness, suggesting that those high in openness have greater levels of stress resilience (Williams et al., 2009). Similarly, Ó Súilleabháin et al. (2017) found that higher openness was associated with an adaptive cardiovascular stress response within the context of exposure to changing levels of acute stress; participants who were higher in openness showed efficient habituation to changes in stress exposure. Both studies conclude that openness to experience buffers individuals from the negative effects of stress, suggesting that individual differences are implicated in stress response (Ó' Súilleabháin et al., 2017; Williams et al., 2009). While the implications of levels of openness have not thus far been explored in the context of green exercise or nature connection research, findings from other fora indicate that for individuals whom are more sensitive to aesthetic experience, a beneficial physiological response to stress, and thus more positive health outcomes, is more likely.

2.2 Context

2.2.1 Policy. A fundamental component for the promotion of a child's mental health and well-being is the school setting (DES, 2015). Within and without the school context, concern regarding the psychological well-being of Irish children and adolescents has given rise to policy initiatives. *Better Outcomes, Brighter Futures*, a whole-of-government policy, envisages Ireland as a place in which children's rights are respected and fulfilled and children are supported to fulfil their maximum potential (DCYA, 2014). Acknowledging that one third of the Irish population is under 25 years of age and that events early in life affect health and well-being in later life, it is considered that the evidence base for a life course approach is strong

(DCYA, 2014). Among the national outcomes set out to be achieved are that children will have good mental health, have positive social and emotional well-being, will be engaged in learning, will enjoy play, recreation, culture and nature and will be socially and environmentally conscious (DCYA, 2014). These national outcomes are drawn from the DCYA's (2005) *National Set of Child Well-Being Indicators*. Based on a definition of well-being which encompasses healthy physiological, psychological and behavioural functioning, the well-being indicators include access to positive environments in which to spend time, quality of childcare and education, positive mental health, high levels of self-esteem and self-reported happiness (Andrews et al., 2002; DCYA, 2005). The Healthy Ireland framework proposed by the Department of Health [DOH] (2013) also takes a lifespan approach, aiming to address risk factors to health and promote proactive factors, at every life stage. Through effective intervention, the creation of economic, social, cultural and physical environments that foster healthy living and focused partnerships between government departments and other relevant agencies, the vision of Healthy Ireland is to achieve a healthy society (DOH, 2013).

The national policy drive towards health and wellness is mirrored in school policy and curriculum development. From early years, through to post-primary education, a focus on holistic learning, on building children's competencies beyond the academic has begun to emerge (National Council for Curriculum and Assessment (NCCA), nd). Parallels may be drawn between this new direction and the drive for positive education by positive psychologists (Seligman, Ernst, Gillham, Reivich & Linkins, 2009). Positive education can be defined as education which encompasses both traditional skills (literacy, numeracy, discipline) and skills for happiness (Seligman et al., 2009). Proponents of positive education assert that increased well-being is synergistic with better learning; through increased levels of well-being, improved attention, more creative thinking and more holistic thinking are produced (Seligman et al., 2009).

In considering the challenges comprised in adopting and fostering a well-being approach in contemporary education, O'Brien and O'Shea (2017) suggest that the issue of being "authentically or sincerely engaged in making well-being a reality" (p.5) represents a significant change within both the educational context and in the broader social and cultural context. Sincere engagement with a well-being strategy

requires buy-in and commitment from educators at every level, from DES to school personnel on the frontline. As teachers encounter the challenges in supporting students' development towards greater well-being and in developing a well-being curriculum, they will need training and support (O'Brien & Shea, 2017). As the authors outline, ensuring ongoing well-being centred practice that is deeply embedded and not tokenistic may require rethinking and revisiting elements of school culture, the physical and emotional spaces that contribute to this, and the prioritisation of types and methods of learning which move away from the conventional, emphasising respect, listening and attunement rather than academic success and measurable achievements (O'Brien & Shea, 2017).

By age 13, one in three young people in Ireland is likely to have experienced some type of mental disorder (Cannon, Coughlan, Clarke, Harley & Kelleher, 2013). As outlined, the NCSE's (2006) latest account of children in schools who are experiencing mental health difficulties states that approximately 86,083 school-aged children attending have a moderate to severe mental health difficulty. The NCSE (2006) report further suggests that this is a conservative figure which likely excludes children with milder mental health difficulties. The Better Outcomes, Better Future initiative recognises the vital role played by early years settings, schools, youth and sports organisations in promoting positive mental health and well-being. Through these fora a safe, supportive environment for teaching life skills, building emotional resilience and fostering a sense of connectedness to school and community is realisable (DCYA, 2013).

Well-being specific policies have been developed at both primary and post-primary school level in Ireland. The *Well-being in Primary Schools* policy document highlights the role of schools and associated education providers in fostering mental well-being, underlining the commitment required to promote mental health and the requirement for this commitment to mental health to permeate through all aspects of school life and learning (DES, 2015). A useful definition of well-being, in the context of the school system, is provided by the DES (2015); well-being is the

> presence of a culture, ethos and environment which promotes dynamic, optimal development and flourishing for all in the school community. It encompasses the domains of relationship, meaning, emotion, motivation, purpose, and achievement. It includes quality teaching and learning for the development of all elements related to healthy living whether cultural,

> academic, social, emotional, physical or technological with particular focus on resilience and coping. (p.9)

Well-being protective factors, in the education setting, include participation in school and community activities, opportunities for skills development and achievement, opportunities for social and emotional learning, a positive school climate and positive classroom management strategies (DES, 2013; DES, 2015). The post-primary well-being policy recognises the vulnerability of adolescence and the potential for psychological or emotional difficulties to present (DES, 2013). Both policies reference the health promoting schools framework as the cornerstone of well-being building in schools (DES 2013; DES 2015). A health promoting school creates safe, healthy, friendly school environments through a holistic model of health which acknowledges the importance of interaction between physical, mental, social and environmental aspects of health (WHO, 2008). Regarding the physical environment, a health promoting school should endeavour to enrich through optimal physical conditions, encouraging students to take responsibility for the school environment, both built and natural (WHO, 2008). Concerning the social environment, the provision of mental, spiritual, emotional and social resources required to foster a safe, inclusive environment is highlighted (WHO, 2008). Likewise, the well-being in schools policies underline the role of the physical and social environment in responding to the social and emotional needs of those who learn and work in or visit the space (DES, 2013; DES, 2015).

2.2.2 Educational curricula. From early years to post-primary curriculum planning, a drive to develop and support emotionally healthy children and young people is evident (NCCA, 2009; DES, 2013; DES, 2015). Health promotion in schools is defined by the Health Service Executive (HSE; 2013) as any activity which strives to improve and/or protect the health of school staff and/or students; thus it goes beyond health education. Health promotion activities relate to healthy school policies, curriculum and learning and extend to the physical and social environment of the school (HSE, 2013).

Aistear, the curriculum framework for early years education in Ireland, was devised by the NCCA (2009). The Aistear framework offers a means of planning for and supporting children's learning and development, ensuring that the early childhood

years provide positive and enjoyable experiences (NCCA, 2009). Aistear, the Irish word for 'journey', is considered to be the beginning of a child's lifelong adventure as a learner, highlighting the need for children to have opportunity to learn from rich and varied experiences (Early Childhood Ireland & NCCA, 2013). One of four main goals of the Aistear framework is well-being. The specific aims of this goal relate to children's psychological and social development, their physical health and their sense of wonder, awe and exploration. Embracing a child-led, play-based approach to learning, promotes independence, curiosity and problem-solving in children (Early Childhood Ireland & NCCA, 2013).

The development of emphasis on well-being at primary and post-primary level can be observed in the Schools for Health in Ireland policy (HSE, 2013) and the introduction of social, personal and health education (SPHE) as a school subject. The Schools for Health in Ireland policy offers schools a framework for assessing the health needs present in their school and implementing strategies for working towards improved health (HSE, 2013). Benefits of a health promoting school, as outlined in the policy, include increased student self-esteem, better learning outcomes and a more co-ordinated perspective on the social, physical and environmental needs of the school (HSE, 2013). Likewise, the SPHE curriculum has firmly brought health education into the formal curriculum in Irish schools. At primary level, the SPHE curriculum aims to build children's confidence and well-being, to empower them to take responsibility for their own health and to support them to become active, responsible citizens (NCCA, 1999). At post-primary level, objectives of the SPHE curriculum include the development of student's self-efficacy and understanding of health concepts, the development of resiliency and effective decision-making strategy and the development of a willingness to contribute to healthy communities and environments (NCCA, 2011). Additionally, emphasis is placed on a whole school environment which supports healthy eating and physical activity, reinforcing a commitment to health and well-being, not just in the teaching of SPHE, but in every class and throughout the school community (NCCA, 2011).

In 2015, the introduction of a Framework for Junior Cycle, to post-primary schools in Ireland, aimed to provide a more accessible curriculum to students with special educational needs (NCCA, nd). Level 1 Learning Programmes and Level 2 Learning Programmes address the learning needs of post-primary level students with general

learning difficulties (DES, 2018). Level 1 Learning Programmes (L1LP) provide curriculum content for students functioning in the low moderate to severe range of intellectual disability. Level 2 Learning Programmes (L2LP) are designed for students in the low mild to high moderate range of ability. In addition to academic learning outcomes in areas such as literacy and numeracy, the L1LPs and L2LPs support student's learning in relation to health, well-being and personal development. Targeted outcomes at the L1LP level include empowering students to make choices, increasing self-esteem, promoting independence and building emotional literacy (NCCA, nd). The L2LP curriculum places emphasis on development of a healthy lifestyle, stress management and emotional literacy (NCCA, 2014). Both programmes also promote engagement with the local community, building knowledge of local facilities, observing rules of safety in different environments and encouraging participation in the care of the local environment (NCCA, nd; NCCA, 2014).

Across all levels of education provision in Ireland, a drive towards promoting well-being is evident. Building self-awareness, confidence, resilience, emotional health, knowledge of self-care and engagement is recognised as a worthwhile endeavour, in the development of children and adolescent's well-being (NCCA, 2009; NCCA, 2011; NCCA, 2014). However, as O'Brien and O'Shea (2017) highlight, embedding this recognition in education culture, implementing policy in an authentic way, remains a task to be completed.

2.2.3 Forest schools. A forest school is defined as an "inspirational process that offers children…regular opportunities to achieve and develop confidence and self-esteem through hands on learning experiences in a woodland environment" (Murray & O'Brien, 2005, p. 11). Borne from the Scandinavian belief that children's contact with nature is extremely important from an early age, forest schools foster creative development, communication, personal, social and emotional development and a knowledge and understanding of the world (Murray & O'Brien, 2005). A number of key features brought together provide children with the forest school experience; these are flexible and free child-initiated learning in a woodland setting, learning which is linked to a national curriculum, freedom to explore using multiple senses, regular contact with a natural environment and a high adult to child ratio (Murray & O'Brien, 2005). Though an exact figure on the number of forest schools

presently in Ireland is not available, research indicates that they have begun to emerge, both in the form of forest pre-schools and the introduction of forest school principles to primary schools. In the United Kingdom, the forest school movement began in the mid-1990s (Smith, Dunhill & Scott, 2018). The Forest School Association, the professional body for promoting best practice in forest schooling in the United Kingdom, currently cites forty-nine forest school providers (Forest School Association, n.d.)

Examining the role which forest schools can play in fostering children's development over an extended period (eight months), O'Brien (2009) found that attendance at a forest school lead to improved self-esteem, social skills, motivation, concentration and physical motor skills. Additionally, O'Brien (2009) outlines that the impact of forest schools had a follow-on effect in children's home environment, with children sharing their learning experiences with friends and family. Though findings in the study were based on observations by teachers or forest school leaders, through action research, it is suggested that it offers insight into the potential benefits of forest schools (O'Brien, 2009). In contrast to O'Brien (2009) who identified a positive 'ripple' effect of forest schools in the home environment, Slade, Lowery & Bland (2013) suggest that parental involvement was essential in ensuring positive outcomes from forest school. The researchers surmise that a lack of awareness of the forest school project among parents, and thus a reliance on their children for information, reduced the likelihood of forest school experiences being shared at home (Slade et al., 2013). Similarly, though increased self-esteem, social interaction and peer-collaboration were reported, Slade et al. (2013) outline that the children's learning from three visits to a forest school environment required embedding on return to the traditional classroom, through tasks and activities which expand on the learnings of forest school, so as to capitalise on the experience. Exploring forest school as a learning space, Harris (2017) highlights how an outdoor learning space can free teachers and students from the norms and conventions of the classroom, leading to different learning styles being utilised and increased levels of child-led learning. While forest school is still considered an alternative education, Harris (2017) asserts that the movement is currently at a point of intersection between formal and alternative schooling, seeking to situate outdoor learning in every classroom.

2.3 Rationale

The benefits for children of engaging in physical exercise are well-documented. Positive outcomes have been found in relation to reducing risk of chronic diseases such as diabetes, cancer and cardiovascular disease, decreasing likelihood of obesity and high blood pressure, and improving self-esteem, anxiety and depression (Janssen & LeBlanc, 2010; Sothern, Loftin, Suskind, Udall & Blecker, 1999; Warburton, Nicol & Bredin, 2006). Research examining the impact of *where* physical exercise takes place has brought the importance of 'green exercise' in promoting positive outcomes to the fore (Berto, 2005; Bodin & Hartig, 2003; Kelz, Evans & Roderer 2015; Pretty, Peacock, Sellens & Griffin, 2005). Green exercise refers to exercise which takes place in an environment with a high level of greenness. Barton and Rogerson (2017) provide the following definition of greenspace 'maintained or unmaintained environmental areas, which can include nature reserves, wilderness environments and urban parks' (p. 80). Pretty et al. (2005) found that exposure to pleasant rural and urban environments, while engaging in physical exercise, had a significant positive effect on self-esteem and a number of mood measures. For the six measures of mood, as assessed by the Profile of Mood States Questionnaire (POMS), viewing rural pleasant scenes during exercise produced consistent, though not always significant, improvements. However, viewing urban pleasant scenes also resulted in improvements in all six mood measures, of which a majority were significant. With regard to physiological benefits, Pretty et al. (2005) found that rural pleasant scenes were most effective in reducing blood pressure. The results of Pretty et al.'s (2005) study demonstrate the synergistic effect of exercising in a green environment, an effect which was also indicated in Han's (2017) research which investigated how nature, exercise or a combination of both produce benefits. Han (2017) found that visible greenness rates had greater effect on emotions and attention than did physical activity levels, however there was no interaction between visible greenness rates and physical activity levels when engaging in green exercise. Regardless of physical activity level or exercise type (walking or jogging), Han (2017) found that one 15-minute bout of exercise in settings with a high visible greenness rate was beneficial to mood and attention. As in research by Pretty et al. (2005), the POMS was utilised to measure

changes to mood, while attention was tested using a forward spatial span test and backward digit span test drawn from the Wechsler Memory Scale (Han, 2017). Mackay & Neill (2010) identified a significant linear relationship between perceived greenness of the exercise environment and anxiety reduction. The researchers also measured the degree to which participants perceived an environment to be artificial or natural, on a ten-point rating scale. They highlight that subjectively perceived environmental naturalness helped to explain reductions in anxiety and varying effect sizes across different exercise groups, recognising the role of individual differences in mediating response to environment (Mackay & Neill, 2010). Through a simple, short intervention aimed at increasing nature connectedness and thus psychological well-being, Richardson and Sheffield (2017) found successful outcomes. By noticing three good things in nature for five days, sustained and significant increases in nature connectedness were shown (Richardson & Sheffield, 2017). Utilising the General Health Questionnaire (GHQ), which measures current mental health and psychological well-being, the researchers found a significant relationship between post-intervention scores on the GHQ and nature connectedness, in the intervention group. The GHQ includes questions on ability to maintain concentration, feelings of happiness, feelings of unhappiness etc.

Research into the positive impact of green exercise on psychological well-being of adults has been largely confirmatory (Berto, 2005; Bodin & Hartig, 2003; Kelz et al., 2015; Pretty et al., 2005). Exploration of the effects of green exercise on children has produced contrasting findings (Duncan et al., 2014; Kuo & Faber Taylor, 2004). Kuo and Faber Taylor (2004) found that green outdoor activities reduced Attention Deficit Hyperactivity Disorder symptoms (inattention and impulsivity) significantly more than did activities in built-up outdoor environments or indoor environments. However, with the exception of increased fatigue and reduced vigour post green exercise, Duncan et al. (2014) found no significant mood change post-intervention. This finding is contrary to outcomes found in adult-based research (Duncan et al., 2014). With child-based studies finding inconclusive outcomes as to the benefits of nature connection and green exercise, a more comprehensive examination of research in the area is warranted.

2.4 Systematic Review

2.4.1 Aim of the review. The aim of this review is to provide a critical survey of evidence-based interventions which examine the impact of nature connectedness intervention and green exercise on well-being. Considering the comparative dearth of children-focused research, the review will include interventions-based research carried out with children, adolescent or young adult populations. Given the focus of the proposed research on effects on mood state and attentional capacity, for the purposes of this review, changes to 'well-being' encapsulate changes to aspects of mood state and/or attentional capacity. The role of mood and mental health in contributing to children's well-being is well-documented (DCYA, 2005; DES, 2015; WHO, 2008). Similarly, the negative impact of poor attention on emotional well-being, behaviour and performance is widely recognised (Han, 2017; Kuo & Faber-Taylor, 2004; Ohly et al., 2016; Schutte, Torquati & Beattie, 2017).The nature connectedness intervention will include any intervention which takes place in an environment with a higher ratio of natural to manmade elements than is usually encountered by an individual in everyday life (Mackay & Neill, 2010).

2.4.2 Review question.

What is the impact of connection with nature on participants' mood state?

What is the impact of connection with nature on participants' attentional capacity?

2.4.3 Literature search. A comprehensive literature search was carried out on 17th August 2018 using the electronic databases Academic Search Premier, British Education Index, Education Full Text, Education Source, ERIC and PsycARTICLES. Table 1 outlines the search terms which were used.

Table 1

Search Terms used in Literature Search

Databases	Search Terms
Academic Search Premier, British Education Index, Education Full Text, Education Source, ERIC, PsycARTICLES.	Nature connec* AND effects OR impact OR consequences OR influence OR outcomes AND mood OR wellbeing OR emotion OR mental health OR attention

A filter was applied to include only studies written in the English language and studies which were peer-reviewed. The initial search yielded 178 results. Fifty-one articles were removed as duplicates following screening of titles. The 127 remaining studies were screened by title. Following title screening, 39 studies remained for abstract screening. The remaining 39 articles were screened by abstract, further inclusion and exclusion criteria were applied. A total of 18 articles remained for full text screening against inclusion and exclusion criteria, as defined in Table 2.

Table 2

Inclusion and Exclusion Criteria with Rationale

		Inclusion Criteria	**Exclusion Criteria**	**Rationale**
1.	Type of Publication	Peer-Reviewed Journal.	Material in a non-peer reviewed journal.	To ensure high methodological rigour.
2.	Language	Article is written in English.	Article is written in language other than English.	To enable the reviewer to read the information.
3.	Type of Study	Empirical study that involves the collection and analysis of primary data.	The study does not contain primary empirical data.	Allows the reviewer to examine the outcomes of connection with nature.
4.	Focus of Intervention	Intervention must have changes to mood state and/or attentional capacity as primary focus.	Intervention is not specifically targeting mood state and/or attentional capacity.	Area of interest for this review is the effectiveness of interventions on mood state and attentional capacity.
5.	Type of Intervention	Intervention is based in natural environments OR utilises virtual natural environment landscapes.	Intervention is not based in natural environments OR does not utilise virtual natural environment landscapes.	Area of interest for this review is the effectiveness of interventions which take place in natural environments.
6.	Participants	Children, adolescents, young adults (aged 18-25 years)* *Adult-focused studies with a mean age between 18-25 were included for review.	Adults aged over 25 years.	Ensures appropriate age group is being targeted by review.

Following completed application of inclusion and exclusion criteria, 10 articles remained which are listed in Table 3. Articles which were excluded following full text screening, with rationale for exclusion, are presented in Appendix A.

Table 3

References of Included Studies

Barton, J., Bragg, R., Pretty, J., Roberts, J. & Wood, C. (2016). The wilderness expedition: An effective life course intervention to improve young people's well-being and connectedness to nature. *Journal of Experiential Education, 39* (1), 59-72.
Dowdell, K., Gray, T. & Malone, K. (2011). Nature and its influence on children's outdoor play. *Australian Journal of Outdoor Education, 15* (2), 24-35.
Hignett, A., White, M. P., Pahl, S., Jenkin, R. & LeFroy, M. (2017). Evaluation of a surfing programme designed to increase personal well-being and connectedness to the natural environment among 'at risk' young people. *Journal of Adventure Education and Outdoor Learning, 18* (1), 53-69.
Kant, V. & Sharma, S. (2016). Impact of nature on internal aspiration and positive affect. *Indian Association of Health, 7* (11), 1083-1087.
Lieflander, A. K., Frohlich, G., Bogner, F. X. & Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research, 19* (3), 370-384.
Mayer, F. S., McPherson Frantz, C., Bruehlman-Senecal, E. & Dolliver, K. (2009). Why is nature beneficial? The role of connectedness to nature. *Environment and Behaviour, 41* (5), 607-643.
McCree, M., Cutting, R. & Sherwin, D. (2018). The hare and the tortoise go to forest school: taking the scenic route to academic attainment via emotional well-being outdoors. *Early Child Development and Care, 188* (7), 980-996.
Passmore, H. & Holder, M. D. (2017). Noticing nature: Individual and social benefits of a two-week intervention. *The Journal of Positive Psychology, 12* (6), 537-546.
Rose, L., Williams, I. R., Olsson, C. A. & Allen, N. B. (2018). Promoting adolescent health and well-being through outdoor youth programmes: Results from a multisite Australian study. *Journal of Outdoor Recreation, Education and Leadership, 10* (1), 33-51.
Warber, S. L., DeHudy, A. A., Bialko, M. F., Marselle, M. R. & Irvine, K. N. (2015). Addressing 'Nature-Deficit Disorder': A mixed methods pilot study of young adults attending a wilderness camp. *Evidence-based Complementary and Alternative Medicine.* Doi: 10.1155/2015/651827.

An additional literature search was carried out on 22nd August 2018 using the electronic databases Academic Search Premier, British Education Index, Education Full Text, Education Source, ERIC and PsycARTICLES. Table 4 outlines the search terms which were used.

Table 4

Search Terms used in Literature Search

Databases	**Search Terms**
Academic Search Premier, British Education Index, Education Full Text, Education Source, ERIC, PsycARTICLES.	Green exercise

As in the previous search, a filter was applied to include only studies written in the English language and studies which were peer-reviewed. The initial search yielded 28 results. 1 duplicate article was removed following screening of titles. The 27 remaining studies were screened by title. Following title screening, 14 studies remained for abstract screening. The remaining 14 articles were screened by abstract, further inclusion and exclusion criteria were applied. A total of 13 articles remained for full text screening against inclusion and exclusion criteria, as set out in Table 5.

Following completed application of inclusion and exclusion criteria, 6 articles remained which are listed in Table 6. Articles which were excluded following full text screening, with rationale for exclusion, are presented in Appendix A.

Table 5

Inclusion and Exclusion Criteria with Rationale

		Inclusion Criteria	Exclusion Criteria	Rationale
1.	Type of Publication	Peer-Reviewed Journal.	Material in a non-peer reviewed journal.	To ensure high methodological rigour.
2.	Language	Article is written in English.	Article is written in language other than English.	To enable the reviewer to read the information.
3.	Type of Study	Empirical study that involves the collection and analysis of primary data.	The study does not contain primary empirical data.	Allows the reviewer to examine the outcomes of connection with nature.
4.	Focus of Intervention	Intervention must have changes to mood state and/or attentional capacity as primary focus.	Intervention is not specifically targeting mood state and/or attentional capacity.	Area of interest for this review is the effectiveness of interventions on mood state and attentional capacity.
5.	Type of Intervention	Intervention is based in natural environments OR utilises virtual natural environment landscapes.	Intervention is not based in natural environments OR does not utilise virtual natural environment landscapes.	Area of interest for this review is the effectiveness of interventions which take place in natural environments.
6.	Type of Intervention	Intervention must involve physical activity undertaken in the aforementioned environmental settings.	Intervention does not involve participants undertaking physical activity in the aforementioned environmental settings.	Area of interest for this review is the impact of physical activity-based interventions which take place in a green environment.
7.	Participants	Children, adolescents, young adults (aged 18-25 years)* *Adult-focused studies with a mean age between 18-25 were included for review.	Adults aged over 25 years.	Ensures appropriate age group is being targeted by review.

Table 6

References of Included Studies

Akers, A., Barton, J., Cossey, R., Gainsford, P., Griffin, M. & Micklewright, D. (2012). Visual colour perception in green exercise: Positive effects on mood and perceived exertion. *Environmental Science and Technology, 46,* 8661-8666.

Duncan, M. J., Clarke, N. D., Birch, S. L., Tallis, J., Hankey, J., Bryant, E. & Eyre, E. L. J. (2014). The effect of green exercise on blood pressure, heart rate and mood state in primary school children. *International Journal of Environmental Research and Public Health, 11,* 3678-3688.

Han, K. (2014). Influences of green exercise on school adaptation of autistic children in Taiwan. *Journal of Therapeutic Horitculture, 24* (1), 5-24.

Olafsdottir, G., Cloke, P. & Vogele, C. (2017). Place, green exercise and stress: An exploration of lived experience and restorative effects. *Health and Place, 46,* 358-365.

Pretty, J., Peacock, J., Sellens, M. & Griffin, M. (2005). The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research, 15* (5), 319-337.

Reed, K., Wood, C., Barton, J., Pretty, J. N., Cohen, D. & Sandercock, G. R. H. (2013). A repeated measures experiment of green exercise to improve self-esteem in UK school children. *PLOS ONE, 8* (7), e69176.

2.4.4 Weight of evidence. Before synthesising the identified research, it is necessary to assess the evidence for appropriate quality and relevance (Gough, 2007). The weight of evidence (WoE) framework, outlined by Gough (2007) will be applied to critically analyse the quality of evidence from each study in terms of its methodological quality (WoE A), a review-specific focus on methodological relevance (WoE B) and a review-specific judgement on relevance of the research evidence to the review question (WoE C) (Gough, 2007). WoE A, B and C will be combined to form WoE D, an overall assessment of the extent that the study contributes to the answering of this review question. For an overview of the WoE and numerical rating each study received, see Table 7. A more detailed explanation of the WoE ratings and corresponding rationales are presented in Appendix B.

Table 7

Summary of WoE Judgements

Study	WoE A	WoE B	WoE C	WoE D
Barton et al. (2016)	Medium (2)	Low (1)	Medium (2)	Medium (1.6)
Dowdell et al. (2011)	Medium (2)	Low (1)	Medium (2)	Medium (1.6)
Hignett et al. (2017)	Medium (2)	Medium (2)	Medium (2)	Medium (2)
Kant & Sharma (2016)	Medium (2)	Low (1)	Medium (2)	Medium (1.6)
Mayer et al. (2009)	Medium (2)	Medium (2)	High (3)	High (2.3)
Lieflander et al. (2013)	Medium (2)	Medium (2)	Medium (2)	Medium (2)
McCree et al. (2018)	Medium (2)	Low (1)	Medium (2)	Medium (1.6)
Passmore & Holder (2017)	High (3)	Medium (2)	High (3)	High (2.6)
Rose et al. (2018)	Medium (2)	Medium (2)	High (3)	Medium (2.3)
Warber et al. (2015)	Medium (2)	Medium (2)	Medium (2)	Medium (2)
Akers et al. (2012)	High (3)	Low (1)	Low (1)	Medium (1.6)
Duncan et al. (2014)	High (3)	Medium (2)	Medium (2)	High (2.3)
Han (2014)	Low (1)	Low (1)	Low (1)	Low (1)
Olafsdottir et al. (2017)	Medium (2)	Medium (2)	Medium (2)	Medium (2)
Pretty et al. (2005)	High (3)	Medium (2)	Medium (2)	Medium (2.3)
Reed et al. (2013)	High (3)	Medium (2)	Medium (2)	Medium (2.3)

2.5 Review of Nature Connectedness Research

2.5.1 Participants. 1253 participants are included in this review of research examining the impact of nature connectedness on well-being and/or attention. A majority of participants were aged under 25 years. Five hundred and sixty one participants were under 18 years of age, 190 participants were under 13 years of age (Barton et al., 2016; Dowdell et al., 2011; Hignett et al., 2017; Lieflander et al., 2013; McCree et al., 2018; Rose et al., 2018). The remaining studies were carried out with population samples of undergraduate students. With the exception of Mayer et al.'s (2009) research, wherein age range is not stated, adult studies report mean age of participants to be between 18 and 22 years (Kant & Sharma, 2016; Passmore & Holder, 2017; Warber et al., 2015). Females are more highly represented in this review (approximately 55%). A small number of participants' gender is not specified. With the exception of Hignett et al. (2017) and McCree et al. (2018), no study reports mental health difficulties or learning needs with regard to participants. Hignett et al. (2017) accessed a sample of adolescents whom were experiencing social, emotional and behavioural difficulties. McCree et al. (2018) state that

children in their study were coming from economically and emotionally disadvantaged backgrounds and had special educational needs. The 10 studies are considered to represent a relatively broad range of cultural and socio-economic backgrounds, with the research being undertaken in the United States, Canada, India, Australia, Germany and the United Kingdom.

2.5.2 Research design and measures.

Design. Three of the studies reviewed are randomised controlled trials (RCT) (Kant & Sharma, 2016; Mayer et al., 2009; Passmore & Holder, 2017). Two studies follow a quasi-experimental design (Dowdell et al., 2011; Lieflander et al., 2013). The remaining five studies used a single group design (Barton et al., 2016; Hignett et al., 2017; McCree et al., 2018; Rose et al., 2018; Warber et al., 2015). None of the three RCTs provides information on how participants were allocated to either a treatment or control condition; each states that it was done in a random way (Kant & Sharma, 2016; Mayer et al., 2009; Passmore & Holder, 2017). None of the non-RCT studies were described as randomised. The two quasi-experimental studies had a control group. Children in the 'control' group in Dowdell et al.'s (2011) research attended a childcare centre which did not have an emphasis on nature and sustainable education. A student group who did not participate in the intervention formed the control group in research by Lieflander et al. (2013). Information on reasons for non-participation is not provided but it is conveyed that the control group were of the same age range and school year as those in the treatment condition (Lieflander et al., 2013). A majority of studies described the participant flow. With the exception of Dowdell et al. (2011), all studies collected pre and post-intervention data. Additionally, Lieflander et al. (2013) collected retention data, four weeks following completion of intervention. Qualitiative data were also gathered by McCree et al. (2018) and Warber et al. (2015). Forms of qualitative data included fieldwork observations, interviews and focus groups. Dowdell et al. (2011) utilised a behaviour mapping schedule to record observational data.

Control group. As stated, five studies included a control group in their research. In the study by Lieflander et al. (2013), the control group received no intervention. Participants allocated to the control group in research by Dowdell et al. (2011) were also attending a childcare centre daily, however the two centres differed in size of outdoor space, features of the outdoor environment and level of emphasis

on nature and sustainable education. Research by Kant and Sharma (2016), Mayer et al. (2009) and Passmore and Holder (2017) consisted of three groups. Kant and Sharma (2016) divided participants across a nature, urban and abstract condition. Similarly, Passmore and Holder (2017) allocated participants to either a nature condition, a human-built condition or a no-treatment condition. Mayer et al. (2009) report on three studies which examine the effects of exposure to nature; across the three studies, participants were allocated to either a real nature setting or real urban setting, virtual nature or virtual urban setting. Thus in half of the reviewed studies, at least one control group was present and provided an urban or human-built comparison group to the green, natural intervention group.

Measures. A wide variety of measures were used, across studies, to measure aspects of well-being and levels of connection to the natural environment. The most widely used measure of mood state was the Positive and Negative Affect Schedule (PANAS) (Watson, Clark & Tellegen, 1988). PANAS comprises two 10-item self-report scales; the scales list words pertaining to positive and negative emotions and respondents are required to record the extent to which they experienced each emotion over the previous two weeks (Passmore & Holder, 2017). Responses are given on a 5-point Likert scale. Watson et al. (1988) found the PANAS to have high internal consistency and test-retest reliability. The most frequently used tool to assess changes to level of nature connectedness was the connectedness to nature scale (Mayer & Frantz, 2004). The connectedness to nature scale measures the respondent's feeling of emotional connection to the natural world (Mayer & Frantz, 2004). The scale is a single-factor measure that consists of 13 items; items are scored on a 5-point Likert scale (Barton et al. (2016). An alternative measure of nature connectedness was the inclusion of nature in self scale (Schultz, 2002). The inclusion of nature in self scale is a self-report measure. It consists of a series of images of overlapping circles labelled 'self' and 'nature' (Schultz, Shriver, Tabanico & Khazian, 2004). Participants indicate their relationship with the environment by choosing one of seven images of circles, thus indicating their level of perceived interconnectedness with nature (Hignett et al., 2017). Other measures of aspects of well-being which feature in the studies in this review include Rosenberg's self-esteem scale (1965) and the situational self-awareness scale (Govern & Marsch, 2001). Mayer et al. (2009) measured attentional capacity through a timed memory-

loaded search task. The task took place over a 10-minute period, requiring participants to memorise target letters and to find these targets in lines of letters. Of the studies in this review, Mayer et al.'s (2009) was the only study to examine the impact of nature connectedness on attentional capacity.

Application of intervention. Through an understanding of whether an intervention has been implemented with fidelity, one can ascertain the effectiveness of an intervention, how and why it works, and the extent to which outcomes can be improved (Carroll et al., 2007). However, through systematically searching the literature on effects of nature connection, it becomes apparent that a well-tested and widely-used programme for accessing the benefits of an increased connection with the natural environment has not thus far been established. A consequence of a lack of an established approach to increasing nature connectedness is evidenced in the studies being reviewed, wherein a plethora of approaches and styles of intervention are implemented. A varying level of detail of the procedure for intervention is provided in the studies. A summary of interventions is provided in Table 8.

In a number of studies, a wilderness or outdoor education programme formed the basis for intervention (Barton et al., 2016; Lieflander et al., 2013; Rose et al., 2018; Warber et al., 2015). Across these studies, length of time participants spent at wilderness camp varied widely. Participants in Lieflander et al.'s (2013) research engaged with an environmental education programme over 4 weeks, for 6 hours per day. Barton et al. (2016) and Rose et al. (2018) were similar in their analysis of a number of different outdoor education programmes; Rose et al. (2018) focused on programmes run in three different school settings in Australia, while Barton et al. (2016) examined the effects of wilderness programmes in both South Africa and Scotland. In both studies, the intervention programmes lasted for a number of days, ranging from 5 to 11 days in duration (Barton et al., 2016; Rose et al., 2018). Warber et al.'s (2015) was the longest in duration with participants spending 4 weeks in a wilderness camp.

Table 8

Summary of Nature Connection Interventions

	Design	Intervention	Time-Scale of Intervention
Barton et al. (2016)	Single Group Design	Wilderness Expeditions	5-11 Days
Dowdell & Malone (2011)	Quasi-Experiment	Integrating natural environment into education provision	12 Weeks
Hignett et al. (2017)	Single Group Design	Surfing Programme	12 Weeks
Kant & Sharma (2016)	Randomised Controlled Trial	Viewing slides of natural environments vs. urban environments vs. abstract images	1 Minute exposure
Lieflander et al. (2013)	Quasi-Experiment	Environmental Education Programme	4 Days (6 hours per day)
Mayer & Frantz (2009)	Randomised Controlled Trial	Walking in natural environment vs. urban environment; walking in natural environment vs. viewing video of natural environment; walking in natural environment vs. viewing video of natural environment vs. watching video of urban environment	10 Minutes
McCree et al. (2018)	Single Group Design	Integrating natural environment into education provision	3 Years (Weekly)
Passmore & Holder (2017)	Randomised Controlled Trial	Mindfulness of impact on feelings of natural environment vs. urban environment vs. no treatment	2 Weeks
Rose et al. (2018)	Single Group Design	Outdoor Education Programme	5-9 Days
Warber et al. (2015)	Single Group Design	Wilderness Camp	4 Weeks

Content of intervention was relatively similar in the four studies. Outdoor adventure activities, such as hiking and canoeing featured in each programme. Warber et al. (2015) provide limited detail of the content of the four week intervention programme. However, Lieflander et al. (2013) describe multi-sensory nature encounters, exposure to riparian and aquatic animals and practise in judging water quality. Participants in Barton et al.'s (2016) study also engaged in wild swimming, food foraging and nature watching. The surfing programme in Hignett et al's (2017) intervention has both similarities and differences to these research studies. Rather than the green environments which provided the setting for the majority of studies in this review, the researchers explore the benefits of 'bluespace', highlighting the value of this natural environment in delivering positive effects on well-being (Hignett et al., 2017). Similarly to the aforementioned study, the surfing programme

was based on continued exposure to the natural environment, incorporating physical activity (surfing), as well as educational input aimed at building environmental awareness (Hignett et al., 2017). In research carried out by Dowdell et al. (2014) and McCree et al. (2018), in pre-school and primary school settings respectively, intervention focused on bringing the natural environment into education. In the primary school context, intervention comprised weekly visits to local woodlands, during both term-time and school holidays, with activities based on forest school models (scavenger hunts, shelter building, tree climbing, foraging) (McCree et al., 2018). The outdoors was brought to the preschool in Dowdell et al.'s (2014) research; with a play area containing a campfire, frog ponds, a worm farm and a vegetable garden in the 'treatment' condition childcare centre, the researchers compared interaction and play style in this environment and in a control environment.

Intervention in the remaining three studies focused on comparing the impact on attention and well-being of exposure to a natural environment versus exposure to an urban or human-built environment (Kant & Sharma, 2016; Passmore & Holder, 2017; Mayer et al., 2009). While participants in Kant and Sharma's (2016) research spent 1 minute looking at four slides which showed either natural scenes, urban scenes or abstract pictures, the intervention in Passmore and Holder's (2017) was based outdoors. Participants in the latter study were instructed to be mindful over a 2-week period of how objects they encountered in their environment day-to-day made them feel (Passmore & Holder, 2017). Those in the first experimental condition were asked to focus on natural objects/scenes, those in the second experimental condition were asked to hone in on human-built objects/scenes and those in the control condition were instructed to continue with their regular routine (Passmore & Holder, 2017). Through their intervention, Mayer et al. (2009) aimed to ascertain the effects of natural versus urban environments on well-being and attention, as well as exploring whether the use of virtual natural environments was as effective as non-virtual spaces. Across three studies, Mayer et al. (2009) compared the impact of a 10-minute walk in a natural green environment versus urban setting, the impact of a 10-minute walk in a natural green environment versus watching a video of a walk in a natural setting, versus watching a video of a walk in an urban

setting and, lastly, the impact of a 10-minute walk in a natural environment versus watching a video of a 10-minute walk in a natural environment.

2.6 Review of Green Exercise Research

2.6.1 Participants. Three hundred and seventeen participants are included in this review of research which investigates the impact of green exercise on well-being and/or attention. A majority of participants were recorded to be under 25 years of age. One hundred and thirteen participants were aged under 13 years (Duncan et al., 2014; Han, 2014; Reed et al., 2014). The remaining studies were carried out with population samples of undergraduate students. With the exception of Olafsdottir et al.'s (2017) research, wherein age range of participants is not provided, studies report mean age of participants to be between 20 and 24 years (Akers et al., 2012; Pretty et al., 2005). Males are more highly represented in this review (57%). However, the gender breakdown of participants is not provided in two studies (Olafsdottir et al., 2017; Reed et al., 2013); amounting to 165 participants for whom gender is not reported. Han (2014) carried out his research with a sample of children whom had received a diagnosis of autism spectrum disorder (ASD); Han (2014) indicates that participants were moderate on the autism spectrum, as defined in the Handbook for the Physically and Mentally Challenged, issued by the Bureau of National Health Insurance in Taiwan. With the exception of Han (2014), no study specified mental, physical or learning difficulties experienced by participants. Information regarding cultural and socio-economic background is not provided. Four of the six studies were carried out in the United Kingdom. Olafsdottir et al's (2017) research took place in Luxembourg, while Han's (2014) took place in Taiwan.

2.6.2 Research design and measures.

Design. Two of the studies reviewed are RCTs (Olafsdottir et al., 2017; Pretty et al., 2005). Three studies utilised a repeated measures experimental design (Akers et al., 2012; Duncan et al., 2014; Reed et al., 2013). In order to control for cumulative effects, Han (2014) alternated between treatment and non-treatment time units, with six time units altogether. Neither RCT provides information on how participants were allocated to either a treatment or control condition, however, each indicates that allocation was randomised (Olafsdottir et al., 2017; Pretty et al., 2005). In all studies utilising a repeated measures design, conditions were counterbalanced

and participants were randomly allocated to an order (Akers et al., 2012; Duncan et al., 2014; Reed et al., 2013). A majority of studies described the participant flow. With the exception of Akers et al. (2012) and Han (2014), all studies collected pre and post-intervention data. Additionally, Duncan et al. (2014) collected data 15 minutes post-exercise. Olafsdottir et al. (2017) also gathered qualitative data, in the form of semi-structured interviews with a random subsample of participants. Han (2014) gathered data from parents and teachers on weekly basis throughout the intervention period. Akers et al. (2012) gathered physiological data in the last 30 seconds of the physical exercise intervention and mood state was measured post-intervention.

Control group. Each study in this review included a control condition. Han (2014) utilised a schedule of a four week period engaging with the treatment condition, followed by a four week period without engaging with the treatment condition to control for cumulative effects of intervention. As such these control periods acted as buffers; analysis was based on data collected during the treatment phases (Han, 2014). The control conditions in each of the within-subjects experiments comprised exposure to a non-green, human-built condition. Duncan et al. (2014) had participants cycle in front of a blank screen. Similarly, Olafsdottir et al.'s (2017) comparison condition involved a walk in a gym and Reed et al.'s (2013) control comprised running around a built-up school campus. Akers et al. (2012) implemented two comparison conditions, examining the effects of a red environment and a grey environment, as compared with a green environment. Participants in the control condition of Pretty et al.'s (2005) research were required to complete physical exercise without exposure to any imagery.

Measures. A number of studies recorded physiological data of participants, pre and post physical exercise; physiological measures included heart rate, blood pressure, salivary cortisol and respiratory exchange ratio (Akers et al., 2012; Duncan et al., 2014; Olafsdottir et al., 2017; Pretty et al., 2005). Two experiments employed the Profile of Mood States (POMS), devised by McNair, Lorr and Droppleman (1971), to assess changes to mood pre and post-intervention (Akers et al., 2012; Pretty et al., 2005). The POMS measures six mood states: tension, depression, anger, vigour, fatigue and confusion (Akers et al., 2012). This is a self-report measure with participants responding to each item according to a 5-point Likert scale (Pretty et al.,

2005). Mood measures which also feature in this review include PANAS and Brunel Mood State Inventory, used by Olafsdottir et al. (2017) and Duncan et al. (2014) respectively. The Brunel Mood State Inventory, devised by Terry and Lane (2000), is a quick assessment of mood state for use with adolescents. The tension, fatigue and vigour subscales were used by Duncan et al. (2014) to measure mood change. Rosenberg's (1965) self-esteem scale was utilised in two studies (Pretty et al., 2005; Reed et al., 2013). Attention performance changes were measured through the Necker Cube test in Olafsdottir et al.'s (2017) research. The Necker Cube test is designed to measure one's capacity to direct mental effort. Han's (2014) data collection took place through the Abberrant Behaviour Checklist, the Autistic Children's School Adaptation Scale and the Clinical Global Impressions Scale. Pretty et al. (2005) and Reed et al. (2013) also collected data on their participants' habits and attitudes with regard to physical exercise and, in the case of Pretty et al. (2005), their perspectives on the natural environment.

Application of intervention. As in the case of nature connectedness literature, no single approach to exploring the benefits of green exercise is evident. However, studies examining the effects of green exercise do present with a greater level of similarity to each other. Each intervention comprised an element of physical exercise and the majority had participants exercise for a specific dose of time (Akers et al. 2012; Duncan et al., 2014; Olafsdottir et al., 2017; Pretty et al., 2005). A summary of interventions is provided in Table 9.

Participants in Han's (2014) research engaged in physical activity in a natural environment for at least 30 minutes twice a week, during intervention phases. Han (2014) reports that the majority of episodes spent exercising in a natural environment lasted less than an hour, with a few lasting for days (camping). Various physical activities were recorded in this study, including walking, running, cycling and ball games (Han, 2014). While Reed et al. (2013) did not allot a specific number of minutes to their physical exercise component, all participants were required to complete a 1.5 mile (2.4 Kilometres) run which, the researchers indicate, amounted to 10 to 20 minutes of activity. Participants in this study completed two 1.5 mile (2.4 Kilometres) runs; one took place in a local country park and one took place around the school campus (Reed et al., 2013). The two runs took place at the same time of day, exactly one week apart. Running was also the physical exercise component in

Pretty et al's (2005) study. This experiment comprised five conditions; participants were allocated to run on a treadmill for 20 minutes while viewing one of rural pleasant scenes, rural unpleasant scenes, urban pleasant scenes, urban unpleasant scenes or no images (control) (Pretty et al., 2005).

Table 9

Summary of Green Exercise Interventions

	Design	**Intervention**	**Time-Scale of Intervention**
Akers et al. (2012)	Repeated Measures Experiment	Cycling while watching video of green environment vs. achromatic video of green environment vs. red filtered video of green environment	5 Minutes
Duncan et al. (2014)	Repeated Measures Experiment	Cycling while watching video of natural environment vs. watching a blank screen	15 Minutes
Han (2014)	Quasi Experiment	Various physical activities, including camping, in a natural environment	Range across participants: 30 minutes to few days
Olafsdottir et al. (2017)	Randomised Controlled Trial	Walking in a natural environment vs. walking in a gym (treadmill) vs. watching natural scenes on television	40 Minutes
Pretty et al. (2005)	Randomised Controlled Trial	Running on treadmill while viewing rural pleasant scenes vs. rural unpleasant scenes vs. urban pleasant scenes vs. urban unpleasant scenes vs. no images	20 Minutes
Reed et al. (2013)	Repeated Measures Experiment	Running in natural vs. urban environment	1.5 mile run; 10 -20 minutes across participants

Two studies utilised cycling as their form of physical exercise (Akers et al., 2012; Duncan et al., 2014). The exercise dosage was different in each study; Akers et al. (2012) had participants cycle for 5 minutes, whereas Duncan et al. (2014) required participants to cycle for 15 minutes. Akers et al. (2012) had participants complete a 5-minute cycle in three conditions; while watching a video of a green outdoor environment, while watching the same footage achromatically (grey) and while watching the same footage with a red filter. These three trials were randomly counterbalanced (Akers et al., 2012). Duncan et al. (2014) also employed a repeated

measures design. In the treatment condition, participants cycled for 15 minutes while watching a film of cycling in a forest environment and cycled whilst viewing a blank screen in the control condition. The two trials were separated by 24 hours and were counterbalanced (Duncan et al., 2014).

Olafsdottir et al. (2017) structured their experiment with three conditions. Participants were randomly allocated to spend 40 minutes either walking in nature, walking in the gym or watching nature on television. The walk in nature was situated in a recreational nature park, the gym walk took place on a treadmill in a popular gym and watching nature on television occurred in a 'sitting room' in a university laboratory (Olafsdottir et al., 2017). Individuals participated in two identical, individual experimental sessions, first during a relaxed, non-examination period and then again during a more stressful examination period (Olafsdottir et al., 2017). Notably, three of the six experiments in this review took place in 'virtual' green environments rather than a natural, outdoor environment (Akers et al., 2012; Duncan et al., 2014; Pretty et al., 2005).

2.7 Synthesis of Findings

Through two literature searches, 16 research articles were identified which met the criteria for inclusion. Ten of these resulted from a search focusing on nature connectedness and six resulted from a search focusing on green exercise. For the purposes of providing a comprehensive review of the impact of the natural environment on well-being and attention, the findings from the 16 studies will be collated and reviewed below. A summary of key findings is provided in Table 10.

WoE showed similar levels of quality and relevance across twelve of these studies; these studies achieved a medium overall rating (Akers et al., 2012; Barton et al., 2016; Dowdell et al., 2011; Hignett et al., 2017; Kant & Sharma, 2016, Lieflander et al., 2013; McCree et al., 2018; Olafsdottir et al., 2017; Pretty et al., 2005; Reed et al., 2013; Rose et al., 2018; Warber et al., 2015). One study achieved low overall WoE ratings and thus was considered to be less significant in the context of this review (Gough, 2007). The remaining studies achieved a high overall rating (Duncan et al., 2014; Mayer et al., 2009; Passmore & Holder, 2017). Identified variations in rating were generally due to differences in the methodological quality and the relevance of the research evidence to the review question.

Table 10

Summary of Key Findings

Research Study	Key Findings
Barton et al. (2016)	Increased nature connectedness and self-esteem levels following engagement with wilderness expedition.
Dowdell & Malone (2011)	Engagement with natural environment supported imaginative play and positive relationships between children.
Hignett et al. (2017)	Increased pro-social behaviour, more positive attitude towards school, improved relationships with peers, increased emotional literacy and levels of motivation following engagement with surfing programme.
Kant & Sharma (2016)	Viewing of natural environment slides and abstract images increased positive affect and internal aspiration.
Lieflander et al. (2013)	Increase in nature connectedness following participation in wilderness expedition; for some participants impact was sustained at 4-week follow-up.
Mayer & Frantz (2009)	Increased connection to nature, attentional capacity, positive emotions and capacity for reflection following exposure to natural, green environments. Impact more pronounced when exposed to actual rather than virtual green environment.
McCree et al. (2018)	Engagement with natural environment developed nature connectedness, resilience and increased self-regulation.
Passmore & Holder (2017)	Increased positive affect, sense of connectedness and pro-social orientation following mindfulness towards natural, green environment.
Rose et al. (2018)	Increased self-efficacy and school and peer connectedness and decreased levels of fear following outdoor education programme. No significant changes to aggression, depression or nature connectedness.
Warber et al. (2015)	Increased nature connectedness, perceived stress, sense of wholeness and positive emotion following wilderness expedition.
Akers et al. (2012)	Lower total mood disturbance and perceived exertion following green condition. Anger levels higher following red condition.
Duncan et al. (2014)	Blood pressure significantly lower following cycle in green condition, however, fatigue was higher and vigour was lower.
Han (2014)	No significant change to behaviour following activity in natural environments but higher intensity exercise and more exposure improved adaptation capacity.
Olafsdottir et al. (2017)	Reduction in stress hormones across each condition; most pronounced in the green exercise group.
Pretty et al. (2005)	Engagement with rural pleasant scenes had most consistent, though not always significant, impact on mood.
Reed et al. (2013)	No significant impact on self-esteem following green exercise, however, participants reported greater enjoyment of being in green environment.

The articles included in the review find varying outcomes as to the effectiveness of a nature-based intervention in improving aspects of well-being and attentional capacity in various populations. The youngest participants in this review were included in studies by Dowdell et al. (2011) and McCree et al. (2018). Both studies focus on school-based intervention; Dowdell et al. (2011) draw comparison between a childcare centre with a natural, green outdoor environment which fosters environmental awareness and nature connection and a childcare centre without such an apparent focus. McCree et al. (2018) examine the impact of a longitudinal intervention which focuses on engagement with the natural environment. Both studies found positive outcomes for children who engaged in nature-based conditions. Dowdell et al. (2011) highlight the role the natural environment played in supporting children's imaginative play and in nurturing positive relationships between children. McCree et al. (2018) report on the development of self-regulation and resilience, as well as an increase in nature connectedness. In both studies, the natural environment became a stimulating environment which allowed children to become confident and curious learners (Dowdell et al., 2011; McCree et al., 2018). Though demonstrating positive outcomes, both studies engaged a small sample size leading to limited generalisability ($n = 23$). In addition, as McCree et al.'s (2018) intervention took place over a three year period, the researchers acknowledge the wide range of potential parameters which may have contributed to findings.

However, through triangulated data gathered from children, parents and teachers, the natural environment was identified as a primary influence on positive changes which occurred (McCree et al., 2018). Similarly to Dowdell et al. (2011) and McCree et al. (2018), Han (2014) has a small sample size in his research on the effects of green exercise on behaviour and adaptation capacity of children with a diagnosis of ASD. No significant impact of green exercise on behaviour was found, though higher levels of physical exertion and more frequent visits to natural environments had greater influence on adaptation capacity of participants (Han, 2014). A notable limitation in Han's (2014) research is the range of types of physical activity and the range of lengths of time spent in natural environments, as well as the study's reliance on parent report for account of physical activity; these factors contribute to a difficulty in drawing accurate conclusions.

The impact of self-esteem on psychological well-being and on successful functioning is well-documented (Craven & Marsh, 2008; Robins & Trzesniewski, 2001; Seema & Venkatesh, 2017). Two studies targeted this aspect of well-being through nature-based intervention (Barton et al., 2016; Reed et al., 2013). With the recognition that connection to nature is an important predictor of subjective well-being, Barton et al.'s (2016) research found that engagement with wilderness expeditions led to significant increases in both self-esteem and connectedness to nature. The researchers identified a gender effect, with females experiencing a greater increase in self-esteem than males, following intervention. Importantly, the positive outcomes were not found to be significantly affected by participants' home living environment (urban or rural), location or length of expedition (Barton et al., 2016). In contrast to Barton et al.'s (2016) findings, Reed et al., (2013) did not find that exercising in a natural green environment had a significant increase in self-esteem moreso than the control condition (exercise in an urban setting). However, the researchers found that exercising in the green condition was enjoyed more equally by children with differing habits of engagement with physical activity, suggesting that green exercise has greater potential to engage less active children (Reed et al., 2013). Explanation offered for the lack of impact of exercise in the green condition points to the presence of teachers giving instruction and the possibility that the green exercise was viewed as a school activity rather than a potentially restorative one (Reed et al., 2013). Further, the researchers utilised Rosenberg's self-esteem scale for pre and post-intervention measurement; it is suggested that a state scale rather than a trait scale may have had greater sensitivity (Reed et al., 2013).

A number of studies adopted a similar approach to intervention as Reed et al. (2013), comparing effects of a green condition with either an urban/human-built condition and/or a control condition (Duncan et al., 2014; Kant & Sharma, 2016; Mayer et al., 2009; Olafsdottir et al., 2017; Passmore & Holder, 2017; Pretty et al., 2005). Kant and Sharma (2016) and Passmore and Holder (2017) were the only studies to not incorporate an exercise component to this comparison of effects. Kant and Sharma (2016) found that viewing slides showing natural, green scenes and viewing slides of abstract objects both had a significant positive effect on positive affect and internal aspiration. The researchers define positive affect as the experience of positive emotions and positive interactions with others and surroundings. Internal aspiration

is defined as the drive to pursue goals which satisfy basic psychological needs (Kant & Sharma, 2016). Likewise, positive affect was significantly higher post-intervention in the green condition, as compared to the human-built and business-as-usual conditions in Passmore and Holder's (2017) study. Additionally, significant changes to general sense of connectedness and prosocial orientation were identified following intervention which focused on the natural environment (Passmore & Holder, 2017). Qualitiative data added further weight to Passmore and Holder's (2017) outcomes; wordclouds generated by participants in the green condition recorded items including 'peace', 'hope' and 'rejuvenation', while those in the human-built condition generated descriptors including 'annoyance', 'fatigue', 'stress'. Though Passmore and Holder (2017) engaged a large sample of participants, the sample was comprised predominantly of female undergraduate students which may limit the generalisability of the results.

A walking component was utilised as the exercise element of research by Mayer et al. (2009) and Olafsdottir et al. (2017), while Pretty et al. (2005) asked participants to complete a 20-minute run. Mayer et al. (2009) found that exposure to natural green environments increased connection to nature, attentional capacity, positive emotions and ability to reflect on a life problem. Further, the researchers compared the impact of an actual natural environment to that of a virtual natural environment and found that the aforementioned positive effects were more dramatic when contact was with an actual natural environment (Mayer et al., 2009). The inclusion of both actual and virtual environment can be considered a noteworthy strength of this study. Of five conditions in Pretty et al.'s (2005) research, viewing rural pleasant scenes during exercise produced the most consistent, though not always significant, improvements on six measures of mood. Exercising whilst viewing urban unpleasant scenes produced significant improvements, for anger-hostility, confusion-bewilderment and tension-anxiety. In contrast, unpleasant rural scenes diminished the positive impact of exercise, reducing effects on self-esteem levels and mood, including anger-hostility and tension-anxiety. Though the photographic material used in this study is not described in significant detail, the photographs were categorised by an independent panel of 50 people; when 95% of these participants categorised a photograph as strongly representing a particular definition, it was selected for use in the experiment. Examples of photographs used in the study show

trees and meadows (rural pleasant), fields with abandoned, decaying cars (rural unpleasant), a marina with sail boats, trees and modern high-rise buildings (urban pleasant) and a disused building with several windows broken (urban unpleasant). The researchers surmise that perceived threats to a rural environment are of greater negative impact than perceived threat to an urban environment (Pretty et al., 2005).

Olafsdottir et al. (2017) focused on the stress-reducing benefits of contact with a green environment. Participants in each condition experienced reductions in stress hormones. This reduction was most pronounced in the green exercise group though the difference between the groups did not reach significance (Olafsdottir et al., 2017). Qualitative accounts from participants emphasised the nurturing effect of being able to focus attention and experience to a restorative environment, removed from stressful circumstances and surroundings (Olafsdottir et al., 2017). Cycling featured as the exercise component in two studies (Akers et al., 2012; Duncan et al., 2014). Duncan et al.'s (2014) study examined the effects of green exercise on a cohort of primary school aged children. Though blood pressure was significantly lower post a 15-minute cycle while viewing natural, green environment, fatigue was higher and vigour was lower post both the treatment and control condition (Duncan et al., 2014). This is contrary to outcomes in adult-based studies which have reported positive mood changes following exposure to green, natural scenes (Mayer et al., 2009; Pretty et al., 2005). The researchers question whether a generational difference in nature connectedness may underlie this disparity (Duncan et al., 2014). It is worthy of note that mood measures were taken 15 minutes following completion of the intervention which may have dissipated some effects on mood and that the sample size in this study was small, providing limited statistical power (Duncan et al., 2014). Akers et al. (2012) also required participants to complete cycling trials, however the crux of their investigation was the extent to which the colour green contributes to the effects of green exercise. As compared with viewing scenery with a red or a grey filter, the green condition contributed to lower total mood disturbance and lower levels of perceived exertion. In contrast, levels of anger were higher in the red condition (Akers et al., 2012). However, a limitation of this study was the absence of pre-intervention measures of mood, thus post-intervention levels are not controlled for by a baseline.

Three of the remaining studies explored the effects of environmental education/wilderness expeditions on elements of well-being, including nature connectedness, self-efficacy, fear levels, perceived stress and positive and negative emotions (Lieflander et al., 2013; Rose et al., 2018; Warber et al., 2015). Emphasising the role of nature-connectedness in overall well-being, Lieflander et al. (2013) found that participation in an environmental education programme resulted in a robust increase in nature connectedness. Additionally, for participants aged between nine and 10 years, this increased connectedness remained 4 weeks post-intervention. A number of benefits were observed by Rose et al. (2018); following attendance at school-run outdoor youth programmes, increased levels of self-efficacy, connectedness to peers and school, and decreased levels of fear were evident. However, no significant changes to levels of depression, aggression or nature connectedness were found. While the absence of a control group is a limitation of this study, Rose et al. (2018) did access a relatively large sample of participants and participants engaged with one of three outdoor programmes with comparable outcomes from each which allows for a degree of generalisation of results. Warber et al.'s (2015) study produced similar results as Rose et al.'s (2018) research. Following a wilderness expedition, nature-related measures (perceived safety, sense of place, nature connectedness) significantly increased, as did well-being outcomes, which included perceived stress, sense of wholeness and positive and negative emotions (Warber et al., 2015). Like Rose et al. (2018), this study did not engage a control group. Coupled with the small sample size, the inferences which can be drawn from Warber et al's (2015) research are somewhat limited.

The final study in the review expands on the understanding of the natural environment as a necessarily green one. Hignett et al., (2017) look to the impact which 'bluespace' can have on personal well-being and nature connectedness. Following engagement with a surfing programme, participants were found to have increased satisfaction with appearance, increased positive social relationships with peers, increased pro-social behaviour at school and more positive attitudes towards school (Hignett et al., 2017). Further, teacher evaluations detailed increased emotional literacy and levels of motivation. As with a number of studies in this review, the lack of a control group means that the results must be generalised with caution. However, the researchers highlight the potential of 'bluespace'

environments as an alternative location for accessing the benefits of the natural environment, with acknowledgement that further research is required (Hignett et al., 2017).

2.8 Conclusion

This review has aimed to systematically collate evidence on the effectiveness of nature-based intervention on aspects of well-being and attentional capacity. It is apparent throughout the review that well-being is a broad construct, with many variables contributing to a holistic sense of well-being in children (Minkkinen, 2013). The breadth of the construct is evidenced in the different foci of the studies reviewed above, including self-esteem, positive emotion, negative emotion, nature connectedness, social connectedness and resilience. Researchers are compelled to select aspects of well-being to be targeted through intervention. With regard to attentional capacity, this can be considered the lesser researched construct in relation to green intervention. In this review, only Mayer et al. (2009) and Olafsdottir et al. (2017) investigated changes to attentional capacity post-intervention.

In addition to the variety of constructs which formed the focus of the review, the samples of participants with whom the effects of nature connection and green exercise are explored are diverse. From pre-school aged children to undergraduate students, it can be considered that value is placed on the potential of nature-based intervention at all life stages. However, a lesser amount of research has focused on children and, further, some studies which comprise children as the sample have found outcomes which are contrary to those in adult studies (Duncan et al., 2014).

Overall, findings indicate that engaging with intervention did impact on participants' levels of well-being. However, the extent to which interventions increased the targeted construct did differ across studies with some finding that specific changes had not reached a significant level (Hignett et al., 2017; Olafsdottir et al., 2017; Reed et al., 2013; Rose et al., 2018). Findings with regard to mood state were varied. Significant positive mood change was reported by Akers et al. (2012), Hignett et al. (2017), Kant and Sharma (2016), Mayer et al. (2009), Passmore and Holder (2017) and Warber et al. (2015). In contrast, mood did not alter significantly in research carried out by Duncan et al. (2014), Pretty et al. (2005) or Rose et al. (2018). As in the case of mood state, research which honed in on improvements to self-esteem

following a nature-based intervention found mixed results. While Barton et al.'s (2014) wilderness expedition intervention brought significant improvement to self-esteem levels, Reed et al. (2013) found that effects on self-esteem were no more pronounced in the green condition than in the human-built condition. Of those studies which measured nature connectedness following engagement with nature through intervention, a majority report significant positive change (Barton et al., 2014; Mayer et al., 2009; Lieflander et al., 2013; McCree et al., 2018; Warber et al., 2015). Mayer and Frantz (2004) regard connection with nature to be our experiential sense of oneness with the natural environment. The relationship between connection with nature and well-being has been supported by psychological theory and research (Howell, Dopko, Passmore & Buro, 2011; Kaplan & Kaplan, 1989; Nisbet, Zelenski & Murphy, 2011; Ulrich et al., 1991). As stated, only two studies assessed the impact of nature-based intervention on attentional capacity. Mayer et al. (2009) found positive impact on attentional capacity, while participants in Olafsdottir et al.'s (2017) research spoke to the positive experience of directing attention towards a restorative environment.

It is evident from conducting this review that value and potential can be attributed to fostering a connection with nature, through nature-based intervention and green exercise, and that this connection can be instrumental in building psychological well-being. However, the research completed to date does not provide a comprehensive conclusion as to what is the most effective way to build nature connection and what elements of well-being are most susceptible to change as a result of nature-based intervention. Additionally, the variation in times allocated to intervention, both within and between research studies on green exercise and nature connectedness, leads to difficulty in reaching definitive conclusions as to the optimal length of an intervention period and to a challenge in comparing study outcomes.

It became apparent during this review that the role which nature plays in mediating attentional capacity is thus far relatively unexplored. Further, the number of studies which provide evidence of the effects of the natural environment on children's well-being are few (Duncan et al., 2014). Placing reviewed research in the context of current educational and health policy which addresses children's health and well-being, further exploration of the effect of nature on children's emotional state and capacity to maintain directed attention is considered pertinent.

Though research exploring the benefits of nature connectedness and green exercise for children is in its infancy, considered alongside similar research with an adult population, early indications suggest positive effects on mood and attentional capacity. It is considered that research into this area to provide further insight will be valuable in informing well-being, learning and health promotion strategies in schools. This study will aim to answer the following research questions:

1. What is the effect of exercise in a natural, green environment on the mood state of primary school-aged children?
2. What is the effect of exercise in a natural, green environment on the attentional capacity of primary school-aged children?
3. What is the interaction, if any, between a nature connectedness activity and green exercise, on the mood state of primary school-aged children?
4. What is the interaction, if any, between a nature connectedness activity and green exercise, on the attentional capacity of primary school-aged children?

Chapter Three: Methodology

The systematic review of research literature exploring the effects of nature connectedness and/or green exercise on children's mood and attention found that further enquiry was warranted. An experimental approach was utilised to assess the impact of green exercise and nature connection interventions. It was aimed to address the following research questions:

1. What is the effect of exercise in a natural, green environment on the mood state of primary school-aged children?
2. What is the effect of exercise in a natural, green environment on the attentional capacity of primary school-aged children?
3. What is the interaction, if any, between a nature connectedness activity and green exercise, on the mood state of primary school-aged children?
4. What is the interaction, if any, between a nature connectedness activity and green exercise, on the attentional capacity of primary school-aged children?

This chapter outlines the research design, sampling procedure, data collection and data analysis methods employed in this endeavour.

3.1 Epistemological Assumptions

In the context of social and educational research, ontological assumptions give rise to epistemological assumptions which, in turn, inform the decision-making process with regard to methodological approach (Hitchcock & Hughes, 1995). The researcher's perspective on human behaviour will have implications for the formulation of research questions to be answered, methodological concerns and the type of data being sought (Cohen, Mannion & Morrison, 2007). Positivism, conceptualised by Comte, advocated the primacy of empirical data and formal theory in investigating the physical and social world (Miller, 2000). Though fundamental positivism saw a demise through the latter half of the 20th century, the philosophy of post-positivism was birthed, combining realist and social constructionist perspectives (Miller, 2000).

Experimental research embodies the credo of the post-positivist research paradigm; phenomena exist independently of being perceived but human beings cannot fully comprehend this existence (Miller, 2000). In exploring reality from a post-positivist

viewpoint, there is an acknowledgement that one reality does exist and is discoverable, though with unavoidable imperfections on account of the researcher's human limitations (Maxwell, 2012). Similarly, Reichardt (2009) emphasises that quasi-experimental research design strives to contribute to a strong evidence base while accepting that application of rigorous scientific method is difficult when applied to human research in real-world settings. Mertens (2015) highlights the complexity of establishing a cause-effect relationship in human research. Experimental design calls for controlling as many variables as possible and then systematically manipulating one treatment variable to test the effect; a balance between control and manipulation must be struck so that the real-world phenomenon being measured is still represented (Mertens, 2015). It is recognised that a qualitative approach to answering the outlined research questions would also provide valuable insight into green exercise and nature connectedness effects. Adopting a qualitative approach may highlight the individual outcomes of participation in a green exercise/nature connectedness focused study, bringing the meaning which participants attach to the environmental setting to the fore (Denzin & Lincoln, 2011; Patton, 2002). However, as the current study aims to assess the merits of such an intervention on a universal basis, and represents an early foray into examining green exercise effects for primary school-aged children, it is considered that a quantitative approach, which allows for a more effective examination of a cause-effect relationship between variables is pertinent (Mertens, 2015).

An increased emphasis on the importance of the relationship between science and practice and the role of this relationship in the context of accountability and effectiveness is evident in the field of psychology (Lane & Corrie, 2006). With this increased emphasis comes a requirement to ground intervention in evidence-based knowledge (Lane & Corrie, 2006). It is argued that by encompassing research and evaluation in the role of an educational psychologist, the consequences would be more beneficial outcomes for clients of educational psychology, as well as refining and defining the professional identity of practising educational psychologists (Eodanable and Lauchlan, 2009). Likewise, Mertens (2015) outlines that the use of experimental design can contribute to an evidence base which informs educational psychology and school practices. In a study of predicted future trends in psychology, a number of findings shed light on the direction which research in psychology needs

to take, including an increased emphasis on its predictive and scientific status, an increased application of research to everyday life, quality of life and the whole person, and an increased emphasis on research in the real-world setting rather than a laboratory (Haste, Hogan & Zachariou, 2001).

3.2 Student Voice

In researching the effect of connection with nature on primary school-aged children's mood state and attentional capacity, the researcher sought to bring the child's voice to the fore. Rather than gathering teacher or parent perspectives on changes to children's mood or attention, measures which are completed by the child's own self-report were utilised. With the ratification of the United Nations Convention on the Rights of the Child (UNCRC), the concept of 'pupil voice' and its potential influence in informing educational and social policy has drawn attention (Ruddock & McIntyre, 2007). As political, social and educational climates evolve, a recognition of children as 'social agents', who make sense of their lives, has occurred, as well as an increased interest in understanding children's own experiences and perspectives (Tangen, 2008). Lundy (2007) breaks down article 12 of the UNCRC into four elements; space, voice, audience and influence. Space refers to the creation of opportunity for children to express their views. Providing space for children to express views without fear of negative consequence is particularly important in the educational context, where reprisal for speaking out may be encountered on a daily basis (Lundy, 2007). Voice refers to the facilitation of expression. Interpretation of this element of the Article 12 provision indicates that a child's right to express a view is not dependent on capacity to express a *mature* view, it is solely dependent on ability to *form* a view (Lundy, 2007). Audience outlines that the views expressed must be listened to, while influence underlines that the expressed views must be acted upon (Lundy, 2007). As educational policy provision promotes connectedness, engagement, resilience and holistic learning, allowing children's voices to be heard and their perspectives and experiences to be acted upon in facilitating change is a fundamental manifestation of those policies (DCYA, 2014; DES, 2015). Compliance with Article 12 fosters a positive and inclusive educational environment, as well as being a moral imperative (Lundy, 2007).

Through student voice-based research, which engaged students experiencing social, emotional and behavioural difficulties, Flynn (2014) found that a student voice approach to supporting students was essential in developing an inclusive learning environment. The students' perspectives on the experience of school were gathered through semi-structured one-to-one interviews and focus groups. Twenty students participated in the study. Students decided on their level and pace of their engagement with the research process which dictated the frequency of individual meetings and their participation in group activities (Flynn, 2014). The study's findings suggest that for those students whom have experienced being 'silenced' on important issues in their lives, the experience of the voice process was less impactful (Flynn, 2014). Students who had previously experienced not being heard or listened to were sceptical regarding the value of their contribution to the research process. Feelings of frustration or powerlessness impacted on young people's confidence and belief in the voice process (Flynn, 2014). However, the opportunity to have their voice heard was significant for all participants; Flynn (2014) highlights the relationship between voice, empowerment and transformation, as well as the contribution students can make in promoting and participating in strategies and activities that have a positive impact on the school experience.

In the context of the current study, children are provided with space to express their views and are facilitated to use their voice. The use of self-report measures to empower children to explore and understand their own emotional well-being and utilising a direct assessment of attention, rather than teacher report, to maximise children's participation in the research are considered to be empowering for those participating. In addition, pupil assent is sought and those children who express that they do not wish to participate are facilitated, despite presence of parent consent. The element of audience will be achieved through the collating of data and the presentation of findings. As the research process progresses, it is envisaged that influence may be achieved through the dissemination of this research in educational policy and well-being policy fora.

3.3 Research Design

Utilising an experimental design, the study compared the effects of green exercise, non-green exercise, connectedness to a natural environment and connectedness to a non-natural environment on children's mood state and attentional capacity.

Each participant participated in two conditions. Through within-subjects design, causal inferences can be obtained by examining how measures of the dependent variable changed when the conditions of the experiment changed (Charness, Gneezy & Kuhn, 2012). In addition, a between-subjects condition of exercise-only versus exercise+connectedness was implemented. This condition was incorporated as a between-subjects rather than within-subjects factor with consideration that research was being conducted in an educational setting; incorporating exercise-only versus exercise+connectedness as a between-subjects condition reduced the overall disruption to class time for participants. Additionally, this research design eliminated the potential for analytical errors resulting from sequence or order effects. Each participant was assigned to one of these conditions, allowing for outcomes of those in the exercise-only condition to be compared with outcomes for participants in the exercise+connectedness condition. Assessing the merits of between-subjects and within-subjects designs, Charness et al. (2012) assert that the two design approaches can be combined in simple ways so as to ensure the advantages of both methods. A mixed research design allowed for comparison of effects of green and urban conditions, as well as comparison of effects of exercise-only and exercise+connectedness conditions.

Thus, utilising a mixed research design, participants were randomly assigned to complete either:

Exercise in a green environment AND exercise in a non-green environment.

OR

Connectedness activity while exercising in a green environment AND connectedness activity while exercising in a non-green environment.

The research design is represented in Figure 1.

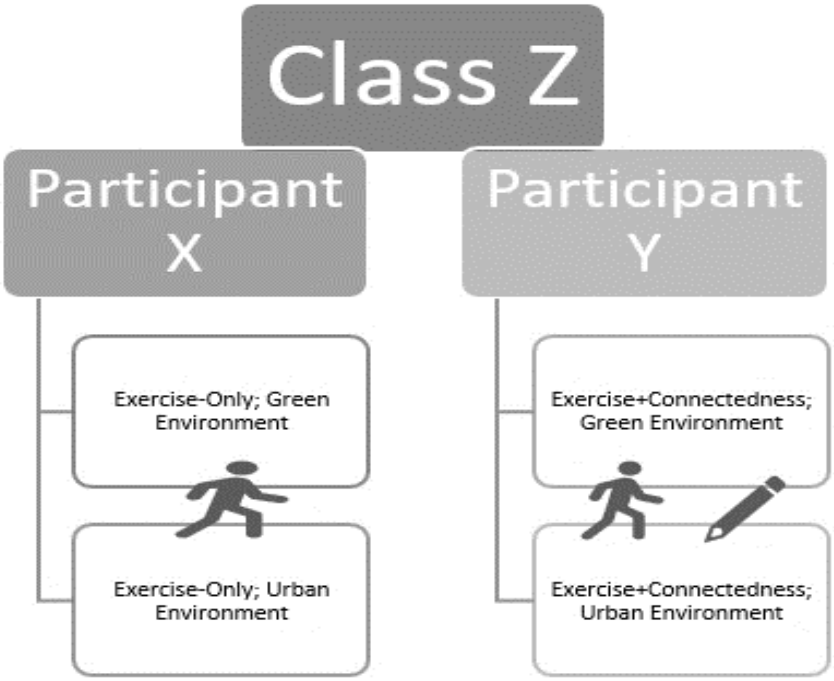


Figure 1. Illustration of Mixed Research Design

Participants were randomly assigned to conditions within their class group. With consideration of the nature of intragroup dynamics, that is how people interact with one another and the emergent values, norms, and structure of a group, this research aimed to address the influences of intragroup dynamics on both group member's individual functioning and intergroup relations within a system (Mateeva & Dimitrov, 2013). In order to control for intra-class dependency, class groups were randomly split, with half the class completing green and non-green exercise and half the class completing green and non-green exercise+connectedness activity. Through splitting class groups between the exercise only and exercise+connectedness conditions, the potential confounding effects of large differences between classes and smaller differences within classes, on baseline measures, was addressed.

It was aimed for participation in each condition to be 1-week apart. This interval is in line with previous research by Bodin and Hartig (2003), who explored the impact of the outdoor environment on the psychological benefits associated with running. Participants in Bodin and Hartig's (2003) study engaged in running sessions with a 7-day interval incorporated between sessions. With the exception of one class group, all participants in the current study participated in each condition with a 7-day interval. Inclement weather caused a greater interval for one class group; this group participated in the second condition 14 days later.

As outlined in the systematic review, variability in terms of the length of green exercise and nature connectedness interventions implemented in research is evident. However, previous research examining the impact of green exercise found that one 'dose' of exercise which is greater than 15 minutes in duration is sufficient to bring benefits, regardless of intensity of the exercise (Han, 2017; Mackay & Neill, 2010; Parks et al., 2011; Pretty et al., 2007). Recognising the 'dose' found to be effective in previous research and the practicalities of building the research intervention into the structure of a school day, the exercise-only conditions comprised 20 minutes of low intensity exercise (walking) in both green and built-up environmental conditions. For the green condition, the intervention took place in a natural, green environment, as defined by Barton and Rogerson (2017). For the built-up condition, the intervention took place in a non-green environment, such as a housing estate, city centre or industrial environment. Though both groups were required to take a short walk to access the exercise space, the 20 minutes of low intensity exercise began once the green or non-green space had been reached[1]. During the walk, children walked in pairs. Walking in pairs was considered to be more helpful in supporting health and safety while on the walk. Selection of pairings was at each class teacher's discretion. While some teachers were observed to have pre-established pairings, other pairings were dependent on participant's seat in the classroom or position in line when embarking on the walks.

The same settings used for completing green and non-green exercise-only conditions were visited for exercise+connectedness conditions. While visiting each setting, participants were asked to take note of features of the environment. For example, in the green condition, a flower, tree, butterfly or bird, and in the non-green condition, a car, house or building. These features were recorded by each participant on a template provided by the researcher; templates were completed by placing a tick next to image-based samples of features observed in the environment. The template was completed by participants while walking in the relevant environment (Appendix C). This connectedness activity was adapted from adult-based research by Richardson and Sheffield (2017). The researchers found that writing 'three good things in nature' each day for 5 days increased participants' nature connectedness, as

[1] The environments through which participants walked to access the exercise space comprised either residential areas or urban streets. Participants walked on footpaths, for approximately 2-5 minutes depending on proximity to the exercise space.

compared with a control group. Completion of participation in each connectedness condition also took place 1-week apart, with the exception of the aforementioned one class group.

Pre-intervention measures were administered in the classroom, immediately prior to participation in each condition. Post-intervention measures were administered upon return to the classroom, following participation in each condition. In order to account for unforeseen events which may impact on participants' response to intervention, the researcher maintained a record of events for each condition. Events occurring en-route to, in situ or on return from the intervention location were recorded; examples of such events include a participant meeting a familiar person while walking, negative interactions between participants, a participant receiving negative attention from a teacher and presence of maintenance workers in the green environment. The weather on each day was also recorded in this template, with recognition that it may impact on participants' mood (Keller et al., 2005). Record of weather conditions during intervention is provided in Appendix D.

3.4 Sampling

A stratified purposeful sampling strategy was utilised to recruit participants to this study. Schools were initially screened on the basis of their proximity to appropriate green, natural spaces and to a suitable, non-green, man-made area. Once the researcher had identified suitable environments, under 5 minutes walking distance from a school, a recruitment letter was sent out to several schools inviting them to participate in the study.

Four schools agreed to participate, all of which were located in the Munster province. Three schools were centrally located in a large city, while the fourth was a rural school, located within a small village in a neighbouring county. Images of the green and non-green environments identified are provided in Figure 2. Two of the schools were located in close proximity to each other and thus accessed the same green and non-green environments; these are the first green and non-green environments in Figure 2.

Within participating schools, third to sixth class students formed the research sample. This age range was selected as they were considered to have the appropriate level of literacy to complete the self-report well-being measure and also came within

the recommended age-range for completion of the digit span task (Wechsler, 2014). Whole class groups were invited to participate with no exclusion criteria relevant to individual pupils. The sample on which the digit span test was administered to measure attentional capacity was selected at random from within each participating class.

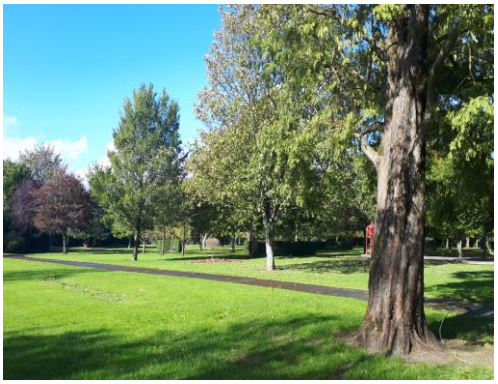
	Green Environments	**Non-green Environments**
1.		
2.		
3.		

Figure 2. Intervention Environments

3.5 Participants

Participants comprised third to sixth class students in four mainstream primary schools in Ireland. The number of participants that engaged in this research was 350. Of this number, 119 categorised themselves as female and 231 categorised themselves as male. A breakdown of participants by age is provided in Table 11. A breakdown of number of participants at each class stage is provided in Table 12. Within one participating school, it was the principal's preference that only fifth and sixth classes participated. In another school, two fifth classes and two sixth classes took part. These factors lead to a higher overall number of students in this class range participating in the study.

Table 11

Age of Participants

8 Years	**9 Years**	**10 Years**	**11 Years**	**12 Years**	**13 Years**
11%	18%	26%	30%	13%	1%
(*n* = 40)	(*n* = 63)	(*n* = 91)	(*n* = 106)	(*n* = 46)	(*n* = 4)

Table 12

Class Level of Participants

3rd	**4th**	**5th**	**6th**
19%	17%	34%	30%
(*n* = 67)	(*n* = 58)	(*n* = 120)	(*n* = 105)

Of 350 participants, 124 were enrolled in a designated DEIS school, while the remaining participants were enrolled in non-DEIS designated schools. A DEIS school is one which is designated as disadvantage by the DES (2005) under the 'Delivering equality of opportunity in schools: action plan for inclusion' which aims to address the educational needs of children from disadvantaged communities.

3.6 Measures

Pre and post-intervention measures of mood were gathered through use of short self-report questionnaires. The mood measure is presented in Appendix E. Created for this study, this measure incorporates elements of the 'Fast Assessment of Children's Emotion' (FACE) scale (Kennedy, Unnithan & Wamboldt, 2015). FACE was

assessed for reliability and validity through administering to a sample of adolescents whom were attending mental health services on an outpatient basis (Kennedy et al., 2015). Participants were aged between 12 and 17 years (Kennedy et al., 2015). The researchers found that the measure achieved high reliability (Cronbach's alpha 0.7734) and correlated significantly with the Brunel Mood Scale (BRUMS) (Kennedy et al., 2015). The BRUMS is well-established as a reliable and valid measure of mood state and has been utilised to measure mood in children and adolescents (Duncan et al., 2014). The FACE showed significant changes in mood from before to after a therapeutic intervention for all participants. FACE measures some feelings which are not of concern in this study, for example 'confusion', and some of the language used was not considered appropriate to the cultural context of Irish schools, for example 'grouchy' and 'on edge'. Given these limitations, it was tailored to the aims and context of this research, targeting more pertinent feelings, such as 'worried', and incorporating more culturally appropriate language.

Following this adaptation, the measure was forwarded to two children's research experts for review. Research interest areas of the expert reviewers are children's cognitive development and children's health and well-being. Feedback from the expert review included consideration of labelling of some of the feelings to accurately capture the foci of the research, aligning the format of the measure as closely as possible to the original so as to maintain reliability and validity, and consideration of the level of sensitivity of the 3-point Likert scale in measuring change following intervention. Following receipt of this feedback, adaptations were made to include an additional emotion – energetic - and the formatting of the measure was revised. 'Energetic' was included as it was considered appropriate in the context of measuring exercise response.

The next step was to pilot the questionnaire on an appropriate student cohort. The mood measure was piloted on a sample of third class and sixth class students, in the setting of a co-educational, mainstream primary school. Forty-three students completed the questionnaire. Of these, 22 participants were in third class and 21 were in sixth class. 65% of participants in the pilot study were female. Participants were aged between 8 and 12 years. A total of 22 participants were 8-9 years of age, while 21 participants were 11-12 years of age. Through piloting, it was established that the measure was accessible to the proposed research sample; all participants

were able to complete the questionnaire independently, following reading of an explanatory script which provided a description of each emotion.

When reviewing completed pilot questionnaires, the sensitivity of a 3-point Likert scale became a concern. With recognition that the original FACE measure was trialled on a clinical sample, the Likert scale was increased to a 5-point rather than 3-point scale. As suggested through expert review and evidenced in the piloting phase, a scale with greater sensitivity was required for use with a non-clinical sample. Ambiguity exists regarding the optimal number of response items on a Likert scale (Preston & Coleman, 2000). Research exploring the amount of response items which achieve highest reliability has found varying results (Jacoby & Mattell, 1971; Lehmann & Hulbert, 1972; Preston & Coleman, 2000). Jacoby and Mattell (1971) assert that a scale with too few response items may be too crude, resulting in diminished discriminative power for respondents, whereas too many items on a scale may go beyond the limits of the rater's level of meaningful discriminability. This point is particularly pertinent when conducting research with primary school-aged children participants. Assessing the reliability, validity and discriminating power of scales, Preston and Coleman (2000) found that 2-point, 3-point and 4-point scales performed more poorly than scales with more response categories. Seven-point scales performed better than other scales, however, the researchers also highlight that a scale which is too difficult to use may lead to respondents experiencing frustration and becoming demotivated (Preston & Coleman, 2000). Recognising the population sample, the nature of the research design and research into the effectiveness of Likert scales, a 5-point response scale was utilised to assess changes to mood post-intervention.

Attentional capacity was measured pre and post-intervention through administering a digit span test (digit span forward and digit span backwards); this was administered to a randomly selected group within the overall sample. Digit span's role in the context of a cognitive assessment is to assess working memory capacity. Outcomes on the task are considered to be representative of attention, concentration and mental control (Wechsler, 2014). Digit span is one of the most commonly used measures of attentional capacity in neuropsychological research (Hale, Hoeppner & Fiorello, 2002; Ostrosky-Solis & Lozano, 2006). In the context of research on green exercise, it has been employed to assess changes to attentional capacity following exercise in

various settings (Bodin & Hartig, 2003; Faber Tayler & Kuo, 2009; Han, 2017). Content for the digit span measure was sourced from the Wechsler Intelligence Scale for Children – V (WISC-V) (Wechsler, 2014). It was presented verbally by the researcher to the group. The researcher called out the digits; once participants heard a noise signal (bell tone); they recorded their responses in writing. As the discontinue rule could not be applied in the context of group administration; all participants in this subsample attempted all items. By administering digit span to all participants in a class at once, the disruption to class time was reduced and results between conditions are more effectively comparable. When available, a class teacher or special education teacher was present to ensure that all participants began writing numbers after hearing the bell tone. When an additional invigilator was not available, the researcher monitored this by moving around the classroom while administering the digit span test.

In addition to measures of mood and attention, demographic information (age, class, gender) were gathered for each participant. In order to address potential confounding variables and accurately analyse intervention effects, participants responded to a number of questions pre and post-intervention (Appendix F). Scaled questions on pre and post-intervention measures were answered on a Likert scale. Participants responded to the following questions pre-intervention;

1. How is your day going so far? (*It's a very good day – It's a very bad day)*
2. How much do you like walking? (*I really like walking – I really don't like walking)*
3. How much do you like being outside? (*I really like being outside – I really don't like being outside)*
4. How many times per week do you usually exercise? (*0-1/2-4/3-5/6-7)*

Participants answered the following questions post-intervention:

1. How much did you like the place you visited with your class today? (*I really like the place we visited – I really didn't like the place we visited)*
2. Did you find the place you visited nice to look at?
3. Did you find this activity fun/relaxing/boring/scary/uncomfortable/nice/ difficult?

3.7 Ethical Considerations

This research was designed and implemented in adherence with the Psychological Society of Ireland's Code of Professional Ethics (2010). In addition, the research was reviewed by the Research Ethics Committee of the Doctorate in Educational and Child Psychology, Mary Immaculate College. Approval for the study was granted in May 2018. Application for Ethical Approval is presented in Appendix G. Principal ethical concerns related to this study are outlined below.

3.7.1 Informed consent. The Psychological Society of Ireland (PSI) (2010) states that a psychologist should:

> Provide, in obtaining informed consent, as much information as a reasonable or prudent person, family, group, or community would want to know before making a decision or consenting to an activity. The psychologist relays this information in language which the persons understand…(p. 7).

Informed consent was initially gained from the participants' parents. An information sheet detailing the researcher's background, the purpose and nature of the research, and information regarding the procedure for retaining data, confidentiality, anonymity, dissemination of research and right to withdraw was provided to parents (PSI, 2010) (Appendix H). Informed consent was also gained from participants using a child-friendly assent form (See Appendix I). This form included visual images and symbols, differentiated language and large print to support participants in understanding the meaning of agreeing to consent. The assent form was read out to each participating class group before beginning data collection. Participants were invited to ask any questions or voice concerns, on an individual or group basis, as preferred.

3.7.2 Confidentiality. The PSI states that a psychologist should "explore and collect only that information which is germane to the purposes of a given investigation or intervention, or which is required by law" (PSI, 2010, p. 6).

Both the parental and child consent forms provided information about confidentiality and anonymity. Information in this regard was also provided to school principals at the point of recruitment (Appendix J). For the purposes of tracking pre to post-intervention data, participants provided their first name only on completed measures. As the researcher had no prior familiarity with participants, identification of an individual was not possible through first name only. In addition, following data

collection, all participants were allocated a number which was utilised for inputting data for analysis. The participating schools or their locality have not been named in this document, nor have identifiable details been included, to ensure further anonymity.

3.7.3 Right to withdraw. The PSI states that a psychologist should "respect the right of individuals to discontinue participation or service at any time, and are responsive to non-verbal indications of a desire to discontinue if individuals have difficulty in verbally communicating such a desire" (PSI, 2010, p. 8).

As in the case of confidentiality and anonymity, school, parent and child information sheets included detail on the rights of any party to withdraw from the research. It was conveyed that any individual, parent or school may withdraw from the study at any point, without need to provide a reason and without fear of consequence. It was also outlined that if a child or parent did not wish to participate in the study, the child may still attend the intervention walks but would not complete any data measures.

3.8 Data Analysis

Gathered data were inputted to SPSS for statistical analysis. Data were analysed according to a multi-level model. Field (2018) suggests that multilevel models should be used to analyse data that have a hierarchical structure, such as patients who see different therapists in different clinics, or, as in this research, students, within class groups, within schools. Similarly, Raudenbush and Bryk (1986) argue that multilevel modelling presents a flexible statistical approach to examining the influence on educational processes of variations in pertinent policies and practices. Individual-level analysis within hierarchically structured data neglects the likelihood that a shared environment results in individuals being more similar to each other than to individuals in a different environment. Ignoring the nested structure of a dataset, such as children in class groups, in schools, can have notable negative consequences (Kahn, 2011). As many traditional statistical tests assume independence and nested data structures violate this assumption, omission of group-level analysis can produce excessive type 1 errors and biased parameter estimates (Kahn, 2011; Peugh, 2010). By applying a multi-level model, the risk of erroneous or misleading statistical outcomes is reduced (Peugh, 2010).

In the context of school based-research, multi-level modelling has principally been applied to the analysis of school effectiveness, examining the role of inputs and processes at the classroom and school level in determining achievement outcomes (Rumberger & Palardy, 2004). Multi-level modelling applied to repeated measures research allows for questions regarding within-person variability and change to be addressed (Kahn, 2011; Peugh, 2010). For the purposes of this study, multi-level modelling was employed to investigate responses to intervention at the individual and class group level. Figure 3 outlines the levels of analyses employed in building a multi-level model:

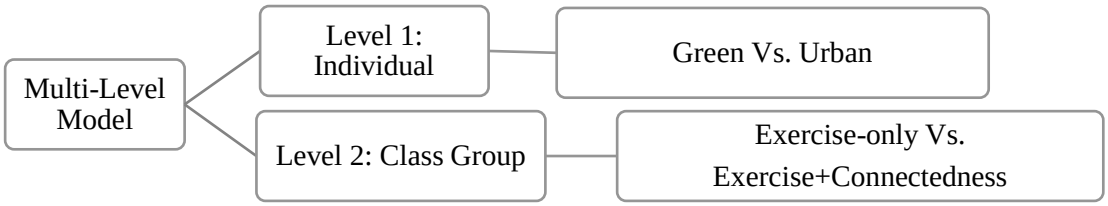


Figure 3. Levels of Analyses

In the context of this study, multi-level modelling will lend understanding of response to intervention at each level of the nested structure. The number of individuals nested within each level of analysis meets with the recognised minimum of 30 units but does not reach the ideal of 100, as outlined by Maas and Hox (2005). Building on analysis of response to condition and individual response, intraclass correlation indicates the proportion of total variability in the outcome which is attributable to membership of a particular class group (Field, 2018). The role of teacher characteristics, classroom climate and school climate may be explored in light of results of statistical analyses (Galvan, Spatzier & Juvonen, 2011; Jennings & Greenberg, 2009; Yoon, 2002).

3.9 Conclusion

This chapter has detailed the methodological approach to this research study. Methodological considerations have been informed by previous research in the area of green exercise and nature connectedness, previous research into children's mood state, and the research population and context in which the study was conducted. Results of the research study are outlined in Chapter Four.

Chapter Four: Results

Response to intervention is analysed through multilevel modelling. Multilevel modelling examines predictors of post-intervention response at the individual level (level one) and class level (level two)[2]. Mood measure items and pre and post-intervention measures, including attitude to walking, attitude to being outdoors, perception of intervention activity and enjoyment of environmental setting, were explored through factor analysis. Exploratory factor analysis provided insight into the underlying relationships between measured variables, informing dimension reduction prior to further analyses.

4.1 Descriptive Statistics

Mean scores pre and post engagement in intervention in the green and urban environment are displayed in Table 13. With regard to items on the mood measure administered pre and post-intervention, higher scores on each facet of mood; Happiness, Relaxed, Energetic, Sadness, Worry and Anger, indicate higher levels of these mood states. Higher scores on Happiness, Relaxed and Energetic suggest higher levels of well-being. Higher scores on Sadness, Worry and Anger indicate lower levels of well-being.

Table 13

Summary of Means and Standard Deviations for Pre and Post-intervention Scores on Mood Measure

Variable	**Green Environment**		**Urban Environment**	
	Pre	Post	Pre	Post
Happiness	3.84 (1.1)	3.73 (1.3)	3.73 (1.2)	3.72 (1.3)
Relaxed	3.30 (1.3)	3.31 (1.4)	3.21 (1.3)	3.26 (1.5)
Energetic	3.79 (1.3)	3.46 (1.5)	3.65 (1.4)	3.55 (1.5)
Sadness	1.25 (.6)	1.38 (.9)	1.30 (.7)	1.31 (.7)
Worry	1.43 (.79)	1.28 (.8)	1.31 (.7)	1.28 (.7)
Anger	1.23 (.7)	1.47 (1.0)	1.3 (.8)	1.4 (.9)

[2] Multilevel models can also be referred to as mixed effects models, hierarchical linear models and nested data models.

Intervention in a green environmental setting improved mean levels of feeling relaxed and feeling worried among participants. Similarly, intervention in an urban environmental setting brought positive change to mean levels of feeling relaxed and feelings of worry. In both settings, energetic feelings reduced following intervention. Feelings of anger slightly increased following intervention, across both environmental settings. Changes to mean scores following intervention were small across all mood items. Standard deviation from the mean was larger across mood items of happiness, relaxed and energetic, as compared with standard deviations for sadness, worry and anger.

4.2 Exploratory Factor Analysis

Exploratory factor analysis (EFA) was carried out on the adapted mood measure and on other measured covariates. As the mood scale was adapted from the FACE scale (Kennedy et al., 2015), EFA allowed for the adapted measure to be assessed for dimensionality. Through factor analysis, common underlying dimensions within the data can be identified. In addition, EFA supports data reduction through combining measured variables into summary indices (Floyd & Widaman, 1995). EFA was carried out on pre-intervention mood items as this was considered to provide a 'baseline' value reflective of usual patterns of well-being. Additionally, post-intervention mood items were analysed through factor analysis. The following mood measure items were reverse-coded prior to EFA: pre-intervention worry, post-intervention worry, pre-intervention sadness, post-intervention sadness, pre-intervention anger and post-intervention anger.

4.2.1 Analysis of pre-intervention mood measure. Pre-intervention scores on the 6 items of the mood measure were subjected to Principal Axis Factoring using IBM SPSS version 25. With the assumption that a correlation between factors would be present, oblique rotation was employed (Field, 2018). Items measuring negative emotional states (worry, sadness, anger) were reverse-coded prior to analysis. As shown in Table 14, inspection of the correlation matrix revealed the presence of a number of coefficients of .3 and above. However, determinant of the R-matrix (correlation matrix) was .36, greater than the recommended .00001 (Field, 2018), indicating that multicollinearity is not present. Kaiser-Meyer Olkin values for individual items were above .5 and the Kaiser-Meyer Olkin value for the factor

analysis was .71, exceeding the recommended value of .5 (Kaiser & Rice, 1974). Additionally, Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Table 14

Correlation Matrix for Pre-Intervention Mood Variables

	Correlation Coefficients					
Item	Pre-Intervention Worry	Pre-Intervention Sad	Pre-Intervention Angry	Pre-Intervention Happy	Pre-Intervention Relaxed	Pre-Intervention Energetic
Pre-Intervention Worry	1.000	**.378***	.195*	.164*	.150*	.157*
Pre-Intervention Sad	**.378***	1.000	**.396***	.267*	.158*	.210*
Pre-Intervention Angry	.195*	**.396***	1.000	.265*	.101*	.159*
Pre-Intervention Happy	.164*	.267*	.265*	1.000	**.443***	**.520***
Pre-Intervention Relaxed	.150*	.158*	.101*	**.443***	1.000	**.395***
Pre-Intervention Energetic	.157*	.210*	.159*	**.520***	**.395***	1.000

Note. Correlation Coefficients over .30 appear in bold.
*$p < .001$

Principal axis factoring revealed the presence of two components with eigenvalues exceeding 1, explaining 39% and 20% of the variance respectively. An inspection of the scree plot (Figure 4) indicates an inflection after the second component, suggesting that two components be retained for further investigation. The two-component solution explained a total of 60% of the variance. To aid in the interpretation of these components, direct oblimin rotation was performed. The rotated solution revealed the presence of a simple structure (Thurstone, 1947) with both components showing a number of strong loadings and all variables loading strongly on only one component (Table 15). A high level of similarity between the pattern matrix and structure matrix is evident. Factors loadings above 0.4 were retained for interpretation, as recommended by Stevens (2002). Interpretation of the

two components shows positive affect items loading strongly on component 1 and negative affect items loading strongly on component 2. Previous research on the FACE scale also identified two main factors; one included mood states of sadness, confusion and anger and the other included energy states of anxiety, energy and tired (Kennedy et al., 2015). The results of this analysis support the use of the positive affect items and negative affect items as separate scales.

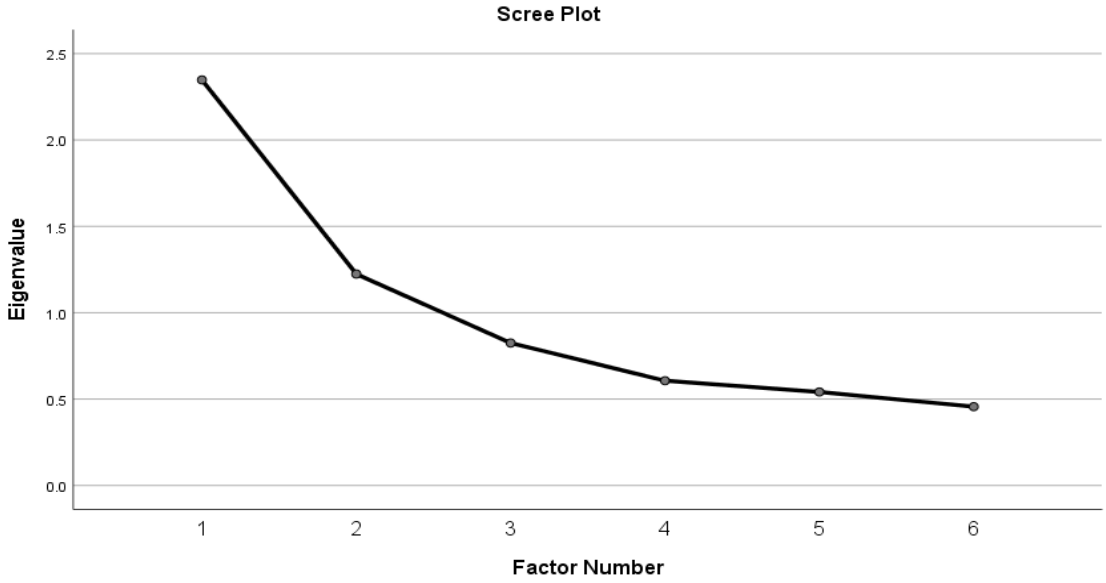


Figure 4. Scree Plot for Factor Analysis of Pre-Intervention Mood Measure items.

Table 15

Pattern and Structure Matrix for Principal Axis Factoring with Oblimin Rotation – Pre-Intervention Mood Variables

Item	Pattern Coefficients		Structure Coefficients	
	Factor 1	Factor 2	Factor 1	Factor 2
Pre-Intervention Worry	.031	**.422**	.222	**.436**
Pre-Intervention Sad	-.108	**.904**	.301	**.855**
Pre-Intervention Angry	.057	**.442**	.257	**.458**
Pre-Intervention Happy	**.747**	.060	**.773**	.398
Pre-Intervention Relaxed	**.590**	-.028	**.578**	.239
Pre-Intervention Energetic	**.675**	.002	**.675**	.307

Note. Factor loadings above .40 appear in bold.

4.2.2 Analysis of post-intervention mood measure. Principal Axis Factoring was also completed on post-intervention scores on the mood measure. Items measuring negative emotional states were reverse-coded prior to factor analysis. As with pre-intervention scores, the correlation matrix indicated a number of coefficients of .3 or above (Table 16). Determinant of the R-matrix (correlation matrix) of .2 indicates that multicollinearity is not present (Field, 2018). Kaiser-Meyer Olkin values for individual items were above .5 and the Kaiser-Meyer Olkin value for the factor analysis was .75, exceeding the recommended value of .5 (Kaiser & Rice, 1974) and Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Table 16

Correlation Matrix for Post-Intervention Mood Variables

	Correlation Coefficients					
Item	Post-Intervention Happy	Post-Intervention Relaxed	Post-Intervention Energetic	Post-Intervention Worry	Post-Intervention Sad	Post-Intervention Angry
Post-Intervention Happy	1.000	**.531***	**.594**	.191*	**.364***	**.436***
Post-Intervention Relaxed	**.531***	1.000	**.460***	.111*	.230*	.297*
Post-Intervention Energetic	**.594***	**.460***	1.000	.071*	.269*	.329*
Post-Intervention Worry	.191*	.111*	.071*	1.000	**.462***	.239*
Post-Intervention Sad	**.364***	.230*	.269*	**.462***	1.000	**.490***
Post-Intervention Angry	**.436***	.297*	**.329***	.239*	**.490***	1.000

Note. Correlation coefficients over .30 appear in bold.
*$p<.05$

As with pre-intervention loadings, principal axis factoring showed the presence of two components with eigenvalues exceeding 1. These components explained 46% and 20% of the variance respectively. As shown in Figure 5, the scree plot indicated an inflection after the second factor, suggesting that two components be retained for

further investigation. The two-component solution explained a total of 66% of the variance. Oblimin rotation was completed to assist interpretation of these components. In line with factor analysis of pre-intervention items, the rotated solution showed each variable loading higher on one component. However, unlike pre-intervention items, the variable of post-intervention anger and post-intervention happiness loaded quite strongly on both components. These results are shown in Table 17. Despite anger and happiness loading on both components, examination of the pattern and structure matrices suggests that a two-factor solution as resulted from factor analysis of pre-intervention items can be interpreted. Positive affect items of happiness, relaxed and energetic comprised factor one, while variables loading on factor two were negative affect items, worry, sadness and anger.

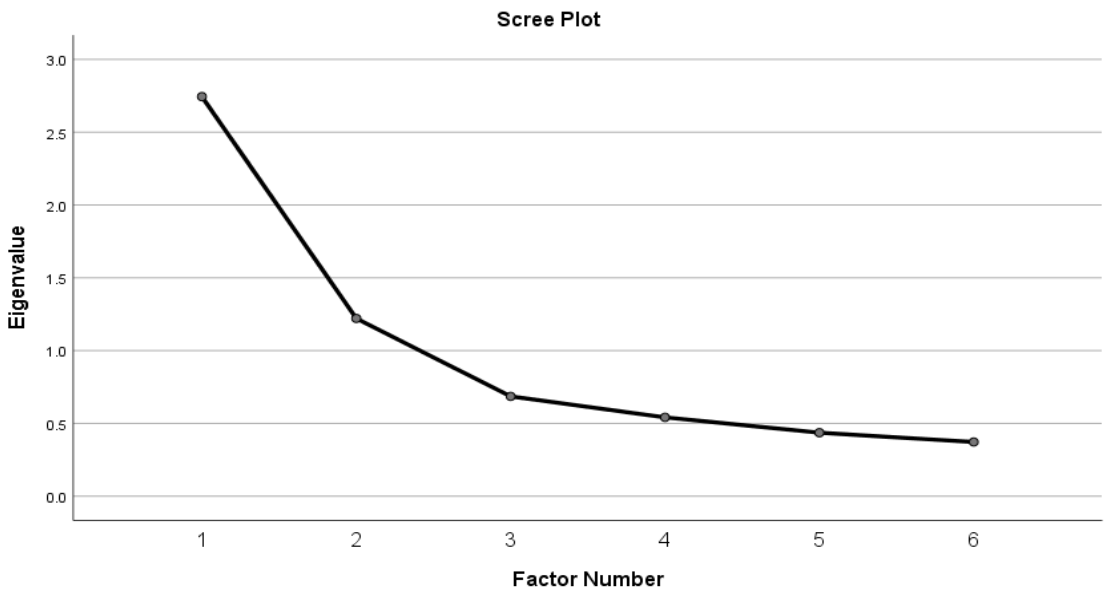


Figure 5. Scree Plot for Factor Analysis of Post-Intervention Mood Measure items.

Table 17

Pattern and Structure Matrix for Principal Axis Factoring with Oblimin Rotation – Post-Intervention Mood Variables

Item	Pattern Coefficients		Structure Coefficients	
	Factor 1	Factor 2	Factor 1	Factor 2
Post- Intervention Happy	**.807**	.066	**.835**	**.402**
Post-Intervention Relaxed	**.646**	.024	**.636**	.245
Post-Intervention Energetic	**.738**	.048	**.718**	.259
Post-Intervention Worry	.051	**.529**	.169	**.508**
Post-Intervention Sad	.025	**.895**	.397	**.905**
Post-Intervention Angry	.325	.390	**.488**	**.526**

Note. Factor loadings above .40 appear in bold.

4.2.3 Analysis of pre and post-intervention variables. Covariates measured at pre and post-intervention were also subjected to principal axis factoring. EFA aided determination of whether dimensional reduction was warranted, informing further statistical analyses and supporting model parsimony. These covariates comprise results of four items measured at pre-intervention and 3 items measured at post-intervention. Suitability of the data for factor analysis was explored. Kaiser-Meyer Olkin values for individual items were above .5 and the Kaiser-Meyer Olkin value for the factor analysis was .65, exceeding the recommended value of .5 (Kaiser & Rice, 1974). Bartlett's test of sphericity reached statistical significance, supporting the use of factor analysis (Bartlett, 1954). Sampling adequacy was achieved; all diagonals of the anti-image correlation matrix were >0.5. However, inspection of the correlation matrix found that only four correlations were above .3. Given these overall indicators, factor analysis was deemed not to be suitable with all seven items. A total of three items were eliminated because they did not contribute to a simple factor structure and failed to meet a minimum criterion of having a primary factor loading of .3 or above.

Suitability of the remaining four covariates for factor analysis was conducted. Inspection of the correlation matrix revealed the presence of a number of coefficients of .3 and above. Kaiser-Meyer-Olkin values for individual items were >.5 and for

the factor analysis was .59, exceeding the recommended value of .5 (Kaiser & Rice, 1974). Bartlett's test of sphericity reached statistical significance, supporting the use of factor analysis (Bartlett, 1954). Determinant of the R-matrix (correlation matrix) of .53 indicated that multicollinearity is not present (Field, 2018). In addition, examination of the correlation identifies no correlation over .8 (Hutcheson & Sofroniou, 1999).

Following assessment for suitability, principal axis factoring was conducted on the four items with oblique rotation (direct oblimin). Two factors had eigenvalues over Kaiser's criterion of 1 and in combination explained 73.68% of the variance. While the scree plot is ambiguous (Figure 6), the level of variance explained by the two factors which met Kaiser's criterion and Jolliffe's criterion warrants retention of two factors (Jolliffe, 1972; Kaiser, 1960). The items which cluster on the same factor suggest that factor 1 represents situational factors and factor 2 represents attitudinal factors. Factor 1, situational factors, comprises variables measured at post-intervention; enjoyment of the intervention setting and aesthetic pleasure taken from the intervention setting. Factor 2, attitudinal factors, comprises variables measured pre-intervention: attitude to walking and attitude to being outdoors. These results are presented in Table 18. As in EFA of pre-intervention mood items, a high level of similarity between pattern and structure matrices is evident.

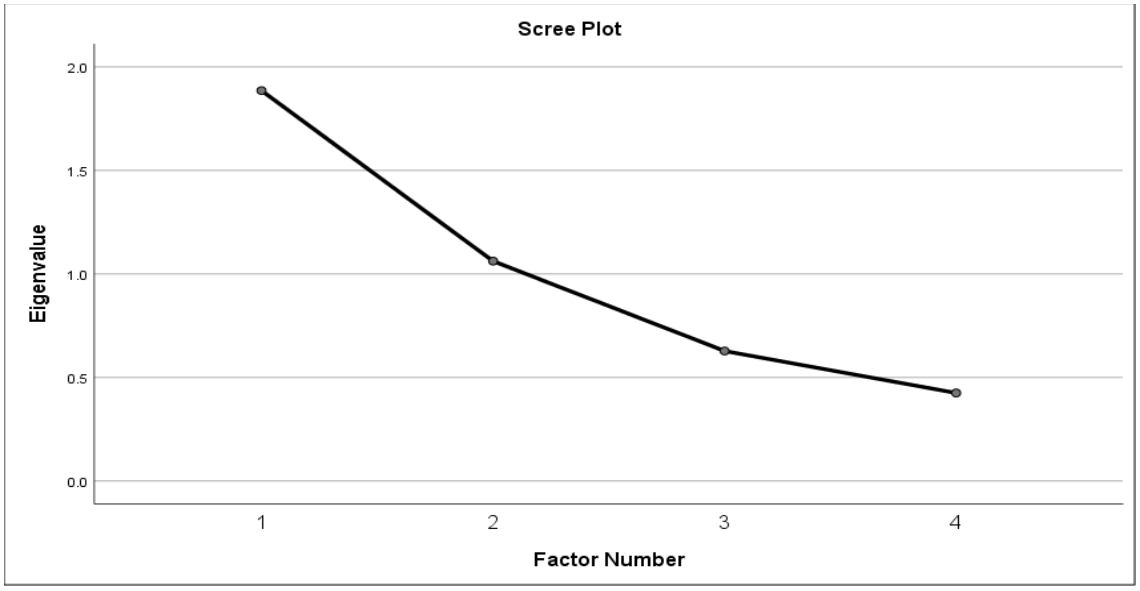


Figure 6. Scree Plot for Factor Analysis of Pre and Post-Intervention Covariates.

Table 18

Pattern and Structure Matrix for Principal Axis Factoring with Oblimin Rotation

Item	Pattern Coefficients		Structure Coefficients	
	Factor 1	Factor 2	Factor 1	Factor 2
Attitude to Walking	.121	**.578**	.350	**.626**
Attitude to Exercise	-.064	**.591**	.171	**.566**
Enjoyment of Setting	**.734**	.011	**.739**	.302
Aesthetic Pleasure	**.778**	-.001	**.778**	.307

Note. Factor Loadings above .40 appear in bold

4.2.4 Exploratory factor analysis – summary. From EFA of items measuring mood at pre and post-intervention, a two-factor solution emerged. Positive affect comprises the emotional states of happy, relaxed and energetic. Negative affect comprises the emotional states of angry, worried and sad. With consideration of these results, subsequent analyses will treat pre and post-intervention mood measures as two separate variables (positive affect and negative affect). Additionally, items measured at pre and post-intervention, including frequency of exercise, attitude to being outdoors and enjoyment of intervention setting, were subjected to EFA in order to assess commonality and support dimension reduction in subsequent analyses. Two factors emerged, comprising four covariates. Situational factors comprises variables measured post-intervention; enjoyment of intervention setting and aesthetic pleasure taken from intervention setting. Attitudinal factors comprises variables measured pre-intervention; attitude to walking and attitude to being outdoors. The role of these factors in predicting response to intervention is explored in subsequent analyses.

4.3 Preliminary Analyses

4.3.1 Between-subjects analysis. In order to establish concordance in between-subjects mood scores prior to intervention, an independent-samples t-test was carried out comparing the pre-intervention mood scores (positive affect and negative affect) of those participating in the exercise-only condition and those participating in the exercise+connectedness condition. As shown in Table 19, no significant differences in mood were evident across the two groups. Additionally, an independent-samples t-test was conducted to assess score differences on pre-

intervention covariates for those in each experimental condition (exercise-only; exercise+connectedness). There was no significant statistical differences in attitudinal factors between the exercise-only group (M = 5.04, SD = .95) and the exercise+connectedness group (M = 4.95, SD = .99); t (625) = .75, p = .45. These results indicate that there were no statistical differences on measured variables between these groups, prior to engaging with the intervention.

Table 19

T-test Results Comparing Pre-Intervention Mood Variables between Exercise-only and Exercise+Connectedness Groups

Mood Variable	Exercise-Only Mean (SD)	Exercise+Connectedness Mean (SD)	t-test	P
Positive Affect	10.75 (2.97)	10.75 (3.11)	.01	.99
Negative Affect	14.05 (1.74)	14.16 (1.52)	-.84	.40

4.3.2 Within-subjects analysis. A paired-samples t-test was carried out to assess attitudinal factors recorded by participants pre intervention in the green and urban environment. There was no statistically significant difference in attitude to walking and attitude to outdoors reported prior to participation in the green environment (M=5.05, SD=.95) and prior to participation in the urban environment (M=5.01, SD=.99), t (279) = .64, p <.52 (two-tailed). This indicates that reported attitudes to walking and attitudes to the outdoors remained constant prior to participation in each environmental condition.

A paired-samples t-test was conducted to evaluate the impact of the intervention in each environmental setting on participants' mood. Examining effects of the intervention in the green environment, there was no statistically significant change in pre to post-intervention scores of negative affect. Changes to pre to post-intervention positive affect scores were approaching statistical significance (p = .051), in the direction of increased positive affect post-intervention in the green environment. No statistically significant changes to positive or negative affect occurred following intervention in the urban environment. These results are presented in Table 20.

Table 20

T-test Results Showing Changes to Affect Post-Intervention in Green and Urban Environments

Type of Affect	Pre-Intervention Green	Post-Intervention Green	t-test	*P*	Pre-Intervention Urban	Post-Intervention Urban	t-test	*p*
	M (SD)	M (SD)			M (SD)	M (SD)		
Positive Affect	10.89 (2.91)	10.50 (3.39)	1.96	.051	10.55 (3.13)	10.53 (3.56)	.15	.88
Negative Affect	14.12 (1.54)	13.92 (2.07)	1.71	.09	14.07 (1.71)	14.02 (1.79)	.48	.64

4.3.3 Between-within subjects analysis. In order to ascertain the potential impact of the order in which participants visited each environmental setting on the aforementioned situational factors, a mixed between-within subjects analysis of variance (ANOVA) was conducted. The ANOVA assessed whether visiting a green environment first, or an urban environment first, affected the rate of enjoyment and aesthetic pleasure taken from the setting. There was no significant interaction between order and situational factors, Wilk's Lambda = .99, F (1, 276) = 2.42, p = .12, partial eta squared = .01. As indicated by t-tests reported above, there was a main effect for environment on situational factors, Wilk's Lambda = .84, F (1, 276) = 52.58, p <.001. Partial eta squared = .16, indicating a large effect size (Cohen, 1988), with higher scores on situational factors following the green condition, for both groups (See Table 21). The main effect comparing the order of environmental settings was not significant, F (1, 276) = 3.10, p = .08, partial eta squared = .01. This suggests that order effects did not impact on participants' enjoyment or aesthetic pleasure taken from the setting.

Table 21

Situational Factors Scores for Green First and Urban First Groups

Environmental Setting	**Green First**	**Urban First**
	M (SD)	M (SD)
Green Environment	5.35 (1.43)	5.77 (1.33)
Urban Environment	4.79 (1.58)	4.90 (1.39)

4.3.4 Preliminary analyses – summary. Inferential statistics show no significant difference on baseline scores of mood or attitudinal factors between

participants in the exercise-only and exercise+connectedness environmental conditions. Further inferential tests outline that participants reported attitude to walking and attitude to being outdoors were not significantly different prior to engagement in the green and urban environmental settings. Assessing change to participants' mood scores post-intervention, no significant change to positive or negative affect post-intervention in either environment was identified. Change to positive affect post-intervention in a green environmental setting was approaching significance. Within-subjects analysis of reported enjoyment of setting and aesthetic pleasure taken from setting shows significant difference following engagement with a green environmental setting; higher scores were attributed to the green environment. Controlling for order effects, with regard to which the order in which each participant visited each environmental setting, this difference remained constant.

4.4 Multilevel Model

Real-world research must recognise that individuals interact with the social contexts to which they belong and that these contexts and their characteristics have an influence on those individuals, resulting in individuals whom share a common environment being more similar to each other than they are to individuals from a different environment (Kahn, 2011; Maas & Hox, 2009). Conceptualising individuals and the contexts to which they belong as a hierarchical system, resulting in nested data structures, a statistical approach which accounts for this data structure is required (Kahn, 2011; Maas & Hox, 2005; Peugh, 2010). Nested data structures violate the independence assumption required by other statistical analyses, such as ANOVA and ordinary least-squares multiple regression (Kahn, 2011; Peugh, 2010). Additionally, these individual-level analyses do not adequately account for the role of group-level factors in a hierarchical system (Kahn, 2011). Multilevel model analyses eliminate these limitations, allowing for the role of group-level factors to be captured and recognising the non-independent nature of observations (Kahn, 2011; Raudenbush & Bryk, 1986). In the context of the current research study, multilevel modelling allows for the simultaneous consideration of multiple levels of effects, specifically individual and class level effects (Pike & Ricconi, 2012).

4.4.1 Assessing for multicollinearity. Predictors were assessed for multicollinearity for each of the criterion variables using tolerance statistics and the variance inflation factor (VIF). A VIF above 5 (Menard, 1995) or tolerance statistic below .20 (Field, 2017) indicates a problem with multicollinearity. The present study data indicated VIF's ranging from 1.04 to 1.79 and tolerance statistics in the range .56 to .96.

4.4.2 Grand mean centring. In order to establish a meaningful point of intercept and to control for multicollinearity, predictor variables were grand mean centred. Centring predictors in a multilevel model leads to a more stable model being built (Field, 2018). Additionally, centring provides more intuitively meaningful values for intercepts of variables with no obvious zero-points.

4.4.3 Building the model. Having met the assumption of multicollinearity and performed grand mean centring on predictor variables, multilevel modelling was conducted in order to explore the following research questions:

1. What is the effect of exercise in a natural, green environment on the mood state of primary school-aged children?
2. What is the effect of exercise in a natural, green environment on the attentional capacity of primary school-aged children?
3. What is the interaction, if any, between a nature connectedness activity and green exercise, on the mood state of primary school-aged children?
4. What is the interaction, if any, between a nature connectedness activity and green exercise, on the attentional capacity of primary school-aged children?

Multilevel modelling was utilised to explore impact of intervention on participants' positive affect and negative affect, respectively. Further, multilevel modelling was used to examine the effects of intervention on levels of attention.

4.4.4 Positive affect – a multilevel model. Model building began with analysis of the variance accounted for by pre-intervention levels of positive affect. Following this, fixed effects of within and between subject variables, environment and exercise-only or exercise+connectedness, and the potential interaction between these covariates were investigated. Following the introduction of these variables to the model, random effects at the class group level were explored. Subsequently, the variance accounted for by attitudinal factors, situational factors and participant

demographics was incorporated into the multilevel model. Random effects at the individual level were explored. Finally, the predictive role of reported frequency of exercise, participant's perceptions of the intervention activity and report on 'day so far' was explored. Levels of variance explained by the final model are detailed. Steps of model-building are outlined in Table 22.

Fit diagnostics indicate that Model 9 is the best-fitting model, according to -2 log likelihood (-2LL) and Akaike's Information Criteria (AIC); *-2LL* = 2808.3, *AIC* = 2834.3.

Table 22

Hierarchical Structure of Model of Post-Intervention Positive Affect

Model Number	**Parameters**
Model 1	Intercept + Pre-Intervention Positive Affect
Model 2	Model 1 + Environment
Model 3	Model 2 + Condition + Condition*Environment
Model 4	Model 3 + Random Effects of Condition by Class
Model 5	Model 3 + Random Effects of Environment by Participant
Model 6	Model 5 + Attitudinal Factors
Model 7	Model 6 + Situational Factors
Model 8	Model 7 + Age + Gender
Model 9	Model 7 + Frequency of Exercise + Day So Far + Perception of Activity

Note. Model 5 is based on Model 3 due to non-significant random effects of parameters introduced to Model 4.

In the final model, levels of positive affect pre-intervention significantly predicted post-intervention levels of positive affect, $F(1, 588) = 84.44$, $p<.001$. The environmental setting and intervention condition variables were coded numerically. With regard to environmental setting, the green environment was coded as '1' and the urban environment was coded as '2'. Similarly, for intervention condition, exercise-only was coded as '1' and exercise+connectedness was coded as '2'. Environmental setting significantly predicted post-intervention levels of positive affect $F(1, 315) = 7.67$, $p=.006$. The direction of this effect was positive, indicating that the urban environment had greater positive impact on positive affect than did the green environment. However, intervention condition, that is exercise-only or exercise+connectedness activity did not significantly predict post-intervention positive affect $F(1, 299) = 2.50$, $p=.115$. Equally, no significant interaction effect between environment and condition was evident $F(1, 305) = 2.01$, $p=.157$.

Participants' enjoyment of the environmental setting and aesthetic pleasure taken from the environmental setting significantly predicted levels of positive affect post-intervention, $F(1, 590) = 172.31$, $p<.001$. The effect direction was positive, indicating that higher levels of these situational factors predicted higher levels of positive affect post-intervention. In contrast, attitudinal factors, comprising participant's attitudes towards exercise and attitude towards being outside did not significantly predict post-intervention levels of positive affect. Participants' age was not a predictor in determining post-intervention levels of positive affect, however gender did significantly predict positive affect levels post intervention; $F(1,321) = 4.77$, $p = .030$. As males were coded as '1' and females as '2' within the gender variable, the positive direction of this effect indicates that females were higher in positive affect post-intervention. Frequency of exercise and report of how a participant's day was going 'so far', introduced to the final model, were significant predictors of post-intervention positive affect. Reports of greater participation in exercise on a weekly basis predicted higher levels of positive affect; $F(1,450) = 11.98$, $p = .001$. More positive reports of 'day so far' also predicted higher levels of positive affect at post-intervention; $F(1,581) = 4.83$, $p = .028$.

With regard to random effects at level two (class level), the relationship between class group and effects of participating in the exercise-only or exercise+connectedness group (condition) did not show significant variance in intercepts across classes, Var (μ_{0j}) = 2.48, $p = .140$. In addition, the slopes did not vary significantly across class group, Var (μ_{1j}) = .58, $p = .307$. Slopes and intercepts negatively covaried, though not significantly, Cov ($\mu_{0j,}$ μ_{1j}) = -.94, $p = .303$. Random effects of class group on experimental condition (exercise-only or exercise+connectedness) were introduced at model 4. As no significant random effects were found, the parameter was removed from later models.

Exploration of random effects at level one (individual-level) found that the relationship between post-intervention positive affect and environmental setting showed significant variance in intercepts across participants, Var (μ_{0j}) = 8.16, $p < .001$. In addition, the slopes and intercepts negatively and significantly covaried, Cov ($\mu_{0j,}$ μ_{1j}) = -3.26, $p < .001$. A test statistic for variance of slopes could not be meaningfully computed which may indicate minimal variation in slope. The negative

direction for covariance shows that as individual's pre-intervention positive affect score is higher, there is less of an effect shown post-intervention.

Fixed effects and random effects estimates for models of predictors of post-intervention positive affect are shown in Table 24.

4.4.5 Negative affect – a multilevel model. The first step in building the model was to analyse the variance accounted for by pre-intervention levels of negative affect. As in the multilevel model for positive affect, fixed effects of within and between subject variables, environment and exercise-only or exercise+connectedness, and the potential interaction between these covariates were explored. Following the introduction of these variables to the model, random effects of condition at the class group-level were investigated. Subsequently, the variance accounted for by attitudinal factors, situational factors and participant demographics was incorporated into the multilevel model. Random effects of environment at the individual level were assessed. Finally, investigation took place of the impact of reported frequency of exercise, participant's perceptions of the intervention activity and report on 'day so far' on post-intervention negative affect levels. Levels of variance explained by the final model are detailed. Steps towards building the final model are outlined in Table 23.

Fit diagnostics indicate that Model 8 is the best-fitting model, according to -2 log likelihood (-2LL) and Akaike's Information Criteria (AIC); -2LL = 2267.97, AIC = 2293.97.

Table 23

Hierarchical Structure of Model of Post-Intervention Negative Affect

Model Number	Parameters
Model 1	Intercept + Pre-Intervention Negative Affect
Model 2	Model 1 + Environment
Model 3	Model 2 + Condition + Condition*Environment
Model 4	Model 3 + Random Effects of Condition by Class
Model 5	Model 3 + Random Effects of Environment by Participant
Model 6	Model 5 + Attitudinal Factors
Model 7	Model 6 + Situational Factors
Model 8	Model 7 + Age + Gender
Model 9	Model 7 + Frequency of Exercise + Day So Far + Perception of Activity

Note. Model 5 is based on Model 3 due to non-significant random effects of parameters introduced to Model 4.

Levels of negative affect pre-intervention significantly predicted post-intervention levels of negative affect, $F(1, 497) = 89.33$, $p<.001$. Higher levels of pre-intervention negative affect were associated with higher levels of post-intervention negative affect. As stated above, the environmental setting and intervention condition variables were coded numerically. With regard to environmental setting, the green environment was coded as '1' and the urban environment was coded as '2'. Similarly, for intervention condition, exercise-only was coded as '1' and exercise+connectedness was coded as '2'. Neither environmental setting or condition (exercise-only or exercise+connectedness) significantly predict levels of post-intervention negative affect; $F(1, 297) = .58$, $p=.447$ and $F(1, 293) = .03$, $p=.875$ respectively. Further, no significant interaction effect between environment and condition was evident, $F(1, 286) = .04$, $p=.833$.

Participants' enjoyment of the environmental setting and aesthetic pleasure taken from the environmental setting significantly predicted levels of negative affect post-intervention, $F(1, 548) = 52.80$, $p<.001$. The effect direction was negative, indicating that higher levels of these situational factors predicted lower levels of negative affect post-intervention. In contrast, attitudinal factors, comprising participant's attitudes towards exercise and attitude towards being outside did not significantly predict post-intervention levels of negative affect, $F(1, 485) = .60$, $p = .440$. A participant's age was not a significant predictor in determining post-intervention levels of negative affect. F score for age was $F(1, 296) = 2.25$, $p = .120$. However, gender played a significant role in predicting levels of negative affect experienced post-intervention, $F(1, 292) = 3.97$, $p = .047$. As stated, the gender variable was coded numerically (1=Male; 2=Female), thus the negative direction of the effect indicates that lower levels of negative affect were reported by females post-intervention. In contrast to positive affect, exercise frequency and reports of 'day so far' did not significantly predict post-intervention negative affect levels.

With regard to random effects at level two (class level), the relationship between class group and effects of participating in the exercise-only or exercise+connectedness group (condition) did not show significant variance in intercepts across classes, Var (μ_{0j}) = .23, p =.294. Slopes and intercepts negatively covaried, though not significantly, Cov ($\mu_{0j,}$ μ_{1j}) = -.02, p = .714. A slope statistic could not be meaningfully computed. Random effects of class group on experimental

condition (exercise-only or exercise+connectedness) were introduced at model 4. As no significant random effects on negative affect were found, the parameter was removed from later models.

At level one (individual level), exploration of random effects found that the relationship between post-intervention negative affect and environmental setting showed significant variance in intercepts across participants, Var (μ_{0j}) = 4.40, $p <$ .001. In addition, the slopes and intercepts negatively and significantly covaried, Cov (μ_{0j}, μ_{1j}) = -1.64, $p < .001$. As in the positive affect multilevel model, a test statistic for variance of slopes could not be computed, suggesting minimal variation in slope. The negative direction for covariance shows that as individuals pre-intervention negative affect score increases, there is less of an effect shown post-intervention.

Fixed effects and random effects estimates for models of predictors of post-intervention negative affect are shown in Table 25.

Table 24

Fixed Effects and Random Effects Estimates for Models of the Predictors of Positive Affect Post-Intervention

Parameter	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
Intercept	10.53 (<.001)	10.18 (<.001)	8.52 (<.001)	8.82 (<.001)	8.60 (<.001)	8.86 (<.001)	7.99 (<.001)	5.99 (<.001)	6.15 (<.001)
Fixed effects									
Pre-intervention positive affect	.57* (.04)	.57* (.04)	.57* (.04)	.55* (.04)	.52* (.04)	.49* (.04)	.41* (.04)	.43* (.04)	.38* (.04)
Environment		.23 (.24)	1.01 (.75)	.87 (.71)	.96 (.63)	.71 (.64)	1.45* (.57)	1.44* (.57)	1.57* (.57)
Condition			1.13 (.77)	.89 (.75)	1.07 (.69)	.91 (.7)	.87 (.62)	.91 (.62)	.98 (.62)
Environment*Condition			-.53 (.49)	-.43(.46)	-.50 (.41)	-.33 (.41)	-.42 (.37)	-.42 (.37)	-.52 (.37)
Attitudinal factors						.56* (.13)	.18 (.12)	.17 (.12)	.06 (.12)
Situational factors							1.02* (.08)	1.02* (.08)	1.00* (.08)
Age								.12 (.1)	.10 (.09)
Gender								.52* (.24)	.52* (.24)
Exercise frequency									.42* (.12)
Perception of activity									-.08 (.06)
Day so far									-.45* (.20)
Random Effects									
Variance of intercept for Condition by Class (Level 2)				2.48 (1.68)					
Variance of slope for Condition by Class (Level 2)				.58 (.57)					
Covariance of slopes and intercepts for Condition by Class (Level 2)				-.94 (.91)					
Variance of intercept for Environment by Student (Level 1)					10.80** (1.62)	9.88** (1.58)	8.51** (1.25)	8.01** (1.23)	8.16** (1.21)
Covariance of slopes and intercepts for Environment by Student (Level 1)					-4.06** (.50)	-3.85** (.49)	-3.37** (.38)	-3.21** (.38)	-3.26** (.37)
-2*Log-likelihood	3092.37	3091.49	3088.43	3045.97***	3056.6***	2992.93***	2830.92***	2825.12	2802.30***
AIC	3098.37	3099.49	3100.43	3063.97	3074.6	3012.93	2852.92	2851.12	2834.30

Note. Model parameter estimates are unstandardised beta coefficients. Standard errors are in parentheses. *p<.05; ** p<.001; ***Significant improvement to model, measured against critical value for chi-square statistic (p <.01). Model parameters reported in-text are based on the best-fitting model according to -2LL and AIC (Model 9)

Table 25

Fixed Effects and Random Effects Estimates for Models of the Predictors of Negative Affect Post-Intervention

Parameter	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
Intercept	4.03 (<.001)	4.22 (<.001)	4.44 (<.001)	4.28 (<.001)	4.39 (<.001)	5.40 (<.001)	6.71 (<.001)	8.16 (<.001)	8.02 (<.001)
Fixed effects									
Pre-intervention negative affect	.51*(.04)	.51* (.04)	.51* (.04)	.49* (.04)	.42* (.04)	.39* (.04)	.39* (.04)	.39* (.04)	.39* (.05)
Environment		.13 (.14)	-.15 (.44)	-.07 (.42)	-.13 (.38)	-.02 (.38)	-.28 (.38)	-.27 (.36)	-.29 (.36)
Condition			-.15 (.45)	-.05 (.43)	-.14 (.42)	-.05 (.43)	-.04 (.41)	-.06 (.41)	-.07 (.41)
Environment*Condition			.01 (.28)	-.04 (.27)	.01 (.24)	-.07 (.24)	-.04 (.23)	-.05 (.23)	-.03 (.23)
Attitudinal factors						-.23* (.08)	-.07 (.08)	-.06 (.08)	-.04 (.08)
Situational factors							-.35* (.05)	-.35* (.05)	-.35* (.05)
Age								-.1 (.06)	-.09 (.06)
Gender								-.32* (.16)	-.33* (.16)
Exercise frequency									-.09 (.08)
Perception of activity									.02 (.13)
Day so far									.03 (.13)
Random Effects									
Variance of intercept for Condition by Class (Level 2)				.23 (.22)					
Covariance of slopes and intercepts for Condition by Class (Level 2)				-.02 (.07)					
Variance of intercept for Environment by Student (Level 1)					4.56** (.56)	4.75** (.57)	4.57** (.53)	4.40**(.53)	4.39** (.54)
Covariance of slopes and intercepts for Environment by Student (Level 1)					-1.77** (.17)	-1.82** (.17)	-1.70** (.16)	-1.64** (.16)	-1.63** (.16)
-2*Log-likelihood	2401.54	2400.71	2399.84	2380.70***	2364.88***	2327.48***	2274.09***	2267.97	2263.52
AIC	2407.54	2408.71	2411.84	2398.70	2382.88	2347.48	2296.09	2293.97	2295.52

Note. Model parameter estimates are unstandardised beta coefficients. Standard errors are in parentheses. *p<.05; ** p<.001; ***Significant improvement to model, measured against critical value for chi-square statistic (p <.01). Model parameters reported in-text are based on the best-fitting model according to -2LL and AIC (Model 8)

4.4.6 Attention – a multilevel model. In order to create a multilevel model of predictors of post-intervention attention levels, the variance accounted for by pre-intervention attention levels, environment, intervention condition (Exercise-only or exercise+connectedness), gender and age was explored. Levels of variance explained by the final model are shown.

Level of pre-intervention attention was the only significant predictor of post-intervention attention scores, $F(1, 134) = 178.65$, $p<.001$. Environmental setting, intervention condition, participant gender or class group were not significant predictors of post-intervention attention scores. These results are shown in Table 26.

Table 26

Fixed Effects Estimates for Models of the Predictors of Post-Intervention Attention

Parameter	Model 1	Model 2	Model 3	Model 4
Intercept	9.43 (<.001)	8.98 (<.001)	2.22 (<.01)	1.97 (<.01)
Level 1 (Subject)				
Environment	.26 (.52)	.26 (.52)	.02 (.32)	.01 (.32)
Condition		.29 (.52)	.37 (.32)	.33 (.32)
Pre-Intervention Attention Score			.73* (.05)	.72*(.05)
Gender				.31 (.33)

Note. Standard errors are in parentheses.
*p <. 05

Analysis of random effects did not significantly affect the model. Random effects were redundant which may indicate result from a lack of statistical power due to the small sample size (Maas & Hox, 2004).

4.4.7 Multilevel models – summary. Multilevel modelling indicates that the largest predictor of post-intervention positive affect, post-intervention negative affect and post-intervention attention scores are pre-intervention levels of each. Environmental setting was a significant predictor of post-intervention levels of positive affect, but did not significantly predict negative affect at post-intervention or attention levels post-intervention. With regard to the significant role of environment on levels of positive affect, fixed effects estimate indicates that the urban environment had greater impact. Participants' post-intervention mood was not predicted by whether they participated in an exercise only or exercise+connectedness intervention condition. Attitudinal factors (attitudes to walking and being outdoors) were not a significant predictor of either positive or negative affect levels post-intervention. However, situational factors (enjoyment of setting and aesthetic

pleasure taken from setting) significantly predicted positive and negative affect post-intervention. Higher scores on situational factors were related to higher levels of positive affect and lower levels of negative affect post-intervention. Examining random effects, significant variance in intercepts was evident at level one (participants), across environments, there was no significant variance in intercepts across condition at level two (class group). This trend was consistent in multilevel models of post-intervention positive affect and post-intervention negative affect. Lastly, though gender was not a significant predictor of attention levels, there was a significant variance in post-intervention negative affect and positive affect, accounted for by this variable. The direction of this effect indicates that females present with lower levels of negative affect and higher levels of positive affect post-intervention.

4.8 Conclusion

This chapter outlines statistical analyses of data gathered in this research study. Exploratory factor analysis of the utilised mood measure points to the presence of two dimensions, positive affect and negative affect. Preliminary statistics suggest no significant change to mood following intervention in a green or urban environment. Multilevel models of post-intervention attention levels indicates that only pre-intervention attention levels significantly predicted post-intervention scores. Multilevel models of positive and negative affect post-intervention point to the role of the environment, gender and situational factors in predicting response to intervention. These statistical results will be explored in Chapter Five, in the context of existing research and the theoretical framework.

Chapter Five: Discussion

The discussion chapter outlines the aims and research questions which formed the basis for this study. The key findings of the study are explored and considered in relation to previous relevant literature. Methodological considerations are discussed, examining both the strengths and weaknesses of the methods of data collection and analysis, and the study design. Furthermore, potential implications are acknowledged in relation to promoting well-being in educational settings. Future directions are described with regards to the methodological limitations of the present study, and how these may be addressed in subsequent research.

5.1 Summary of Thesis Findings

5.1.2 Aim. The aim of this research study was to explore the impact of green exercise and a nature connectedness activity on the mood state and attention levels of primary school-aged children. With consideration of this aim, the study set out to investigate the following research questions:

1. What is the effect of exercise in a natural, green environment on the mood state of primary school-aged children?
2. What is the effect of exercise in a natural, green environment on the attentional capacity of primary school-aged children?
3. What is the interaction, if any, between a nature connectedness activity and green exercise, on the mood state of primary school-aged children?
4. What is the interaction, if any, between a nature connectedness activity and green exercise, on the attentional capacity of primary school-aged children?

Though a dearth of child-focused research on the impact of green exercise and nature connectedness currently exists, a range of adult-population studies have pointed to the potential of such interventions in improving emotional well-being and attention. The fundamental hypothesised outcomes of this study included greater positive effects emerging from participants' interaction with green environmental settings (as compared with urban environmental settings) and greater positive effects resulting from engagement with a nature connectedness activity (as compared with engaging in exercise only). Additionally, an exploration of the impact on response to intervention of participants' reported attitude to exercise, attitude to being outdoors, enjoyment of environmental settings, aesthetic pleasure taken from settings, gender

and age was undertaken. Utilising the statistical analysis approach of multilevel modelling permitted recognition of the hierarchical nature of the research sample and the nested data structure which is generated from such a sample.

5.1.3 Key findings.

Environmental setting. Examination of mean scores on mood measures, administered pre and post-intervention, indicates marginal increases to relaxed feeling and marginal decreases to feelings of being worried, following engagement in intervention in both the green condition and the urban condition. Additionally, environment was a significant predictor of post-intervention levels of positive affect, though not of post-intervention negative affect. The impact of environment, as indicated by multilevel modelling, was contrary to the hypothesised greater benefits associated with the green environment. Results showed that the urban environment was more strongly associated with improved positive affect post-intervention. This finding is somewhat similar to that of Pretty et al. (2005) who found that both rural pleasant and urban pleasant scenes had a positive impact on self-esteem and aspects of mood. In the study by Pretty et al. (2005), it was perceived threats to either environment which diminished the positive effects of exercise on mood and self-esteem. However, studies which did not expose participants to real environments, rather utilising virtual representations of green and non-green environments did find significant positive effects on positive affect post-intervention in a green condition (Kant & Sharma, 2016; Passmore & Holder, 2017).

Reviewing these findings in the context of ART's concept of 'escape', of an environment facilitating a sense of being away from what is causing mental fatigue in order to be restorative, conclusions drawn are equivocal (Kaplan & Kaplan, 1989). The environmental settings attended in this study may be considered to more closely meet the 'escape' requirement of Kaplan and Kaplan's (1989) theory than virtual environments utilised in other investigations, due to their actual rather than virtual existence and their proximity close to but away from the school environment (Kant & Sharma, 2016; Passmore & Holder, 2017). As outlined in the systematic review, a comparison of effects between real and virtual environmental settings found that actual green environments have more restorative value (Mayer et al., 2009). Though a potential explanation for improvements to mood post-intervention in an urban environment may be found in the 'escape' which is associated with any place outside

the school environment, this does not account for the greater effect of urban over the green environment in promoting positive affect. However, some insight may be found in research which examines the impact of an urban or rural upbringing on stress processing and environmental identity (Lederbogen et al., 2011; Prevot, Clayton & Mathevet, 2018; Yan et al., 2015). As three of four of the participating school were in inner-city locations, an assumption may be made of an urban upbringing for a majority of students. Exploring environmental identity, or nature connectedness, Prevot et al. (2018) found that participants who had a rural upbringing had a significantly higher environmental identity than those who had an urban upbringing. Considering these findings, along with those which highlight children's limited direct experience of the natural world, a stronger association between an urban environment and positive affect may be understood (Charles & Louv; Prevot et al., 2018).

In contrast to the current study, research exploring the impact of environmental education programmes/wilderness expeditions has identified a number of associated benefits, including increased levels of self-efficacy, increased levels of nature connectedness, reduced perceived stress, increased positive emotions and decreased negative emotions (Lieflander et al., 2013; Rose et al., 2018; Warber et al., 2015). However, it is worthy of note that these studies did not engage a control group which had comparable exposure to a non-natural, man-made environment. Thus, the question of whether similar outcomes would have resulted from a control group engaging with a non-green environment, as in the current study, must be posed.

In identifying no significant increase to self-esteem following exercise in a green environment, compared to an urban environment, Reed et al. (2013) suggest that the lack of impact may be explained by the presence of teachers giving instruction during intervention. The researchers suggest that this presence may have reduced the perception of green exercise as a restorative experience and increased the likelihood of it being perceived as a school activity. Considering the proffered explanation in the context of the current study, it is recognised that there were teacher(s) present during intervention, that negative interactions between participant and teacher did occur at times, and that teacher's individual approaches may have impacted on outcomes (Coldren & Hively, 2010; Walker, 2009). Additionally, for three of the participating schools, the green environment was an urban park which held a

playground. Several participants queried whether utilising the playground was permitted and expressed disappointment when advised that the time in the park would be spent either walking or walking while completing a connectedness activity. It may be considered that visiting the green environment was perceived by participants as an opportunity for free-play and the disappointment of engaging with a more structured, adult-led activity impacted on potential benefits to children's mood. Further, the value brought by children's attendance at forest school has been attributed to the flexible, child-initiated nature of learning in the natural environment, adding to the idea that the structured activity in which children participated in this study may have diminished the restorative impact of children's attendance in this environment (Murray & O'Brien, 2005).

Findings also indicate that the environmental setting did not significantly predict attention levels following intervention. This is in contrast to findings by Mayer et al. (2009) who identified a significant positive effect on attentional capacity subsequent to exposure to natural, green environments. Further, this effect was more pronounced when participants were exposed to an actual rather than virtual green environment (Mayer et al., 2009). The memory-loaded search task, utilised by Mayer et al. (2009) to assess attention levels, may have acted as a more effective attention measure. This will be explored further when reviewing the methodological strengths and limitations of the current study.

Nature connectedness. Engagement with either the exercise-only or exercise+connectedness condition was not a significant predictor of post-intervention outcomes, for either positive or negative affect. However, though not significant, the multilevel model indicates that the connectedness activity contributed to greater positive affect and reduced negative affect post-intervention, compared with exercise-only. This finding is in line with results from Richardson and Sheffield's (2017) study which found that noticing three good things in nature each day for five days increased levels of nature connectedness and happiness and increased ability to maintain attention. It may be hypothesised that a more sustained connectedness activity, such as that implemented by Richardson and Sheffield (2017), may contribute to higher impact on well-being attributes. Whereas the aforementioned research was conducted on an adult population, following research on a child population, Duncan et al. (2014) surmised that a generational difference in

nature connectedness may account for a disparity in findings between their own and research undertaken with adults. However, it must also be considered that Duncan et al.'s (2014) findings were based on participants' exposure to virtual rather than authentic environmental conditions and on a small sample of 14 participants. Additionally, recognising the relatively narrow age-range (8-13 years), age did not account for a significant amount of variance in post-intervention affect levels in the current study.

With regard to attention, as with environmental setting, exercise-only versus exercise+connectedness was not a significant predictor of increased attention levels post-intervention. However, as in the case of affect, attention levels were positively associated with engagement in the connectedness activity while exercising. Positioning this finding in the theoretical framework attached to green exercise and nature connection research, it is considered that directed attention was of benefit to participants' attention levels post-intervention rather than the involuntary attention, which is proposed by ART to be restorative (Ulrich, 1983).

Attitudinal factors. Though more positive attitudes to being outdoors and attitudes to walking were associated with greater well-being (higher levels of positive affect and lower levels of negative affect), this was not a significant predictor of post-intervention outcomes. This finding may support Reed et al.'s (2013) conclusion that exercising in a green environment has appeal to a wider range of children, rather than only those who are more active. The researchers suggest that green exercise is enjoyable to children regardless of their habits of engagement with physical activity (Reed et al., 2013).

Situational factors. In contrast to attitudinal factors, situational factors did significantly influence post-intervention affect. Participants' enjoyment of the environmental setting and the aesthetic pleasure they experienced in the setting predicted levels of positive and negative affect. Inferential tests outline that higher levels of overall scores on situational factors followed intervention in the green environment. It was hypothesised that the green environmental setting would be more impactful on participants' well-being overall, however, multilevel modelling indicates that perceptions of the environmental setting, degree of enjoyment taken from each setting and the extent to which each setting was found to be aesthetically

pleasing, were not uniform across participants. Further, these factors played a significant role in positive and negative affect outcomes post-intervention. A potential explanation to this may be found in personality theories, looking to individual differences in openness to experience (Lu et al., 2016; Costa & McCrae, 1978). Where an assumption may be made that a natural, green environment may be more pleasing to each person, the findings of this study indicate that individual differences may mediate this response. Further, significant random effects at the participant level (Level one) suggest that participants differ in their well-being on the basis of environment, as well as on the situational factors of enjoyment of setting and aesthetic pleasure taken from setting.

Gender. Research studies explored through systematic review comprised an overall higher number of female participants than male. In contrast, the present study had more participants who identified as male (66%) than as female. In a similar way to outcomes of research by Barton et al. (2016), engagement in intervention brought increased benefits to those participants who identified as female. Positive and negative affect post-intervention were significantly predicted by gender; self-categorised females reported higher levels of positive affect and lower levels of negative affect than those who categorised themselves as male. Barton et al. (2016) found that a wilderness expedition had a more significant impact on female participants' self-esteem. Research states that an individual's openness to aesthetic experience can dictate their response to a restorative experience (Lu et al, 2016; Roe & Aspinall, 2011). Personality research has found differences in the trait of openness according to gender (Costa, Terracciano & McCrae, 2001; Weisberg, DeYoung & Hirsh, 2011). Though gender differences are not apparent at the 'big 5' level of personality theory (openness to experience, conscientiousness, extroversion, agreeableness, neuroticism), researchers have developed the aspect level of this trait to include two dimensions, openness to ideas and openness to feelings. At this aspect level, gender differences have been identified (Costa et al., 2001; Weisberg et al., 2011). Examining cross-cultural personality data, Costa et al. (2001) found that females presented with a higher level of openness to feelings than males. Recognising that gender differences emerged in the traits of neuroticism, agreeableness and extroversion at the 'big 5' level, Weisberg et al. (2011) also report gender differences on all five personality traits at the aspect level. Mirroring Costa et

al.'s (2001) findings, the researchers found that females scored higher on the aspect of openness to feeling, whereas males scored higher on openness to ideas (Weisberg et al., 2011). Though the current study did not measure openness, there was no interaction effect found between gender and those variables which most closely relate to openness (enjoyment of setting and aesthetic pleasure taken from setting). Equally, studies investigating the role of personality in mediating stress response have not highlighted a gender-related effect. However, given previous personality research into gender differences at the aspect level and the current study's findings which suggest that gender did play a role in response to environment, further examination of the relationship between the trait of openness and the impact of intervention in different environmental settings on mood may be warranted.

As studies undertaken with a predominantly female population highlight the limits this places on generalisability, so the current study's generalisability would have been improved by a greater gender balance among the population sample (Passmore & Holder, 2017). No difference in attention levels was predicted by gender.

5.2 Methodological Considerations

In order to provide context to the findings discussed above, it is pertinent to consider the strengths and weaknesses of methods and measures which were utilised in this study.

5.2.1 Research design. A number of studies investigating the effects of green exercise and nature connection on well-being and/or attention have not included a control group measure (Barton et al., 2014; Hignett et al., 2017; McCree et al., 2018; Warber et al., 2015). The absence of a control group reduces the generalisability of findings, diminishing a study's power to isolate factors which have influenced outcomes (Kendall, 2003). In contrast, outcome differences produced by two groups randomly assigned to treatment or control suggests that post-intervention difference are likely due to the experimental conditions, rather than to differences between the groups which existed before engaging with the research (Shadish, Cook & Campbell, 2002). In the present study, an urban exercise-only and an urban exercise+connectedness condition allowed for a more in-depth exploration of the processes which produce positive or negative effects on well-being and attention. This is evident in the slightly increased means on certain mood aspects,

post-intervention in both green and urban environments, suggesting that the power of influence may be explained by a phenomenon other than exposure to a green environment.

A strength of the current study lies in the sample size (350 participants). This is a larger sample than those of reviewed studies, particularly as compared to those with child participants (Dowdell et al., 2014; Duncan et al., 2014; McCree et al., 2018; Han, 2014; Warber et al., 2015). Though only 70 participants partook in the measure of attention pre and post-intervention, the digit span task is considered to be a well-validated tool which lends to its generalisability in this context. Too small a sample can prevent study findings from being extrapolated (Faber & Fonseca, 2014). A large sample size lends generalisability to this study, though this is somewhat restricted by the aforementioned gender imbalance of the population sample. Due to the requirements for schools to have appropriate environments in close proximity and the challenge of sourcing schools willing to participate, it was not possible to also select participants on the basis of providing gender balance to the study.

As outlined in the methodology, there are advantages and disadvantages inherent in conducting research in the setting of the real-world (Maxwell, 2012; Reichardt, 2009). As stated by research, the teacher presence during intervention may negatively impact on the restorative impact of particular environments (Reed et al., 2013). The presence of teachers was necessary to conduct this research. The health and safety of participants was of primary ethical concern, consequently teacher's willingness to attend and support the experiment was highly valued. Nonetheless, a teacher's differing level of control over students, the preferred level of discipline they create in the school context and the teacher's interpersonal behaviour with students are important aspects of the school environment (Van Petegem, Creemers, Rossel & Aelterman, 2005). Further, it is suggested that a teacher's stress level is likely to influence the quality of teacher-student relationships; teacher's empathy, interaction styles and communication styles are predictors of a positive relationship between a teacher and students (Yoon, 2002). Differing teaching styles were observed over the course of data collection for this study. Though acknowledged as a potential confounding variable, teacher characteristics are inherent to any school-based intervention. Thus, it is considered that the generalisability of the results of this study are not comprised by the presence of teachers during intervention. Further,

the absence of a significant effect of random variance between class groups indicates that the influence of teachers on intervention outcomes was, if present, minimal.

While this study strived to capture student voice through children's self-reporting of their emotional state and their perceptions of environment, exercise and being outdoors, it is considered that the extent to which participants had *influence* in the current study is somewhat limited. This is evident in the expression of some children's wishes to engage in free-play rather than engage in the 20-minute walking activity. Though these views were listened to and recognised, post-intervention, in the context of discussing the study's findings, it is considered that acting upon these views when designing the research study would bring a more meaningful student voice to the research (Lundy, 2007). The intervention activities utilised in the current research were premised on foregoing research into green exercise and nature connectedness, however, these studies were largely adult-based (Mayer & Frantz, 2009; Pretty et al., 2005; Richardson & Sheffield, 2017). In order to fully and meaningfully incorporate student voice into an examination of the effects of green exercise and nature connectedness, working collaboratively with children to design an intervention activity would be a worthwhile endeavour.

A key task driving this research was the identification of suitable intervention environments in close proximity to primary schools. In order to minimise risk to participants, an appropriate green and urban environment, within a 5-minute walk from school grounds, was required prior to an invitation to participate being issued. It is considered that the selected environments were highly appropriate in capturing the conceptual exploration of this study. A high contrast in greenness was evident across each of the green and urban environments which were visited. As highlighted in research, a strong contrast between environments and experimentation in actual rather than virtual environmental settings can be considered a strength of the current study (Han, 2017; Mayer et al., 2009).

5.2.2 Measures. Two measurement tools were employed in this study. The mood measure, adapted from the FACE Scale, recorded change to participants' mood pre and post-intervention (Kennedy et al., 2015). The digit span forward and digit span backward tests, adapted from the WISC-V, measured change to participants' attention levels pre and post-intervention (Wechsler, 2014).

The mood measure is considered to have been an accessible, appropriate measurement tool to the current study. The FACE scale was developed by Kennedy et al. (2015) with a view to being an easy to administer, age appropriate, psychometrically sound tool for measuring the effectiveness of hospital and school-based interventions with children (Kennedy et al., 2015). Assessing face validity, convergent and divergent validity and internal consistency, FACE was psychometrically evaluated through administering to a sample of participants (aged 12-17) whom had participated in psychiatric intervention programmes in the context of a hospital (Kennedy et al., 2015). As the current study utilised an adapted version of this scale on a non-clinical sample of children, some revisions were necessary. These revisions were informed by external review by expert researchers and piloting of the questionnaire on a non-clinical sample. A key revision was to increase Likert response scales from 3-point to a 5-point scale. Following piloting, this was considered necessary to accommodate the mood state of a general population, non-clinical sample of children. Additionally, mood items which were pertinent to green exercise research and which reflected the potential mood states of a non-clinical sample were included. With recognition of the adaptations made to the scale, for use in the current study, an evaluation of the psychometric properties of the adapted scale would be beneficial. Assessing the reliability and validity of the adapted scale would lend insight into the value of its continued utility in research with non-clinical child population samples.

Exploratory factor analysis of the gathered mood data indicated two dimensions, positive affect and negative affect. Factor analysis conducted by Kennedy et al. (2015) of the original FACE scale also produced a two-factor solution, mood states and energy states. The positive and negative affect dimensions conceptualised by children's responses may provide insight into the emotional knowledge of children within this age bracket. In addition, the two dimensions are reflective of the dimensions measured by the positive and negative affect schedule (PANAS), a frequently used self-report mood instrument (Watson, Clark & Tellegen, 1988). High positive affect scores on the PANAS reflect the extent to which the respondent feels energetic and is experiencing pleasure; high negative affect is associated with a state of general distress and unpleasurable engagement, with an absence of calmness. Research suggests that positive affect and negative affect are not opposite poles of a

single dimension, rather they are separate dimensions on which an individual can experience high or low levels of each simultaneously (Merz et al., 2013). Factor analysis of the measure used in the present study contributes to this perspective.

As Kennedy et al. (2015) outline, the use of emoticons on this measure adds to its cultural universality and accessibility to younger populations. In the context of the current study, the mood measure acted as an easily-administered, child-friendly measure which could be completed in class groups in the school setting, reducing disruption to class time while also providing an effective means of measuring post-intervention change.

The digit span subtest of the Wechsler Intelligence Scales is considered to be a measure of attention, concentration, sequencing and auditory short-term memory (Hale et al., 2002). The digit span test is widely used to measure changes to attention in intervention-based research (Faber-Taylor & Kuo, 2009; Han, 2017; Schutte et al., 2017; Tennessen & Cimprich, 1995). In the current study, the digit span tests were administered to participants as a group. The strengths and limitations associated with diverging from standardised procedure were considered; it was decided that the optimum choice, under the constraints of the present study, was to administer in a group format. This adaptation was made so as to reduce the disruption to class time which would result from extracting participants individually from the classroom. Additionally, as measures were being administered by a sole researcher, administering this measure to a group allowed for a larger subsample of participants to engage with this aspect of the study. Though it appears to have been an effective adaptation in the context of this study, administering digit span tests to a group does not adhere to standardised procedure, as indicated in the WISC-V manual (Wechsler, 2014). Administering the test in such a manner warrants further examination, so as to ascertain whether individuals perform in a way which is consistent with performance on an individually administered digit span test.

It is worthy of note that data gathering took place on site in the four primary schools which participated in the study. Inevitable disparities in school presentation, such as the physical building, number of teachers present, size of class group and surrounding noise levels, were evident. Thus a limitation of this study, inherent in its

real-world setting, is that measures were not completed by participants in a wholly controlled environment.

5.2.3 Statistical analysis. A considerable strength of this study lies in the statistical methods used to analyse the gathered data. As school psychology is inherently a multi-level field, data gathered in the educational context is nested data (Huang, 2018). As nested data structures violate the independence assumption necessary to traditional statistical tests, multilevel modelling is required to reduce the potential for Type 1 errors and biased parameter estimates (Peugh, 2010). In the present study, applying multi-level modelling allowed for the exploration of class-level effects, thus producing more statistically accurate output.

5.3 Implications for Educational Policy and Curriculum

National and educational policy highlights the potential role of the school setting in ameliorating children's psychological well-being (DES, 2015). National policy-based aims include children having positive social and emotional well-being and opportunities for play, recreation and nature (DCYA, 2014). The importance of promoting proactive, health-maintaining factors, rather than reacting to ill-health has been widely recognised (Cane & Oland, 2015; DOH, 2013; WHO, 2004). Identifying means of utilising the resource that schools present, in building pro-active strategies for fostering well-being, is an essential aspect of realising the aims outlined at policy level (DES, 2015).

The findings of this research can play a role in informing such strategies. The aforementioned findings indicate that the impact of green or urban exercise on children's negative affect does not reach statistical significance. Urban environments are indicated to have greater effect than green environments on positive affect, when pre-intervention mood is accounted for. However, inferential statistics show that positive affect in the green environment was the only variable to be close to significance (negative affect in green and urban and positive affect in urban were not near significance). These results are more ambiguous than those of adult-based studies which have attested to the benefits of green exercise on adult's psychological well-being (Berto, 2005; Bodin & Hartig, 2003; Kelz et al., 2015; Pretty, et al., 2005). However, with consideration of the current findings in light of research into the benefits of the daily mile, which include increases to physical fitness and reduced

sedentary time, implications for educational policy can be identified. Statistical outcomes which suggest that the urban environment had greater associations with well-being, than the green environment, lends to the potential reach of this approach to nurturing well-being. As experienced by the researcher in identifying schools for this study, accessing a natural, green environment, in close proximity to a school, can present a challenge. However, the current findings suggest that a 20-minute period of low intensity exercise in an urban environment can nurture positive affect in primary-school aged children. As will be discussed below, further research into the psychological effects of green exercise on children is required. However, the significance of environment in predicting post-intervention positive affect, as well as the physical benefits of school-based daily exercise for children highlights the importance of such initiatives in informing school health and well-being policy.

Additionally, though not significant, the positive association between completion of a connectedness activity while exercising and mood state attests to the potentiality of connectedness activities in increasing the benefits to well-being. It may be surmised that the connectedness activity increased participant's engagement with the environmental setting. Completion of the connectedness activity, though not complex, appears to have heightened the impact of 'soft fascination' in the environments, as compared with an exercise-only approach (Kaplan, 1995; Roe & Aspinall, 2011). As in research by Richardson and Sheffield (2017), a connectedness activity which is accessible and simple in nature is optimal; the aim being to supplement engagement with the environment, promote effortless appreciation of aspects of the environment and reduce mental fatigue through indirect attention (Kaplan & Kaplan, 1989).

The insignificance of attitudes to exercising and to being outdoors in predicting outcomes adds to the potential universality of an intervention of this nature. The exercise level and duration will not exclude those children whom do not enjoy exercise or whom perceive themselves as less able to exercise than their peers. Additionally, it is envisaged that participation of less able-bodied children can be facilitated with a low intensity exercise. As Reed et al. (2013) concluded that green exercise is appealing to a wide range of children, the current study's findings attest to the potential of a 20-minute, low intensity exercise period, incorporating a connectedness activity, taking place outside school grounds, as an intervention to

promote well-being. However, the role of situational factors (enjoyment of setting and aesthetic pleasure taken from setting) must be recognised in managing expectations when planning such an intervention in schools.

5.4 Implications for Practice

The role of the educational psychologist has evolved beyond a view of difficulties as being inherent within a child (Scottish Executive, 2002). Rather, a more systemic approach, encompassing a child's environment, accounting for factors from individual to microsystem-level to mesosystem-level and beyond, is considered more effective in removing obstacles to learning and supporting children's well-being (Bronfenbrenner, 1979; Cameron, 2006; Scottish Executive, 2002). The current research study set out to contribute to the evidence base which informs well-being interventions for children in schools and in clinic settings. A number of important considerations for educational psychology practitioners are borne from the study's findings.

The concept of psychologist as scientist-practitioner emerged at the Boulder Conference in 1949; it has since been much discussed, often rethought and heavily strived towards within the discipline of educational psychology (Baker & Ludy, 2000; Eodonable & Lauchlan, 2009; Shapiro, 2002; Stoner & Green, 1992). Since the time of the Boulder Conference, players in the field of psychology have continued to support and advocate for the joining together of professional practice and research within educational psychology. Jones and Mehr (2007) define the scientist practitioner as 'someone who applies critical thoughts to practice, uses proven treatments, evaluates treatment programmes and procedures, and applies techniques and practices based on supportive literature' (p.770). Two key elements in embodying the scientist practitioner role include carrying out research in settings in keeping with that in which an intervention may be introduced and ensuring that an emphasis on scientific thinking and acting is to the fore in everyday psychology practice (Shapiro, 2002).

It is argued that educational psychology practice must make use of the best available research evidence and that implemented interventions should be evaluated using appropriate outcome monitoring (Passenger, 2013). Limitations in time and resources, as well as issues around generalisability and applicability of research are

to be negotiated in defining the role of educational psychologist as scientist-practitioner (Fox, 2003; Huber, 2007). The adapted FACE measure presents a valuable tool to be utilised by educational psychologists, in the Irish context, for outcome monitoring. Factor analysis of the measure showed two constructs, positive affect and negative affect. As stated, this provides insight into the conceptual model of emotion held by children aged 8-13 years and is in parallel with the dimensions shown on the PANAS, a widely used measure of mood. A particular usefulness of the measure is found in its accessibility to children and the speed and ease with which it can be administered. These characteristics allow for the adapted FACE measure to be used in school-based practice context and in clinic-based practice to assess changes to children's mood state post-intervention. Equally, the measure could be utilised to assess subjective mood during weekly one-to-one therapeutic intervention, presenting as a child-friendly, non-intrusive but consistent measure of mood state. The use of an adapted FACE measurement tool in the current study attests to its utility in the practice of educational psychology in Ireland.

The research hierarchy proposed under the medical model, placing greatest weight on randomised controlled trials (RCTs), is not the most relevant form of research to the practice of educational psychology (Fox, 2003). In subsequent work by Fox (2011), it is argued that RCTs do not account for the impact which the therapeutic relationship may have on outcomes. By removing this variable, the efficacy of the intervention could be perceived to be reduced. It is suggested that RCTs are based on an assumption that one size fits all and, as a result, should not be the basis for choosing to implement a particular intervention with an individual (Fox, 2011). Like Fox (2011), Birch, Frederickson and Miller (2015) highlight the issue of generalisability in psychological research. It is outlined that any case in which an educational psychologist is engaged is most likely complex and idiographic and thus findings from a research study, in which all identical variables could not be applied, can offer an indication of likely success but cannot be taken as prescriptive. Similarly, Stoner and Green (1992) question what research practices should form the bases of educational psychology and how the knowledge garnered from research can be applied. It is suggested that knowledge and truths identified in one setting, through research, may not hold true in another (Stoner & Green, 1992). It is recommended that interventions are implemented and either used continually if

successful or discarded, depending on local empirical outcomes, rather than used continually to keep with research literature (Stoner & Green, 1992). In this way, the role of the educational psychologist as critical consumer and distributor of research is emphasised. By evaluating research critically, identifying that which is high quality and which may be applicable and effective in a local context, a psychologist is better positioned to discern the value or suitability of an intervention or programme (Keith, 2008).

The current study is testament to this standpoint, highlighting the need for an intervention approach to be implemented locally and analysed critically in the local context. While adult and adolescent-based research speaks to the benefits of the green environment in improving aspects of psychological well-being, the current research outlines the potentially limited generalisability of such findings to children. Assessing whether this limit to generalisability is specific to primary school-aged children or to children attending Irish primary schools or to children in a non-clinical sample requires additional exploratory research to be carried out. Equally, this idiographic-focused perspective is bolstered by the potential role which teacher presence plays in mediating response to intervention. As proposed by research, the impact of an authority figure being present, and the connotations of this for children engaging in a well-being driven intervention, suggests a requirement to be careful and strategic in the application of interventions to particular real-world practice settings. As any intervention must be monitored systematically and outcomes evaluated accordingly, Stoner and Green (1992) advocate for a move away from investing in one particular intervention that an advocate in literature has stated will work, and thus scientist-practitioners are directed towards the resolution of local issues and concerns and the best interest of the child is placed at the centre of practice.

The evidence base used in psychology practice must incorporate professional expertise (Fox, 2011). Advocating a view of psychologist as artist as much as scientist, Fox (2011) bases his conceptualisation on the reality that every intervention with a child is different and that one learns to ‘act’ as psychologist by engaging in both these idiographic situations and in reflective practice. Fox (2011) recognises that the meaning or frame of reference which a psychologist brings to an intervention must meet with the frame of reference of the child, parent, teacher etc. If there is

cohesion in frame of reference and meaning across parties, an intervention may allow the child to develop and flourish. However, if the issue is being viewed in different ways, this may be an obstacle to change. Findings in the current study, which demonstrate the differing effects of the individual's aesthetic experience of an environmental setting on mood post-intervention, point to the importance of assessing a child's or teacher's meaning or frame of reference before introducing an intervention. While a naïve assumption may be made that *all* individuals will experience a particular environment as more enjoyable and more aesthetically pleasing than another, the results of this study indicate that this is not the case. The role of individual differences, in terms of personality, gender and upbringing, in dictating an individual's response to intervention merits further investigation but it may be considered that a one-size-fits-all intervention approach is not the most effective.

5.5 Implications for Future Research

Considering the present study's strengths and limitations and its position in the context of foregoing research, directions for future research in this area are suggested. As outlined, the number of green exercise or nature connectedness studies which focus on child populations are few in comparison to adult-based research. Further, for those studies which are child-focused, a number had a small sample size and or had no control condition (Barton et al., 2014; Dowdell et al., 2014; Duncan et al., 2014; Han, 2014; Hignett et al., 2017; McCree et al., 2018; Warber et al., 2015). Given that the current findings indicate a greater association between urban environments and well-being, contrary to adult-based studies, further research focusing on outcomes for children is warranted. Further exploration on outcomes for children would benefit from the presence of a control condition so as to isolate the factors which predict response to intervention. Additional research which engages larger population samples and which incorporates a control condition would provide clarity on the usefulness of exercise and connectedness activity in a green and/or urban environment, as an intervention for supporting children's well-being.

The results of this study indicate that completing a connectedness activity while exercising may have benefits for participants. Psychological benefits to completing a connectedness activity were also found in Richardson and Sheffield's (2017) adult-

based study. Participants completed the connectedness activity everyday, over five days and, importantly, benefits were sustained at two-month follow-up. These outcomes suggest that an examination of effects on children of completing a connectedness activity over a longer period would be worthwhile. Further, assessing the longevity of any effect would provide further insight into the potential of connectedness activities for children. Research of this nature would be useful in informing practices in school which aim to improve children's well-being and/or attention.

Findings of the current study point to the potential role which personality plays in dictating response to environment. Additional research on effects of green exercise and nature connectedness which encompass a personality measure may provide a more in-depth understanding of the aforementioned gender-based differences in outcomes. A more detailed insight into the aesthetic pleasure which an individual experiences in a given setting and an account of the aspects of openness (ideas and feelings) which correspond to this would lend clarity to interpretations of green exercise and nature connection effects. Similarly, the impact of intervention being conducted in a school setting, with teachers present, merits exploration. While some of the value of an intervention for children, such as green exercise and nature connection, lies in its applicability and feasibility in the school context, it would be pertinent to elucidate whether such a context and/or the presence of authority figures does impact on the restorative potential for children's psychological health which the environment holds. As such, a qualitative approach to further research would be of benefit, allowing for a more in-depth exploration of the diversity of individual differences and contextual circumstances which may affect environmental impact.

In the current study, no change to attention levels was identified following intervention. While this is contrary to findings of some child-based research, adult-focused research on attention outcomes has been inconclusive (Berto, 2005; Han, 2017; Mayer et al., 2009). Further, in comparison to mood-related investigation, effects of exposure to nature on attention are relatively unexplored. As noted when reviewing the strengths and limitations of this study, administering digit span tests to a group moves away from standardised procedure. It is considered that further nature-based research with child populations, which has capacity to administer digit span on an individual basis would be useful. Alternatively, a study which compares

outcomes of digit span administered individually and on a group basis would be valuable, potentially providing support for the use of group-administered digit span tests, in the research forum.

Lastly, the use of multilevel modelling accounted for the nested nature of the data collected in this study. Future research in this area would benefit from utilising a multilevel modelling approach to statistical analysis, in order to account for random variance in the efficacy of interventions of this kind. In this way, accurate conclusions as to the suitability and potential effectiveness of interventions can be drawn, with reduced likelihood of statistical error.

Chapter Six: Conclusion

This study set out to explore the outcomes of green exercise and nature connection-based interventions for children in third to sixth classes, delivered in a school setting. It aimed to add to the evidence base regarding the benefits of nature connectedness and green exercise for children, as well as informing well-being focused policy and educational psychology practice. Capturing the student voice through self-report measures represented an important aspect of the study. Rather than basing findings on adult perceptions of change to mood or attention (parent or teacher), children's own perceptions of their mood state pre and post-intervention, of the environments and activities with which they engaged, and an individually completed attention task, formed the foundation of analysis. Such an approach provided more in-depth insight into children's constructs of emotion and mood and individual differences in terms of children's response to environment.

This study found that engaging in a green exercise or nature connectedness intervention did not significantly predict changes to participants' attention levels. With regard to changes to positive affect, the environment was a significant predictor of post-intervention levels, however, this effect was more pronounced following intervention in the urban environment. Environmental setting did not play a significant role in determining post-intervention levels of negative affect. Though not reaching significance, the direction of effect for engagement in a nature connectedness activity suggests that further exploration of this style of intervention would be worthwhile. Participants' reported enjoyment of the setting they had attended and the aesthetic pleasure they had taken from the setting was significantly related to post-intervention affect. Greater enjoyment and aesthetic value lead to higher levels of positive affect and lower levels of negative affect. Gender significantly impacted on post-intervention levels of affect; females reported lower levels of negative affect and higher levels of positive affect than males. The presence of school-based authority figures, playgrounds being located in two of the three green environments which were accessed and the assumed urban upbringing of a majority of participants may have contributed to the current findings. The study highlights the need for a heightened understanding of the influence of various factors which impact on green exercise and nature connectedness outcomes.

The strengths and limitations of this research have been outlined. Utilising an adapted FACE scale to assess children's mood pre and post-intervention has been effective. As an easily-administered, accessible measure, the adapted FACE scale is a useful tool for child populations, in the research or practice context. Additionally, the use of a multilevel modelling approach to statistical analysis has recognised the inherent nested structure of school-based data. Multilevel models recognise the potential for class-level effects in school-based intervention studies, minimising the potential for statistical errors to be produced. The adapted use of the digit span subtest of the Wechsler Intelligence Scales, in a group administration format, is a potential limitation which requires investigation for consistency and accuracy with the task when it is individually administered. Additionally, a greater gender balance among participants would lend greater generalisability to study outcomes.

Placing the findings of the current study in the context of foregoing research, it is suggested that further child-based research is required to explore the benefits of green exercise and nature connection for children and signals the need for caution in generalising findings of adult-based studies to child populations. Moreover, further research which incorporates a control (urban) environment is warranted. The impact of individual differences, including personality and social and environmental background, on response to environment merits further exploration. Further, a similarly designed, non-school-based intervention study would allow for the potential impact of teacher presence to be assessed.

With the advent of initiatives such as The Daily Mile, forest schools and curriculum developments geared towards the promotion of children's psychological well-being, a need for a strong evidence base on which to grow and nurture such initiatives is apparent. The current study represents an early endeavour into exploring how nature connectedness and green exercise can be incorporated into school systems in an accessible and beneficial way. As stated, additional research is required to determine whether a more enduring nature connectedness activity than that implemented in this study, will bring greater positive outcomes. Further, the study indicates that individual differences should be recognised during the policy-making process and in implementing well-being driven interventions in schools. As psychological practice moves away from one-size-fits-all models to needs-based, individualised care, so a similar approach should shape the promotion of well-being in the school setting. Likewise, for psychology practitioners, the findings of the study highlight the

necessity of being purposeful in determining what is an appropriate and effective intervention in a particular practice setting. While the psychological effects of participation in green exercise and nature connectedness activities have been broadly lauded in adult-based research and child-based research indicates potential positive outcomes for children, the current research indicates that the process of gaining the benefits of green exercise and nature connection is complex. Building on the role of the environment in mediating these effects, the role of personality, gender and previous environmental exposure should not be ignored. As proponents of the scientist-practitioner approach to psychological practice have asserted, an intervention study which has been proven beneficial in research must also be considered in the context of local practice.

6.1 Reflection

The following section is a brief reflective account of how the current research study has influenced the professional attitudes and psychology practice of the author. Kolb's experiential learning cycle is utilised to structure this reflection (Kolb & Fry, 1975). Kolb's experiential learning cycle comprises four stages:

1. Concrete Experience – a new experience or situation is encountered;
2. Reflective Observation – reviewing/reflecting on the experience;
3. Abstract Conceptualisation – concluding/learning from the experience;
4. Active Experimentation – planning/utilising what has been learnt.

6.1.1 Concrete Experience. The experience of conducting this research study presented a significant learning trajectory for the author. The process of designing a research study which was viable for implementation in the real-world context of primary schools and which accurately captured and explored the intervention approach, was the first significant step to be taken. Following this, the recruitment of schools for participation, the collection of data as a sole-researcher, and the analysis of gathered data brought challenges and triumphs both. However, in collating this trajectory in this dissertation, the author has been provided with the opportunity to reflect on the significance of the aforementioned tasks and the study's outcomes, for one's own professional practice, as well as for the field of educational psychology practice and research.

6.1.2 Reflective Observation. The journey from research design, through data collection, through thesis writing has been, if not complex, certainly non-linear. However, it is considered that conducting research in a real-world context, particularly with primary school-aged children, is by its nature not simple or linear. The complexities of working with school principals and teachers, indirectly with parents, with children, and with weather, required in-depth exploration and review of the purpose of the research. At times, it was necessary for the author to self-remind as to the goal of the research and the value which intervention research, such as in this study, could bring in supporting children's well-being. On reflection, keeping the core value of research such as this to the fore when carrying out the study was an important driver for both the researcher and the schools which participated. It is indubitable that primary schools are busy environments with numerous priorities and many initiatives with which to contend. Acknowledging this, the well-being of children being at the heart of this research is considered to be what drove it on and brought it to completion. As an almost-qualified child and educational psychologist, this drive has reinforced the essence of this profession; the focus on and motivation towards children's well-being which brings so many of us to this professional pathway.

6.1.3 Abstract Conceptualisation. As outlined in the discussion section of this thesis, a number of implications for psychological practice, resulting from the study, can be identified. The role of psychologist as scientist-practitioner is one which continues to hold importance but also, to some extent, elude educational psychology practitioners. Throughout professional training, an emphasis is placed on evidence-based practice and practice-based evidence. Conducting this research has underlined the absolute necessity for educational psychologists to embody this role and to do so in a critical, non-passive manner. This research has indicated that caution must be applied to the generalisation of findings from adult-based research to work with children and research findings generally to a particular local practice context. The process of integrating the current findings with previous research in this area has highlighted the need to be alert to quality of research design and to deeply consider the implications of results. Additionally, the statistical approach employed, which accounts for the nested structure of school-based data, has prompted the author to look more critically still at outcomes of intervention-based research. The bird's-eye

view which can be taken through multilevel modelling has broadened the authors mind to variables which can have potential impact on outcomes for children.

6.1.4 Active Experimentation. In entering practice as a newly qualified psychologist, the author will endeavour to apply learnings from the research process. Translating these findings and implications into practice will require the author to consider the local context of work, the presence of the therapeutic relationship and the quality of the particular evidence-base in informing intervention planning. Rather than passively consuming research or applying a particular intervention as it is in vogue, the author will strive to take a holistic approach to professional practice. Decision-making will be founded on a critical analysis of the available evidence, as well as a careful consideration of the case presentation, including the ecological system which surrounds a child and the group-level factors which may be at play.

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Appendices

Appendix A – Articles Excluded from Systematic Review

Articles Excluded from Nature Connectedness Review	Reason for Exclusion
Cervinka, R., Roderer, K. & Hefler, E. (2011). Are nature lovers happy? Our various indicators of well-being and connectedness with nature. *Journal of Health Psychology, 17* (3), 379-388.	Type of intervention - Intervention is not based in natural environments OR does not utilise virtual natural environment landscapes.
Cho, Y. & Lee, D. (2018). 'Love honey, hate honey bees': Reviving biophilia of elementary school students through environmental education programme. *Environmental Education Research, 24* (3), 445-460.	Focus of intervention – Intervention is not specifically targeting mood state and/or attentional capacity.
Crain, W. (1997). How nature helps children develop. *Montessori Life, 9* (2), 41-43.	Type of study – study does not contain primary empirical data.
Flom, B., Johnson, C., Hubbard, J. & Reidt, D. (2011). The nature school counsellor: Using nature to promote mental health in schools: *Journal of Creativity in Mental Health, 6,* 118-131.	Type of study – study does not contain primary empirical data.
Louv, R. (2011). Reconnecting to nature in the age of technology. *The Futurist,* 41-45.	Type of study – study does not contain primary empirical data.
Nisbet, E. & Zelenski, J. M. (2011). Underestimating nearby nature: Affective forecasting errors obscure the happy path to sustainability. *Psychological Science, 22* (9), 1101-1106.	Participants - Adults aged over 25 years.
Pasanen, T. P., Tyrainen, L. & Korpela, K. M. (2014). The relationship between perceived health and physical activity indoors, outdoors in build environments, and outdoors in nature. *Applied Psychology: Health and Well-being, 6* (3), 324-346.	Participants - Adults aged over 25 years.
Scott, T. L., Masserm B. M. & Pachana, N. A. (2015). Exploring the health and wellbeing benefits of gardening for older adults. *Ageing & Society, 35,* 2176-2200.	Participants - Adults aged over 25 years.
Sobko, T., Tse, M. & Kaplan, M. (2016). A randomised controlled trial for families with preschool children – promoting healthy eating and active playtime by connecting to nature. *BMC Public Health, 16* (505), 1-11.	Type of study – study does not contain primary empirical data.

Articles Excluded from Green Exercise Review	Reason for Exclusion
American Chemical Society (2010). Green exercise may be good for your head. *Environmental News.* 3649.	Type of Study - The study does not contain primary empirical data.
Christie, M. A., Thomson, M. Miller, P. K. & Cole, F. (2016). Personality disorder and intellectual disability: The impacts of horticultural therapy within a medium-secure unit. *Journal of Therapeutic Horticulture, 16* (1), 4-17.	Type of Intervention - Intervention does not involve participants undertaking physical activity in the aforementioned environmental settings.
Christie, M. A. & Cole, F. (2017). The impact of green exercise on volunteers' mental health and well-being – findings from a community project in a woodland setting. *Journal of Therapeutic Horticulture, 27* (1), 18-33.	Participants – Adults aged over 25 years. Type of Intervention - Intervention does not involve participants undertaking physical activity in the aforementioned environmental settings.
Mackay, G. J. & Neill, J. T. (2010). The effect of green exercise on state anxiety and the role of exercise duration, intensity, and greenness: A quasi-experimental study. *Psychology of Sport and Exercise, 11,* 238-245.	Participants – Adults aged over 25 years.
No Author (2007). News review. *Journal of Holistic Healthcare, 4* (3), 3-4.	Type of Study - The study does not contain primary empirical data.
Shanahan, D., Franco, L., Lin, B. B., Gaston, K. J. & Fuller, R. A. (2016). The benefits of natural environments for physical activity. *Sports Medicine, 46,* 989-995.	Type of Study - The study does not contain primary empirical data.

Appendix B – Weight of Evidence Framework

Weight of Evidence A – Methodological Quality Quality Criteria Checklist – RCT Studies	Kant & Sharma (2016)	Mayer et al. (2009)	Passmore & Holder (2017)	Olafsdottir et al. (2017)	Pretty et al. (2005)
1. Did the study have an active control group?	Yes	Yes	Yes	Yes	Yes
2. Was the study described as randomised?	Yes	Yes	Yes	Yes	Yes
3. Was the method used to generate the sequence of randomisation described and appropriate?	No	No	No	No	No
4. Were participants or experimenters blind to treatment assignment?	No	No	No	No	No
5. Was information about participant flow provided (no. of participants assigned to each condition, analysed, dropped out)?	No	No	Yes	No	Yes
6. Did the study report the experience/qualifications of the intervention facilitator?	NA	NA	NA	NA	NA
7. Were all standardised measures used to examine effect of the intervention on dependent variables?	Yes	Yes	Yes	Yes	Yes
8. Was post-intervention outcome controlled for baseline outcome?	Yes	Yes	Yes	Yes	Yes

9. Was the most appropriate method of analysis used considering the study design and recommendations? Quality Score (/8) or (/9)	Yes 5/8 63%	Yes 5/8 63%	Yes 6/8 75%	Yes 5/8 63%	Yes 6/8 75%

Quality Criteria Checklist - Quasi-Experimental & Other Studies

	Barton et al. (2016)	Dowdell et al. (2011)	Hignett et al. (2017)	Lieflander et al. (2013)	McCree et al. (2018)	Rose et al. (2018)	Warber et al. (2015)	Akers et al. (2012)	Duncan et al. (2014)	Han (2014)	Reed et al. (2013)
1. Did the study have an active control group?	No	Yes	No	Yes	No	No	No	Yes	Yes	No	Yes
2. Was the study described as randomised?	No	No	No	No	No	No	No	Yes	NA (*Repeated Measures)*	No	NA *(Repeated Measures*)
3. Were participants/experimenters blind to treatment assignment?	No	No	No	No	No	No	No	No	No	No	No
4. Was information about participant flow provided (no. of participants assigned to each condition, analysed, dropped out)?	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
5. Did the study report the experience/qualifications of the intervention facilitator?	No	Yes	Yes	No	Yes	No	No	NA	NA	NA	Yes

6. Were all standardised measures used to examine effect of the intervention on dependent variables?	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Was post-intervention outcome controlled for baseline outcome?	Yes	NA	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes
8. Was the most appropriate method of analysis used considering the study design and recommendations?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Quality Score (/6) or (/7) or (/8)	3/8	4/7	4/8	5/8	5/8	4/8	3/8	5/7	5/6	2/7	6/7
	38%	57%	50%	63%	63%	50%	38%	71%	83%	29%	86%

Weight of Evidence B – Methodological Relevance

High – A study achieved a high rating on methodological relevance if they had a large sample size, if a control group/condition was present and participants in the study were allocated to treatment and control group/condition in a randomised way, if mood and/or attention was the primary target of the intervention, if the participant sample was primary school-aged children, if the intervention was applicable to a school setting and similar to that of the proposed study.

Medium: Medium: A study achieved a medium rating on methodological relevance if it had a medium sample size, participants were allocated to control or treatment in a randomised but not ideal way, if mood and/or attention was one of a number of targets of the intervention, if the participant sample had a mean age under 18 years, if the intervention was applicable to a school setting.

Low: A study achieved a low rating on methodological relevance if it had a small sample size (and thus limited generalisability), there was no active control group, mood and/or attention was not a primary target of the intervention, if the participant sample's mean age is over 18 years, or the intervention cannot be conducted in a school setting.

Weight of Evidence C – Relevance of Evidence to Review Question

High – A study achieved a high rating if the results of the study were considered generalisable and reliable, as indicated by sample size, intervention procedure (clear and comprehensive) and quality of pre and post-intervention measure type (standardised measures).

Medium – A study achieved a medium rating on relevance of evidence to review question if the results of the study were considered generalisable and reliable, as indicated by sample size, intervention procedure and type of pre and post-intervention measure. Studies scoring a medium rating are considered to be less relevant to review question than those achieving a higher rating.

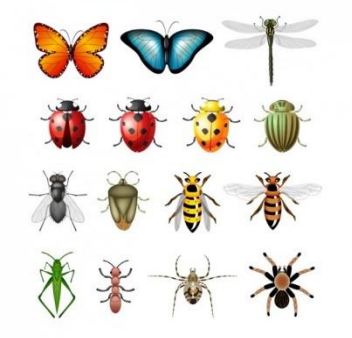
Low – A study achieving a low rating on relevance of evidence to review question will be considered to have limited generalisability and limited reliability, as indicated by sample size, intervention procedure and quality of pre and post-intervention measures.

Appendix C – Nature Connectedness Activity

Name: _____

What did you see today? Please put a ✓ next to the things you saw today.

Trees _____



Insects _____

Flowers _____

Grass _____

Leaves _____

Birds _____

Bushes _____

Name: _____

What did you see today? Please put a ✓ next to the things you saw today.

 Cars _____

 Houses _____

 Gates _____

 Office Buildings _____

Footpath _____

Traffic Signs _____

Shops _____

Road _____

Appendix D – Record of Weather Conditions during Intervention

School	Class Group	Environmental Setting	Weather
School 1	Class 1 Class 2	Green	Cloudy and dry; 15˚Celsius.
School 1	Class 1 Class 2	Urban	Cloudy, patchy sun; 13 ˚Celsius.
School 1	Class 3 Class 4	Urban	Cloudy and dry; 15˚Celsius.
School 1	Class 3 Class 4	Green	Cloudy and dry with breaking sun.
School 2	Class 5	Urban	Cold and sunny; 6˚Celsius.
School 2	Class 5	Green	Cloudy, drizzly for short periods; 10˚Celsius.
School 2	Class 6 Class 7	Green	Cold and sunny; 8˚Celsius.
School 2	Class 6 Class 7	Urban	Dull and grey; 10˚Celsius.
School 3	Class 8 Class 9	Urban	Cold and sunny; 5˚Celsius.
School 3	Class 8 Class 9	Green	Dull and cloudy; 14˚Celsius.
School 4	Class 10 Class 11	Green	Dull, cloudy, grey skies.
School 4	Class 10 Class 11	Urban	Cloudy, warm for time of year; 12 ˚Celsius.
School 4	Class 12 Class 13 Class 14	Green	Cloudy and dry.
School 4	Class 12 Class 13 Class 14	Urban	Light, drizzly rain throughout.
School 4	Class 15 Class 16	Urban	Cloudy, light drizzle at times; 8˚Celsius.
School 4	Class 15 Class 16	Green	Overcast, rain as return to school; 7 ˚Celsius.

Appendix E – Mood Questionnaire

I am _____ years old.

I think of myself as a boy/girl.

I am in 3rd/4th/5th/6th class.

How do you feel <u>right now</u>?

Under <u>each</u> picture, put a tick in the box for how you are feeling now.

Happy	Worried	Sad	Relaxed	Angry	Energetic
					
How happy are you?	How worried are you?	How sad are you?	How relaxed are you?	How angry are you?	How energetic are you?
Extremely ☐	Extremely ☐	Extremely ☐	Extremely ☐	Extremely ☐	Extremely ☐
Very ☐	Very ☐	Very ☐	Very ☐	Very ☐	Very ☐
Somewhat ☐	Somewhat ☐	Somewhat ☐	Somewhat ☐	Somewhat ☐	Somewhat ☐
A little ☐	A little ☐	A little ☐	A little ☐	A little ☐	A little ☐
Not at all ☐	Not at all ☐	Not at all ☐	Not at all ☐	Not at all ☐	Not at all ☐

Appendix F – Pre and Post-Intervention Questions

Name: _____

Please answer the questions below. Read each question and tick a box to answer each one.

How is your day going so far?	It's been a good day	☐
	It's been an okay day	☐
	It's been a bad day	☐
How much do you like walking?	I really like walking	☐
	I like walking	☐
	I don't like walking	☐
How much do you like being outside?	I really like being outside	☐
	I like being outside	☐
	I don't like being outside	☐
How many times per week do you usually exercise?	0-1 times per week	☐
	2-3 times per week	☐
	4-5 times per week	☐
	6-7 times per week	☐

Name: _____

Please answer the questions below. Read each question and tick a box to answer each one.

How much did you enjoy the place you visited with your class today?	I really liked the place we visited.	☐
	I liked the place we visited.	☐
	I didn't like the place we visited.	☐
Did you find the place you visited nice to look at?	It was very nice to look at.	☐
	It was nice to look at.	☐
	It was okay to look at.	☐
	It wasn't nice to look at.	☐
How did you find the activity you did today?	It was relaxing.	☐
	It was boring.	☐
	It was fun.	☐
	It was scary.	☐
	It was uncomfortable.	☐
	It was nice.	☐
	It was difficult.	☐

Appendix G – Application for Ethical Approval

MARY IMMACULATE COLLEGE COLÁISTE MHUIRE GAN SMÁL	**Doctorate in Educational and Child Psychology Research Ethics Committee** DECPSY Ethics Application Form

1a Title of Research Project
Examining the effect of green exercise and nature connectedness on the psychological well-being and attentional capacity of primary school aged children.
1b Brief Outline (50-75 words)
This research will compare the impact of green exercise, exercise in a built-up environment, connectedness to a green environment and connectedness to a built- up environment on the psychological well-being and attentional capacity of primary school aged children. All participants will complete a measure of mood state and some participants will complete a measure of attentional capacity pre and post participation. The experiment comprises the following four conditions: • 20 minute period of low intensity exercise (walking) carried out within a natural environment, with a high level of natural greenness. • 20 minute period of low intensity exercise (walking) within a built-up environment, with a limited level of natural greenness. • Completing a nature connectedness exercise while walking in a natural environment, with a high level of natural greenness. • Completing a nature connectedness exercise while walking in a built-up environment, with a limited level of natural greenness.

2	**Proposed Start Date**	**Month**	March	**Year**	2018
	Anticipated Completion Date	**Month**	September	**Year**	2020

3 Applicant			
3a Applicant Details			
Name:	Alison O'Keeffe	**Student ID:**	00661473

E-mail:	00661473@micstudent.mic.ul.ie	**Phone:**	0876198689

3b Ethical Guidelines / Ethical Clearance from Another Source				
Are there Ethical Guidelines to which you must adhere in your field of study? **If yes, please specify below:**	**Yes**	✓	**No**	
Psychological Society of Ireland (PSI) Ethical Guidelines				
Do you require Ethical Clearance from another source? **If yes, please specify below:**	**Yes**		**No**	✓

4 Supervisor			
To be completed by the research supervisor. I hereby authorise the applicant named above to conduct this research project in accordance with the requirements of DECPSY REC 2 FORM* and I have informed the applicant of their responsibility to adhere to the recommendations and guidelines in DECPSY REC 2 Form **The DECPSY REC 2 will outline the decision of the ethics committee and may contain a number of recommendations pertaining to the study. This form will be emailed to both the trainee and supervisor.*			
Name	**Contact Details**	**Date**	**Signature**
Dr. Johanna Fitzgerald Dr. Paul Mulcahy	Johanna.fitzgerald@mic.ul.ie Paul.mulcahy@mic.ul.ie	1st may 2018 1st May 2018	

5 Study Descriptors			
Please mark the terms that apply to this research project with a ✓			
Healthy Adults		Vulnerable Adults	
Children (< 18 yrs)	✓	Vulnerable Children (<18yrs)	
Physical Measurement		Psychological Measurement	✓
Video Recording/Photography		Voice recording	
Questionnaire/Interview	✓	Observational	
Physical Activity	✓	Record Based	

Project is Off-Campus	✓	'Other' descriptor(s) not named here	
Please specify 'Other' descriptor(s)			

6	**Project Design and Methodology**
6a	**Rationale, Purpose and Benefits of Research Project**

Rationale

By age 13, 1 in 3 young people in Ireland is likely to have experienced some type of mental disorder (Cannon, Coughlan, Clarke, Harley & Kelleher, 2013). The National Council for Special Education (NCSE) (2006) outlines that an estimate of 86,083 children attending Irish schools have a moderate to severe mental health difficulty. The NCSE (2006) report further suggests that this is a conservative figure which likely excludes children with milder mental health difficulties. A fundamental component for the promotion of a child's mental health and well-being is the school setting (Department of Education and Skills (DES), 2015). The well-being in primary schools policy document highlights the role of schools and associated education providers in fostering mental well-being, underlining the commitment required to promote mental health and the requirement for this commitment to mental health to permeate through all aspects of school life and learning (DES, 2015).

As the Scottish Executive (2002) outlines, the role of the educational psychologist has evolved beyond a view of difficulties as being inherent within a child. Rather, a more systemic approach, encompassing a child's environment, curriculum, teachers, peers etc., is considered more effective in removing obstacles to learning and supporting children's well-being (Cameron, 2006; Scottish Executive, 2002). Recognising the prevalence of mental health difficulties in children in Ireland and the role of the educational psychologist in assessing and interpreting interactions between a child and the components of his/her environment (physical, social, psychological etc.), it is considered that this research will be a valuable contribution to the evidence base.

Purpose

Green exercise refers to exercise which takes place in an environment with a high

level of greenness. Barton and Rogerson (2017, p. 80) provide the following definition of greenspace 'maintained or unmaintained environmental areas, which can include nature reserves, wilderness environments and urban parks'. Research into the positive impact of green exercise on psychological well-being of adults has been largely confirmatory (Berto, 2005; Bodin & Hartig, 2003; Kelz, Evans & Roderer 2015; Pretty, Peacock, Sellens & Griffin, 2005). Exploration of the effects of green exercise on children has produced contrasting findings (Duncan et al., 2014; Kuo & Faber Taylor, 2004). Duncan et al. (2014) found a significant positive effect of green exercise on some measures of blood pressure, however, the effect was not significant for mood states. In this study, green exercise comprised exercising while watching video of a forest environment (Duncan et al., 2014). Kuo and Faber Taylor (2004) found that green outdoor activities reduced Attention Deficit Hyperactivity Disorder symptoms (inattention and impulsivity) significantly more than did activities in built-up outdoor environments or indoor environments. Richardson and Sheffield (2017) examined the benefits to well-being which may result from connecting more fully with nature. In an adult population study, the researchers found that by noting three good things in nature each day, a significant increase in nature connectedness occurred, which had positive impact on psychological well-being. Utilising the General Health Questionnaire (GHQ), which measures current mental health and psychological well-being, the researchers found a significant relationship between post-intervention scores on the GHQ and nature connectedness, in the intervention group. The GHQ includes questions on ability to maintain concentration, feelings of happiness, feelings of unhappiness etc.

Though research exploring the benefits of nature connectedness and green exercise for children is in its infancy, considered alongside similar research with an adult population, early indications suggest positive effects on mood and attentional capacity. It is considered that research into this area to provide further insight will be valuable in informing well-being, learning and health promotion strategies in schools.

Research Questions:

1. What is the effect of exercise in a natural, green environment on the mood state of primary school-aged children?

2. What is the effect of exercise in a natural, green environment on the attentional capacity of primary school-aged children?
3. What is the effect of a nature connectedness activity during green exercise on the mood state of primary school aged children?
4. What is the effect of a nature connectedness activity during green exercise on the attentional capacity of primary school aged children?

6b (i) Research Methodology

Utilising an experimental design, the proposed study will compare the effects of green exercise, non-green exercise, connectedness to a natural environment and connectedness to a non-natural environment on children's psychological well-being and attentional capacity.

Each participant will participate in two conditions. Utilising a mixed research design, participants will be randomly assigned to complete either

1. Exercise in a green environment AND exercise in a non-green environment.
   OR
2. Connectedness activity while exercising in a green environment AND connectedness activity while exercising in a non-green environment.

Participants will be randomly assigned to conditions according to their class group. In order to control for intra-class dependency, classes will be split, with half the class completing green and non-green exercise and half the class completing the green and non-green connectedness activity. Participation in each condition will be 1 week apart. This interval is in line with previous research by Bodin and Hartig (2003), whom explored the impact of the outdoor environment on the psychological benefits associated with running. Participants in Bodin and Hartig's (2003) study engaged in running sessions with a 7-day interval incorporated between sessions.

Experimental design calls for controlling as many variables as possible and then systematically manipulating one treatment variable to test the effect; a balance between control and manipulation must be struck so that the real world phenomenon being measured is still represented (Mertens, 2015). As Mertens (2015) outlines, within post-positivist research, despite attending to control of confounding variables insofar as possible and the systematic manipulation of the treatment variable, results of experimentation can be interpreted as 'true' only at a certain level of probability.

However, in order to protect against potential confounding variables and isolate the effects of the proposed interventions, a profile of attitude to exercising, attitude to environment and other pertinent factors, will be compiled for each participant. Questions used to construct this profile are presented in the next section.

6b(ii) Research / Data Collection Techniques

Pre and post-intervention measures of mood will be gathered through use of short self-report questionnaires. Please see Appendix G for a copy of the mood measure. Created for this proposed study, this measure incorporates elements of the 'Fast Assessment of Children's Emotion' (FACE) scale (Kennedy, Unnithan & Wamboldt, 2014). This measure will be piloted with a cohort of primary school-aged children prior to carrying out the study, to ensure suitability. Attentional capacity will be measured pre and post-intervention through administering a digit span test (digit span forward and digit span backwards); this will be completed with a randomly selected group within the overall sample. Please see Appendix H for a copy of the digit span test and Appendix I for digit span response sheet. Digit span is one of the most commonly used measures of attentional capacity in neuropsychological research (Hale, Hoeppner & Fiorello, 2002; Ostrosky-Solis & Lozano, 2006). In the context of research on green exercise, it has been employed to assess changes to attentional capacity following exercise in various settings (Bodin & Hartig, 2003; Faber Tayler & Kuo, 2009; Han, 2017). Content for the digit span measure will be sourced from the Wechsler Intelligence Scale for Children – V (WISC-V). It will be administered by the researcher to the group. The researcher will call out the digits; once participants hear a noise signal (bell tone); they will record their responses in writing. Class teachers will support this process by monitoring and ensuring that all participants begin writing their responses at the appropriate time. As the discontinue rule cannot be applied when administering to a group; all participants in this subsample will complete all items. By administering digit span to all participants in a class at once, the disruption to class time is reduced and results between conditions are more effectively comparable.

In addition to measures of mood and attention, demographic information (age, class, gender) will be gathered for each participant. In order to address potential confounding variables and accurately analyse intervention effects, participants will

respond to the following questions pre-intervention:

1. How is your day going so far? (*It's a very good day – It's a very bad day)*
2. How much do you like walking? (*I really like walking – I really don't like walking)*
3. How much do you like being outside? (*I really like being outside – I really don't like being outside)*
4. How many times per week do you usually exercise? (*0-1/2-4/3-5/6-7)*

And will answer the following questions post-intervention:

1. How much did you like the place you visited with your class today? (*I really like the place we visited – I really didn't like the place we visited)*
2. Did you find this activity fun/relaxing/boring/scary/uncomfortable/nice/ difficult?

Scaled questions will be answered on a 5-point Likert scale.

In line with previous research on green exercise, the exercise-only conditions will comprise 20 minutes of low intensity exercise (walking) in both green and built-up environmental conditions. Previous research examining the impact of green exercise found that one 'dose' of exercise which is greater than 15 minutes in duration is sufficient to bring benefits, regardless of intensity of the exercise (Han, 2017; Mackay & Neill, 2010; Parks, Furuya, Kasetani, Takayama, Kagawa & Miyazaki, 2011; Pretty, Peacock, Hine, Sellens, South & Griffin, 2007). For the green condition, this exercise will take place in a natural, green environment, as defined by Barton and Rogerson (2017). For the built-up condition, the exercise will take place in a non-green environment. Though both groups will be required to take a short walk to access the exercise space, the 20 minutes of low intensity exercise will begin once the green or non-green space has been reached. During the walk, children will walk in pairs. Walking in pairs is considered to be more helpful in supporting health and safety while on the walk. Selection of pairings will be at the class teacher's discretion.

With regard to the connectedness conditions, intervention will take place in a natural, green environment, as defined by Barton and Rogerson (2017) and in a built-up environment. The same setting used for completing green and non-green exercise-only conditions will be visited for connectedness conditions. While visiting each

setting, participants will be asked to take note of three features of the environment. For example, in the green condition, a flower, tree, butterfly or bird, and in the non-green condition, a car, house or building. These three features will be recorded, by each participant, on a template provided by the researcher. The template will be completed by participants while walking in the relevant environment. Please see template in Appendix L.

It is envisaged that at least two school staff members (class teachers; special needs assistants) will be present for outings required in each condition. School staff will be asked to keep interactions with participants to the minimum necessary during the walk/connectedness activities, in order to reduce confounds. During each outing, the researcher will be present and will maintain a role of 'observer-as-participant', with the exception of providing guidance at the beginning of the experimental condition with regard to what is required (ie walking for 20 minutes or completing connectedness activity) (Robson, 2009, p.319).

Completion of participation in each condition will take place 1 week apart. Pre intervention measures will be administered immediately prior to participation in each condition. Post-intervention measures will be administered upon return to the classroom following participation in each condition. The time of day at which participants will engage with each condition will be confirmed through discussion with school principals. As the researcher will be present in each school on the day of intervention and guide teachers, special needs assistants etc. on what is required, implementation fidelity will be ensured.

In order to account for unforeseen happenings which may influence data results, the researcher will maintain a record of events for each condition. Events occurring en-route to, in situ or on return from the intervention location will be recorded. The weather on each day will also be recorded in this template as this may impact on participants' mood. Please see template in Appendix K.

Gathered data will be inputted to SPSS for statistical analysis. Data will be analysed according to a multilevel model. Field (2009) suggests that multilevel models should be used to analyse data that have a hierarchical structure, such as patients who see different therapists in different clinics, or, as in this research, students, within class groups, within schools. Similarly, Raudenbush and Bryk (1986) argue that multilevel

modelling provides a flexible statistical tool for studying how variations in policies and practices influence educational processes. Applying a multilevel model to analysis, the role of group-level factors is more adequately captured (Kahn, 2011).

6c Steps taken to Minimise Risk

The proposed study requires participants to partake in *either* 2 X 20 minutes of low intensity physical exercise (walking) *or* 2 X connectedness to environment activities while walking. In order to minimise any health and safety risk associated with this activity, parents and students will be provided with detailed information of what is involved in participation in order to provide informed consent/assent. They will be informed of their right to withdraw from the study, at any stage, and that they do not need to provide a reason for doing so.

Participants will be required to leave school grounds to complete the intervention. The identified green and non-green spaces will be in close proximity to schools (less than a 5-minute walk). At the stage of identifying schools to be invited to participate, it will be ensured that it is not required to cross main roads in order to access the exercise space and that the space is away from high traffic areas.

In the case of a parent or child choosing not to participate in the research, it will be recommended to schools that s/he complete the activities with the class group but does not complete any data collection measures. Should the school wish to make an alternative arrangement for children not participating, this will be at their discretion.

It will be recommended to the school that a risk assessment for the outing be undertaken or that usual accommodations for a school outing are put in place, for example additional teacher or presence of special needs assistant(s). Each school's risk assessment will be completed in consultation with the researcher. The risk assessment will take account of the potential for injury of participants in the study (when travelling to the exercise location or during the 20 minutes of exercise). Protocol in case of injury will be agreed upon with the school at this stage; this protocol will adhere to each school's existing policy with regard to administering first aid, contacting parents etc.

6d Location(s) of Project

The project will take place on site in and close to participating schools. The non-

green (control) conditions will take place in a non-green environment in close proximity to the school, such as a local housing estate or local village. The green (intervention) conditions will take place in a field/woodland etc. in close proximity to the schools (less than a 5 minute walk); these locations will be agreed upon with each school in advance of the date the intervention will take place.

Pre and post-intervention measures of mood will be administered in classrooms. Assessment of attentional capacity will take place on site in each school, in a quiet space which is not open to distractions.

6e Questionnaires and Interview/Survey Questions

The well-being measure is based on items on the FACE scale (Kennedy et al., 2014). FACE was assessed for reliability and validity through administering to a sample of adolescents. It achieved high reliability (Cronbach's alpha = 0.7734) and correlated significantly with the Brunel Mood Scale (Kennedy et al., 2015). The FACE showed significant changes in mood from before to after a therapeutic intervention for all participants. FACE measures some feelings which are not of concern in this study, for example 'confusion', and some of the language used was not considered appropriate to the cultural context of Irish schools, for example 'grouchy' and 'on edge'. Given these limitations, it has been tailored to the aims and context of this research, incorporating more pertinent feelings and more culturally appropriate language, as perceived by the researcher. This scale may be adapted in light of the pilot phase. Please see Appendix G for assessment of mood measure.

The digit span test is a well-established, standardised neurocognitive measure which assesses directed attentional capacity and has known reliability and validity capacities (Bodin & Hartig, 2003). This test is a component of the Wechsler intelligence scales for children. Please see appendix H for the digit span test. It will be administered by the researcher to the group. The researcher will call out the digits; once participants hear a noise signal (bell tone); they will record their responses in writing. Class teachers will support this process by monitoring and ensuring that all participants begin writing their responses at the appropriate time. As the discontinue rule cannot be applied when administering to a group; all participants in this subsample will complete all items. By administering digit span to all participants in a class at once, the disruption to class time is reduced and results

between conditions are more effectively comparable.

7	Participants
7a	**How will potential research participants be identified and selected?**

Schools which have an appropriate space for green exercise and non-green exercise, in close proximity, will be identified and invited to participate in the study.

Within participating schools, 3rd to 6th class students will form the research sample. This age range has been selected as they are considered to have the appropriate level of literacy to complete the self-report well-being measure. Children who may have difficulty in completing the mood assessment will be identified prior to administering the tool through discussion with the class teacher. For these children, assistance will be provided by the researcher or class teacher. In addition, assistance will be provided to any other children seeking clarification, as necessary. Prior to administering assessment, discussion will take place with the class teacher to outline what assistance can be provided and how to deliver it. In this way, consistency in terms of support provided will be ensured thus limiting threat to data validity. In addition, a record of the students who required assistance will be maintained so that any effects of receiving support may be determined at the analysis stage. Assistance which may be provided includes acting as 'reader' or supporting on task behaviour. A script explaining each feeling on the mood measure and instructions for completion will be read out prior to administration. Please see Appendix I for the explanatory script for mood measure.

As Cannon et al. (2013) found that one in three children will experience mental health difficulties before age thirteen, this is considered to be the appropriate target age group for this intervention. Whole class groups will be invited to attend with no exclusion criteria relevant to individual pupils. The sample on which the digit span test will be administered to measure attentional capacity will be selected at random from within each participating class.

7b	How many participants will be recruited?

The researcher aims to recruit three schools for participation in the proposed study; each school will participate in both the treatment and control condition. Within each school, 3rd-6th class pupils will be invited to participate. Allowing for variation in school size, it is hoped that a sample of approximately 300 participants will be achieved through the three schools. This sample size is in line with Onwuegbuzie, Jiao and Bostck's (2004) recommendation of 64 participants per group in quasi-experimental research, testing a two-tailed hypothesis. Within each participating class, eight students will be randomly selected to complete the measure of attentional capacity; it is hoped to achieve a subsample of 96 participants who complete this measure.

Schools will be initially screened on the basis of their proximity to appropriate green, natural spaces and to a suitable, non-green area. Once the researcher has identified suitable environments, under 5 minutes walking distance from the school, a recruitment letter will be sent out to schools inviting them to participate in the study (Appendix A). Following expression of interest, the researcher will meet with the school principal to discuss access to the identified green and non-green environment, health and safety concerns, and feasibility of the school's participation in the study. If feasibility is confirmed, information sheets will be provided to school (Appendix B) and information sheets and informed consent forms will be provided to parents/guardians of pupils in 3rd-6th class (Appendix C and D).

7c	**Will participants be reimbursed for taking part in this research project? If YES, please attach the details to this application.**	**Yes**		**No**	✓
7d	**Will incentives / inducements be provided to participants for taking part in this research project? If YES, please attach the details to this application.**	**Yes**		**No**	✓
7e	**Will Recruitment Letters/Advertisements/e-mails, etc. be used to recruit participants? If YES, please attach the details to this application.**	**Yes**	✓	**No**	

8	**Confidentiality of collected data and completed forms (e.g. informed consent)**
8a	**What measures will be taken to ensure confidentiality of collected data?**
Anonymity will be maintained throughout the data collection process. No identifiable details will be used at any stage of the study, including names of	

individuals, schools, locations etc. A random ID number will be generated for each participant and it is this number rather than the participant's name which will be held with the data to maintain their anonymity. Pseudonyms will be utilised when reporting the research findings. Participants, including schools and parents, will be informed, at the outset, of the measures taken to ensure confidentiality.

8b Where and how will the data be stored / retrieved?

Paper data (e.g. consent forms, measures of well-being and attention) will be stored in a locked file box. This locked file box will be kept in a storage cupboard in the researcher's home office. Soft-data, such as SPSS input and output, will be stored on an encrypted memory stick.

8c Who will have custody of, and access to, the data?

Alison O'Keeffe (Researcher) will have custody of the data. Johanna Fitzgerald (Research Co-Supervisor), Paul Mulcahy (Research Co-Supervisor) and Therese Brophy (Research Coordinator) will have access to the data. Research supports in Mary Immaculate College may have temporary access to the data should assistance be necessary.

8d For how long will the data from the research project be stored? *(Please justify)*

In accordance with the Data Protection Act (2003), data will be retained no longer than is necessary for the purpose of the research. As outlined by the Mary Immaculate College Record Retention Schedule, research records will be kept for the duration of the study plus three years and research data, findings and notes will be retained indefinitely.

9 Information Documents

Indicate which of the following information documents are applicable to your Research Project by ticking either Yes or No in the checklist below. Attach a copy of each applicable information document to the application.

	Applicable Please ✓	
Documents	***Yes***	***No***
Participant Information Sheet	✓	
Parent/Responsible Other Information Sheet	✓	
Participant Informed Consent Form/Assent Form	✓	
Parent/Responsible Other Informed Consent Form	✓	
Questionnaires, Interview Schedules (or sample)	✓	

10 Declaration

The information in this application form is accurate to the best of my knowledge and belief, and I take full responsibility for it. I undertake to abide by the ethical principles outlined in the DECPsy Research Ethics Guidelines**. If the research project is approved, I undertake to adhere to the study protocol without unagreed deviation, and to comply with any conditions sent out in the letter sent by the DECPsy REC Committee notifying me of this. I undertake to inform the DECPsy REC of any changes in the protocol.** I accept without reservation that it is my responsibility to ensure the implementation of the guidance as outlined in DECPsy REC 2 Form

Name (Print) _Alison O'Keeffe_

Signature 

Date _01 May 2018

References

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Appendix H – Parent Information Sheet

Parent/Guardian Information Sheet

What is the project about?

Green exercise is physical exercise which takes place in natural environments. I am interested in learning whether exercise in a green, natural environment will have more benefits for children than exercise in a built-up, non-natural environment. I would also like to find out if taking notice of our surroundings in a green environment is more beneficial than taking notice of our surroundings in a non-green environment. I would like your permission for your child to participate in two 20-minute walks, one in a green environment and one in a non-green or to complete two nature connectedness activities, while walking in a green environment and in a non-green environment. Your child would be randomly assigned to one of these activity types. Each phase will be completed with his/her classmates and teacher and your child will complete a short questionnaire before and after the activity.

Who is undertaking it?

My name is Alison O'Keeffe and I am currently in my second year of training on the Doctorate in Educational and Child Psychology programme at Mary Immaculate College, Limerick. The school your child attends has agreed to participate in my research, which will form part of my doctoral thesis. This research is being conducted under the supervision of Dr. Johanna Fitzgerald and Dr. Paul Mulcahy.

Why is it being undertaken?

The aim of the study is to explore the effects of green exercise and connectedness to nature on children's psychological well-being and attention.

What are the benefits of this research?

It is hoped that the data gathered from participants will enhance our understanding of the effects of green exercise and noticing nature on children's psychological well-being and on children's attention.

Exactly what is involved for the participant (time, location, etc.)

Depending on the activity your child is assigned to, he/she will complete a short questionnaire which measures mood state, before and after 20 minutes of walking in a natural, green environment close to his/her school and before and after 20 minutes of walking in a non-green, built-up environment close to his/her school *or* will complete the same questionnaire before and after completing a noticing nature activity while walking in

the same green and non-green environments. The mood measure involves your child ticking boxes to show how s/he is feeling at that moment. In addition, 8 children from each class group will be randomly selected to complete a pre and post activity measure of attention. The attention measure will be administered to the selected children in a group and will be approximately 5-10 minutes in duration. The attention measure involves your child being provided with lists of numbers, orally, and recording the numbers they recall on a response sheet.

Are there risks associated with this research?

As participation in this research involves participation in two 20 minute walks and walking to a public area to complete the activities, there may be a risk of injury. As walking is a low intensity, it is not considered to bring a high level of risk. The spaces identified for completing the walks are in close proximity to the school (less than a 5-minute walk). In order to further minimise risk, a risk assessment will be completed collaboratively by the researcher and your child's school. Should any injury occur, school protocol will be adhered to.

Right to withdraw

You and your child have the right to refuse to participate in this programme. Your child is free to withdraw from the study at any time without giving a reason and without consequence. If your child is withdrawn, s/he may still participate in the activities with classmates but will not complete any measurement tools.

How will the information be used / disseminated?

The data gathered from your child's school will be combined with that of the other participating schools in this study and used to form the results section of my thesis. Individual participant data will not be shown. Details of school profiles, such as size and gender of student population, rural/urban, may be included in the analysis section of my thesis. Profiles will be presented such that no school will be identifiable. Findings from the research may be disseminated at conferences and/or used in publications arising from the study.

How will confidentiality be kept?

Your child's anonymity will be protected throughout the research process; no identifiable details will be used. A random ID number will be generated for each child. All information gathered will remain confidential; the researcher, the research supervisors and the research director will have sole access to the gathered data. As data will be anonymised, it will not be possible to retrieve data for a specific child once data collection is complete.

What will happen to the data after research has been completed?

All research data will be stored for the duration of the project plus three years. Anonymised research data may be held indefinitely or as required by the researcher.

Contact details:

If at any time you have any queries / issues with regard to this study, my contact details are as follows:

*Researcher's Contact Details

If you have concerns about this study you may contact:

*Research Supervisor's Contact Details

*Research Director's Contact Details

Thank you for taking the time to read this information letter.

Informed Consent Form

Dear Parent/Guardian,

As outlined in the **parent/guardian information letter** the current study will explore the effects of green exercise and nature connectedness on children's psychological well-being and attention. The research will provide insight into the effectiveness of this intervention in improving children's mental health.

The parent/guardian information sheet outlines what will be involved in this research project. This should be read fully and carefully before consenting to your child taking part in the research project.

In addition, it is recommended that you discuss this project with your child, ensuring s/he understands what is involved before s/he gives assent to participating.

Your child's anonymity is assured and you are free to withdraw him/her from the research at any time. All information gathered will remain confidential and will not be released to any third party. In accordance with the MIC Record Retention Schedule all participant data will be stored for the duration of the project plus three years at which time it will be destroyed. Anonymised research data may be held indefinitely or as required by the researcher.

Please read the following statements before signing the consent form.

- I am over 18 years of age.
- I have read and understood the parent/guardian information sheet.
- I understand what the project is about, and what the findings will be used for.
- I have discussed this information with my child and s/he is happy to participate.
- I am fully aware of all of the procedures involving my child, and of any risks and benefits associated with the study.
- I know that my child's participation is voluntary and that I can withdraw him/her from the project at any stage without giving any reason.

Child's Name (Printed: _____

Parent/Guardian Name (Printed): _____

Parent/Guardian Name (Signature): _____

Date: _____

Appendix I – Child Assent Form

Who is doing this research?

My name is Alison O'Keeffe. I am a student in Mary Immaculate College in Limerick. In college, I learn about how children learn best at school and how to help children to be happy and healthy.

What is the project about?

Green exercise is physical exercise, like walking or running, which happens outside, in an area with lots of green grass, trees and plants. I would like to find out how going for a walk in a place with lots of green grass, trees and plants and going for a walk in an area with lots of cars, houses and buildings makes you feel. To help me find this out, I will be asking some children in your class to do two 30-minute walks, one in a natural, green space and one in a not so green space. I will be asking other children in your class to agree to do two other activities, looking at what is around you, while walking. You will do each activity with your classmates and teachers. I will also ask you to fill out a short worksheet before and after each activity so that I can understand how you are feeling. You, or some of your classmates, may also be asked to do another task before and after each activity. This task involves listening to numbers and writing down the numbers you can remember.

How will this research help?

This research will help me, and others, to find out about how exercising in a green space makes children feel.

So what will you be doing?

You will answer a few short questions which ask about your feelings, before and after going for a walk in two different places and before and after doing an activity which involves looking at things around you. You may also be asked to complete another activity, where I will say numbers and ask you to write down the ones you remember.

What happens if I get hurt while walking?

It is unlikely that you will hurt yourself when completing this walk. But, if you do, your class teacher and I will have a plan to take care of you and help you to feel better.

Do I have to take part?

If you decide at any stage that you do not want to take part, you can let me or your teacher know. You will not have to answer the questions on the worksheet but you will still do the different activities with your class. You do not have to tell us why you do not want to take part anymore and you will not get into any trouble.

What will happen to the information I gather?

I will use this information to write a long essay for my course. I may also share the information at a conference or in a magazine. Wherever I am sharing this information, your name will not be in it.

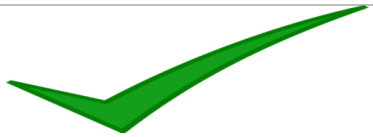
Thank you for taking the time to read this information sheet. ☺

My name is _____.

I am going to go for walks or do a nature activity with my class. I will answer questions about how I am feeling. To answer the questions, I will look at the different types of feelings and tick the boxes that show how I am feeling. I will answer the same questions before and after going for a walk or doing the nature activity with my class. I may also do a task where I listen to different numbers and write down the numbers that I remember.

I know that I don't have to answer the questions if I don't want to. I know that whenever I feel like stopping answering the questions, that's okay, I won't get in trouble and I don't have to say why I feel like not answering.

Please mark next to the ✓ if you want to join in or mark next to the X if you do not want to join in.

Appendix J – School's Information Sheet

What is the project about?

Green exercise refers to physical exercise which takes place in natural environments. Research focusing on effects of green exercise for children is in its infancy. However, early indications show improved attention and concentration and increased physical benefits, compared with exercise in a non-natural environment. Similarly, connecting to natural, green environments has shown positive effects on psychological health of adults. Further research is required to provide insight into the impact of green exercise and nature connectedness on children's psychological well-being, including mood and anxiety levels.

Who is undertaking it?

My name is Alison O'Keeffe and I am currently in my second year of training on the Doctorate in Educational and Child Psychology programme at Mary Immaculate College, Limerick. I am inviting you to take part in my research 'Examining the effect of green exercise and nature connectedness on the psychological well-being and attentional capacity of primary school aged children' which will form part of my doctoral thesis. This research is being conducted under the supervision of Dr. Johanna Fitzgerald and Dr. Paul Mulcahy.

Why is it being undertaken?

The study is being undertaken to explore the effects of green exercise and connecting to nature on children's psychological well-being and attentional capacity. The research will provide insight into the effectiveness of these interventions in improving children's mental health.

What are the benefits of this research?

It is hoped that the data gathered from participants will (a) enhance our understanding of the effects of green exercise and nature connectedness on children's mental well-being, (b) enhance our understanding of the effects of green exercise and nature connectedness on children's attentional capacity and (c) may have implications for how psychological well-being is promoted and maintained in schools in Ireland.

Exactly what is involved for the participant (time, location, etc.)

The study will consist of 3rd-6th class children completing either two sessions of exercise, one taking place in a green environment and one in a non-green environment, or completing two nature connectedness activities while exercising, one taking place in a green environment and one in a non-green environment. Each child will be assigned to complete either the 20-minute walk in two different environments or a nature connectedness activity

while walking in two different environments. Each phase will take place one week apart. Before and after each phase, children will be asked to complete a questionnaire which measures each child's mood state. In addition 8 children from each class group will be randomly selected to complete a pre and post-intervention measure of attentional capacity. The attention measure will be administered by the researcher, and will be approximately 5-10 minutes in duration.

It is envisaged that the experiment will take place during class time. Overall, it is estimated that each phase will last for approximately 45-60 minutes. A suitable time will be identified through discussion with school staff; the researcher will aim to facilitate the school's preferred time.

Are there risks associated with this research?

As participation in this research involves participation in two 20 minute walks *and* walking to a public area to complete the activities, there may be a risk of injury. As walking is a low intensity, it is not considered to bring a high level of risk. The spaces identified for completing each phase are in close proximity to the school (less than a 5-minute walk). In order to minimise risk associated with participation, parents and students will be provided with detailed information of what is involved in order to provide informed consent/assent. They will be informed of their right to withdraw from the study, at any stage, and that they do not need to provide a reason for doing so. In addition, a risk assessment will be completed in consultation with the researcher. The risk assessment will take account of the potential for injury of participants in the study (when travelling to the locations or during the 20 minutes of exercise).

Right to withdraw

The anonymity of each participating school and individual is assured. The school, or any individual within the school, is free to withdraw from the experiment at any time without giving a reason and without consequence. Should a child withdraw, s/he may still participate in the activities with classmates but will not complete any measurement tools.

How will the information be used / disseminated?

The data gathered from your school will be combined with that of the other participating schools in this study and used to form the results section of my thesis. Summary data only will appear in the thesis; individual participant data will not be shown. Details of school profiles, such as size and gender of student population, rural/urban, may be included in the analysis section of my thesis. Profiles will be presented such that no school will be identifiable. Findings from the research may be disseminated at conferences and/or used in publications arising from the study.

How will confidentiality be kept?

The anonymity of participants will be protected throughout the research process. No identifiable details will be used, including names of participants, schools and regional locations. A random ID number will be generated for each participant and it is this number rather than the participant's name which will be held with their data to maintain their anonymity. All information gathered will remain confidential and will not be released to any third party; the researcher, the research supervisors and the research coordinator will have sole access to the gathered data. As data will be anonymised, it will not be possible to retrieve data for a specific child once data collection is complete.

What will happen to the data after research has been completed?

In accordance with the MIC Record Retention Schedule all research data will be stored for the duration of the project plus three years. Anonymised research data may be held indefinitely or as required by the researcher.

Contact details:

If at any time you have any queries / issues with regard to this study, my contact details are as follows:

*Researcher's Contact Details

If you have concerns about this study you may contact:

*Research Supervisor's Contact Details

*Research Director's Contact Details

Appendix K – Empirical Article

Introduction

The National Council for Special Education (NCSE; 2006) outlines that an estimate of 86,083 children attending Irish schools have a moderate to severe mental health difficulty. The NCSE (2006) report further suggests that this is a conservative figure which does not account for children who experience mental health difficulties at a milder end of the spectrum. In recent years, national and educational policy have highlighted the importance of building children's positive well-being and engagement in learning (Department of Children and Youth Affairs, 2014; Department of Health, 2013).

Though mental health has previously been regarded as a term synonymous with mental illness, or conceptualised only in terms of the absence of mental illness, more recently, a reconceptualisation of mental health views it as the presence of positive aspects of well-being (Cane & Oland, 2015; MacDonald, 2006). The World Health Organisation [WHO] (2014) defines health in terms of complete physical, mental and social well-being, going beyond the mere absence of illness. Additionally, the WHO (2004) outlines that the essential aim of mental health promoting action is to improve the well-being and functioning of individuals through a focus on strengths and resources, building levels of resilience and enhancing protective factors. Similarly, Cane and Oland (2015) suggest that this reconceptualisation of mental health encourages the exploration of proactive means of promoting mental health, which may be preventative of mental health difficulties, rather than maintaining a reactive, treatment approach to mental ill-health.

With consideration of proactive means of promoting positive mental health in children, the potential inherent in the school setting warrants examination. A potential school-based well-being focused intervention can be found in children's engagement in green exercise or nature connectedness activities. Green exercise refers to physical activity which takes place in a natural environment (Calogiuri, Patil & Aamodt, 2016). Research has found additional physical and mental health benefits to green exercise, beyond those benefits which result from physical activity alone (Calogiuri et al., 2016). The environment in which green exercise is conducted can be conceptualised as one which has a greater ratio of natural to artificial

elements than is typically encountered by an individual in everyday life (Mackay & Neill, 2010). Though beneficial effects of green exercise have been recorded in research, the combination of factors which may be involved in determining the effect of green exercise, such as exercise variables, individual differences, cognitions, socio-cultural variables and environmental variables, is as yet ambiguous (Mackay & Neill, 2010).

Two theories, attention restoration theory and stress reduction theory, underlie a majority of research into the effects of connection with nature and exercise in natural, green spaces on aspects of well-being (Han, 2017; Mackay & Neill, 2010; Martensson et al., 2009; Olafsdottir, Cloke & Vogele, 2017; Passmore & Holder, 2017; Richardson & Sheffield, 2017; Roe & Aspinall, 2011). Attention restoration theory (ART) proposes that attention fatigue can be restored through particular environments (Kaplan & Kaplan, 1989). Attention fatigue may result from, for example, long hours of study, a period of worry or anxiety or a busy period of working to complete several tasks (Kaplan & Kaplan, 1989). The environments on which Kaplan and Kaplan (1989) focus their theory are natural; their conceptualisation of the natural environment is broad, encompassing environments where there has been little human intervention as well as places designated as 'natural areas' by a government body. Natural environments include woodland, parks, meadows, abandoned fields and domestic gardens (Kaplan & Kaplan, 1989). Stress reduction theory (SRT) adopts a psycho-evolutionary perspective (Ulrich et al., 1991). It suggests that immediate, unconsciously initiated emotional responses play a central role in how one responds to nature, and that these influences impact attention, physiological state and behaviour (Ulrich et al., 1991). In this way, Ulrich's (1983; 1991) theory diverges from attention restoration theory; SRT suggests that the initial response of an individual to the environment is affective rather than cognitive (Hartig et al., 1991).The features of a natural setting and the emotional, cognitive and physiological state in which an individual encounters that setting will dictate adaptive responses; Ulrich (1983) suggests that these adaptive responses can range from stress and avoidance behaviour to restoration and approach behaviour. SRT proposes that nature has a calming effect due to non-demanding stimuli which elicit positive emotional states and suppress negative emotional states (Hartig et al., 1991).

An individual's dispositional sensitivity to engaging with environments on an aesthetic level has been found to play a role in dictating responses (Lu, Wang & Hughes, 2016; Roe & Aspinall, 2011). Research on the topic of personality and aesthetic experience relates to the 'big 5' personality dimension of openness to experience (Lu et al., 2016; McCrae & Costa, 1997). Stress response has been investigated in the context of personality composition with findings that the trait of openness has an influence on an individual's stress response (Ó Súilleabháin, Howard, & Hughes, 2017; Williams, Rau, Cribbet & Gunn, 2009). Following subjection to a laboratory-based stressor, participants who were higher in openness experienced less blood pressure reactivity and a small increase in positive affect during the stressor (Williams et al., 2009). The researchers also found that life stress resulted in poor sleep quality for participants with low levels of openness, suggesting that those high in openness have greater levels of stress resilience (Williams et al., 2009). Similarly, Ó Súilleabháin et al. (2017) found that higher openness was associated with an adaptive cardiovascular stress response within the context of exposure to changing levels of acute stress. Both studies conclude that openness to experience buffers individuals from the negative effects of stress, suggesting that individual differences are implicated in stress response (Ó' Súilleabháin et al., 2017; Williams et al., 2009).

A systematic review of research on the impact of green exercise and nature connectedness interventions on well-being is outlined. Considering the comparative dearth of children-focused research, the review will include intervention-based research carried out with children, adolescent or young adult populations. A literature search focusing on nature connectedness intervention studies and a further literature search on green exercise intervention studies were completed. Before synthesising the identified research, the evidence was assessed for appropriate quality and relevance through application of Gough's weight of evidence (WoE) framework (Gough, 2007). The framework critically analyses each study in terms of its methodological quality (WoE A), a review-specific focus on methodological relevance (WoE B) and a review-specific judgement on relevance of the research evidence to the review question (WoE C) (Gough, 2007). WoE A, B and C will be combined to form WoE D, an overall assessment of the extent that the study contributes to the answering of this review question (Appendix A).

The articles included in the review find varying outcomes as to the effectiveness of a nature-based intervention in improving aspects of well-being in various populations. The youngest participants in this review were included in studies by Dowdell et al. (2011) and McCree et al. (2018). Both studies focus on school-based intervention. Dowdell et al. (2011) draw comparison between a childcare centre with a natural, green outdoor environment which fosters environmental awareness and nature connection and a childcare centre without such an apparent focus. McCree et al. (2018) examine the impact of a longitudinal intervention which focuses on engagement with the natural environment. Both studies found positive outcomes for children who engaged in nature-based conditions. The role the natural environment played in supporting children's imaginative play and in nurturing positive relationships between children is highlighted (Dowdell et al., 2011). The development of self-regulation and resilience, as well as an increase in nature connectedness, is reported by McCree et al., 2018). In both studies, the natural environment became a stimulating environment which allowed children to become confident and curious learners (Dowdell et al., 2011; McCree et al., 2018). Though demonstrating positive outcomes, both studies engaged a small sample size leading to limited generalisability. In addition, as McCree et al.'s (2018) intervention took place over a three year period, the researchers acknowledge the wide range of potential parameters which may have contributed to findings. However, through triangulated data gathered from children, parents and teachers, the natural environment was identified as a primary influence on positive changes which occurred (McCree et al., 2018). Similarly to Dowdell et al. (2011) and McCree et al. (2018), Han (2014) has a small sample size in his research on the effects of green exercise on behaviour and adaptation capacity of children with a diagnosis of ASD. No significant impact of green exercise on behaviour was found, though higher levels of physical exertion and more frequent visits to natural environments had greater influence on adaptation capacity of participants (Han, 2014). A notable limitation in Han's (2014) research is the range of types of physical activity and the range of lengths of time spent in natural environments, as well as the study's reliance on parent report for account of physical activity; these factors contribute to a difficulty in drawing accurate conclusions.

The impact of self-esteem on psychological well-being and on successful functioning is well-documented (Craven & Marsh, 2008; Robins & Trzesniewski, 2001; Seema & Venkatesh, 2017). Two studies targeted this aspect of well-being through nature-based intervention (Barton et al., 2016; Reed et al., 2013). With the recognition that connection to nature is an important predictor of subjective well-being, Barton et al.'s (2016) research found that engagement with wilderness expeditions led to significant increases in both self-esteem and connectedness to nature. The researchers identified a gender effect, with females experiencing a greater increase in self-esteem than males, following intervention. Importantly, the positive outcomes were not found to be significantly affected by participants' home living environment, location or length of expedition (Barton et al., 2016). In contrast to Barton et al.'s (2016) findings, Reed et al., (2013) did not find that exercising in a natural green environment had a significant increase in self-esteem moreso than the control condition (exercise in an urban setting). However, the researchers found that exercising in the green condition was enjoyed more equally by children with differing habits of engagement with physical activity, suggesting that green exercise has greater potential to engage less active children (Reed et al., 2013). Explanation offered for the lack of impact of exercise in the green condition points to the presence of teachers giving instruction and the possibility that the green exercise was viewed as a school activity rather than a potentially restorative one (Reed et al., 2013). Further, the researchers utilised Rosenberg's self-esteem scale for pre and post-intervention measurement; it is suggested that a state scale rather than a trait scale may have had greater sensitivity (Reed et al., 2013).

A number of studies adopted a similar approach to intervention as Reed et al. (2013), comparing effects of a green condition with either an urban/human-built condition and/or a control condition (Duncan et al., 2014; Kant & Sharma, 2016; Mayer et al., 2009; Olafsdottir et al., 2017; Passmore & Holder, 2017; Pretty et al., 2005). Kant and Sharma (2016) found that viewing slides showing natural, green scenes and viewing slides of abstract objects both had a significant positive effect on positive affect and internal aspiration. Likewise, positive affect was significantly higher post-intervention in the green condition, as compared to the human-built and business-as-usual conditions, in Passmore and Holder's (2017) study. Additionally, significant changes to general sense of connectedness and prosocial orientation were identified

following intervention which focused on the natural environment (Passmore & Holder, 2017). Qualitative data added further weight to Passmore and Holder's (2017) outcomes; wordclouds generated by participants in the green condition recorded items including 'peace', 'hope' and 'rejuvenation', while those in the human-built condition generated descriptors including 'annoyance', 'fatigue', 'stress'. Though Passmore and Holder (2017) engaged a large sample of participants, the sample was comprised predominantly of female undergraduate students which somewhat limits the generalisability of the results.

A walking component was utilised as the exercise element of research by Mayer et al. (2009) and Olafsdottir et al. (2017), while Pretty et al. (2005) asked participants to complete a twenty-minute run. Mayer et al. (2009) found that exposure to natural green environments increased connection to nature, attentional capacity, positive emotions and ability to reflect on a life problem. Further, the researchers compared the impact of an actual natural environment to that of a virtual natural environment and found that the aforementioned positive effects were more dramatic when contact was with an actual natural environment (Mayer et al., 2009). Of five conditions in Pretty et al.'s (2005) research, viewing rural pleasant scenes during exercise produced the most consistent, though not always significant, improvements on six measures of mood. Exercising whilst viewing urban unpleasant scenes produced significant improvements, for anger-hostility, confusion-bewilderment and tension-anxiety. In contrast, unpleasant rural scenes diminished the positive impact of exercise, reducing effects on self-esteem levels and mood, including anger-hostility and tension-anxiety. Though the photographic material used in this study is not described in significant detail, the photographs were categorised by an independent panel of 50 people; when 95% of these participants categorised a photograph as strongly representing a particular definition, it was selected for use in the experiment. Examples of photographs used in the study show trees and meadows (rural pleasant), fields with abandoned, decaying cars (rural unpleasant), a marina with sail boats, trees and modern high-rise buildings (urban pleasant) and a disused building with several windows broken (urban unpleasant). The researchers surmise that perceived threats to a rural environment are of greater negative impact than perceived threat to an urban environment (Pretty et al., 2005).

Olafsdottir et al. (2017) focused on the stress-reducing benefits of contact with a green environment. Participants in each condition experienced reductions in stress hormones. This reduction was most pronounced in the green exercise group though the difference between the groups did not reach significance (Olafsdottir et al., 2017). Qualitative accounts from participants emphasised the nurturing effect of being able to direct attention and experience to a restorative environment, removed from stressful circumstances and settings (Olafsdottir et al., 2017). Cycling featured as the exercise component in two studies (Akers et al., 2012; Duncan et al., 2014). Duncan et al.'s (2014) study examined the effects of green exercise on a cohort of primary school aged children. Though blood pressure was significantly lower post a fifteen minute cycle while viewing natural, green environment, fatigue was higher and vigour was lower post both the treatment and control condition (Duncan et al., 2014). This is contrary to outcomes in adult-based studies which have reported positive mood changes following exposure to green, natural scenes (Mayer et al., 2009; Pretty et al., 2005). The researchers question whether a generational difference in nature connectedness may underlie this disparity (Duncan et al., 2014). It is worthy of note that mood measures were taken fifteen minutes following completion of the intervention which may have dissipated some effects on mood and that the sample size in this study was small, providing limited statistical power (Duncan et al., 2014). Akers et al. (2012) also required participants to complete cycling trials, however the crux of their investigation was the extent to which the colour green contributes to the effects of green exercise. As compared with viewing scenery with a red or a grey filter, the green condition contributed to lower total mood disturbance and lower levels of perceived exertion. In contrast, levels of anger were higher in the red condition (Akers et al., 2012). However, a limitation of this study was the absence of pre-intervention measures of mood, thus post-intervention levels are not controlled for by a baseline.

Three of the remaining studies explored the effects of environmental education/wilderness expeditions on elements of well-being, including nature connectedness, self-efficacy, fear levels, perceived stress and positive and negative emotions (Lieflander et al., 2013; Rose et al., 2018; Warber et al., 2015). Emphasising the role of nature-connectedness in overall well-being, Lieflander et al. (2013) found that participation in an environmental education programme resulted in

a robust increase in nature connectedness. Additionally, for participants aged between nine and ten years, this increased connectedness remained four weeks post-intervention. A number of benefits were observed by Rose et al. (2018); following attendance at school-run outdoor youth programmes, increased levels of self-efficacy, connectedness to peers and school, and decreased levels of fear were evident. However, no significant changes to levels of depression, aggression or nature connectedness were found. While the absence of a control group is a limitation of this study, Rose et al. (2018) did access a relatively large sample of participants and participants engaged with one of three outdoor programmes with comparable outcomes from each which allows for a degree of generalisation of results. Similar results were found by Warber et al., 2015). Following a wilderness expedition, nature-related measures (perceived safety, sense of place, nature connectedness) significantly increased, as did well-being outcomes, which included perceived stress, sense of wholeness and positive and negative emotions (Warber et al., 2015). Like Rose et al. (2018), this study did not engage a control group. Coupled with the small sample size, the inferences which can be drawn from Warber et al's (2015) research are somewhat limited.

The final study in the review expands on the understanding of the natural environment as a necessarily green one. Hignett et al. (2017) look to the impact which 'bluespace' can have on personal well-being and nature connectedness. Following engagement with a surfing programme, participants were found to have increased satisfaction with appearance, increased positive social relationships with peers, increased pro-social behaviour at school and more positive attitudes towards school (Hignett et al., 2017). Further, teacher evaluations detailed increased emotional literacy and levels of motivation. As with a number of studies in this review, the lack of a control group means that the results must be generalised with caution. However, the researchers highlight the potential of 'bluespace' environments as an alternative location for accessing the benefits of the natural environment, with acknowledgement that further research is required (Hignett et al., 2017).

Overall, findings indicate that engaging with intervention did impact on participants' levels of well-being. However, the extent to which interventions increased the targeted construct did differ across studies with some finding that specific changes

had not reached a significant level (Hignett et al., 2017; Olafsdottir et al., 2017; Reed et al., 2013; Rose et al., 2018). The research completed to date does not provide a comprehensive conclusion as to what is the most effective way to build nature connection and what elements of well-being are most susceptible to change as a result of nature-based intervention. Further, the number of studies which provide evidence of the effects of the natural environment on children's well-being are few (Duncan et al., 2014). Placing reviewed research in the context of current educational and health policy which addresses children's health and well-being, further exploration of the effect of nature on children's emotional state is considered pertinent. This study aimed to answer the following research questions:

1. What is the effect of exercise in a natural, green environment on the mood state of primary school-aged children?
2. What is the interaction, if any, between a nature connectedness activity and green exercise, on the mood state of primary school aged children?

Methodology

Research Design

Utilising an experimental design, the study compared the effects of green exercise, non-green exercise, connectedness to a natural environment and connectedness to a non-natural environment on children's mood state. Each participant participated in two conditions. In addition, a between-subjects condition of exercise-only versus exercise+connectedness was implemented. This condition was incorporated as a between-subjects rather than within-subjects factor with consideration that research was being conducted in an educational setting; incorporating exercise-only versus exercise+connectedness as a between-subjects condition reduced the overall disruption to class time for participants. Additionally, this research design eliminated the potential for statistical errors resulting from sequence or order effects. Each participant was assigned to one of these conditions, allowing for outcomes of those in the exercise-only condition to be compared with outcomes for participants in the exercise+connectedness condition. A mixed research design allowed for comparison of effects of green and urban conditions, as well as comparison of effects of exercise-only and exercise+connectedness conditions.

Participants were randomly assigned to complete either:

Exercise in a green environment AND exercise in a non-green environment.

OR

Connectedness activity while exercising in a green environment AND connectedness activity while exercising in a non-green environment.

Participants were randomly assigned to conditions within their class group.

Procedure. It was aimed for participation in each condition to take place 1-week apart, in line with previous research (Bodin and Hartig, 2003). With the exception of one class group, all participants in the current study participated in each condition with a 7-day interval. Inclement weather caused a greater interval for one class group; this group participated in the second condition 14 days later. Previous research examining the impact of green exercise found that one 'dose' of exercise which is greater than 15 minutes in duration is sufficient to bring benefits, regardless of intensity of the exercise (Han, 2017; Mackay & Neill, 2010; Parks et al., 2011;

Pretty et al., 2007). Recognising the 'dose' found to be effective in previous research and the practicalities of building the research intervention into the structure of a school day, the exercise-only conditions comprised 20 minutes of low intensity exercise (walking) in both green and built-up environmental conditions. For the green condition, the intervention took place in a natural, green environment, as defined by Barton and Rogerson (2017). For the built-up condition, the intervention took place in a non-green environment, such as a housing estate, city centre or industrial environment (Figure 1). Though both groups were required to take a short walk to access the exercise space, the 20 minutes of low intensity exercise began once the green or non-green space had been reached. The same settings used for completing green and non-green exercise-only conditions were visited for exercise+connectedness conditions. While visiting each setting, participants were asked to take note of features of the environment. These features were recorded by each participant on a template provided by the researcher; templates were completed by placing a tick next to image-based samples of features observed in the environment. The template was completed by participants while walking in the relevant environment (Appendix B). This connectedness activity was adapted from adult-based research by Richardson and Sheffield (2017). The researchers found that writing 'three good things in nature' each day for five days increased participants' nature connectedness, as compared with a control group. Completion of participation in each connectedness condition also took place one week apart, with the exception of the aforementioned one class group.

Measures. Pre and post-intervention measures of mood were gathered through use of short self-report questionnaires. Created for this study, this measure incorporates elements of the 'Fast Assessment of Children's Emotion' (FACE) scale (Kennedy, Unnithan & Wamboldt, 2015).

Following expert review, the mood measure was piloted on a sample of third class and sixth class students, in the setting of a co-educational, mainstream primary school. Forty-three students completed the questionnaire. Of these, 22 participants were in third class and 21 were in sixth class. 65% of participants in the pilot study were female. Participants were aged between eight and twelve years. Through piloting, it was established that the measure was accessible to the proposed research

sample; all participants completed the questionnaire independently, following reading of an explanatory script which provided a description of each emotion.

When reviewing completed pilot questionnaires, the sensitivity of a 3-point Likert scale became a concern. With recognition that the original FACE measure was trialled on a clinical sample, the Likert scale was increased to a 5-point rather than 3-point scale. As suggested through expert review and evidenced in the piloting phase, a scale with greater sensitivity was required for use with a non-clinical sample. Recognising the population sample, the nature of the research design and research into the effectiveness of Likert scales, a 5-point response scale was utilised to assess changes to mood post-intervention (Preston & Coleman, 2000).

Figure 1. Intervention Environments

In addition to a measure of mood, demographic information was gathered for each participant. In order to address potential confounding variables and accurately analyse intervention effects, participants responded to a number of questions pre and post-intervention. Scaled questions on pre and post-intervention measures were answered on a Likert scale. Participants responded to the following questions pre-intervention;

1. How is your day going so far? (*It's a very good day – It's a very bad day)*
2. How much do you like walking? (*I really like walking – I really don't like walking)*
3. How much do you like being outside? (*I really like being outside – I really don't like being outside)*
4. How many times per week do you usually exercise? (*0-1/2-4/3-5/6-7)*

Participants answered the following questions post-intervention:

1. How much did you like the place you visited with your class today? (*I really like the place we visited – I really didn't like the place we visited)*
2. Did you find the place you visited nice to look at?
3. Did you find this activity fun/relaxing/boring/scary/uncomfortable/nice/ difficult?

Participants

Participants comprised third to sixth class students in four mainstream primary schools in Ireland. Three hundred and fifty participants were engaged in this research. Of this number, 119 categorised themselves as female and 231 categorised themselves as male. A breakdown of participants by age is provided in Table 1. A breakdown of number of participants at each class stage is provided in Table 2.

Table 1

Age of Participants

8 Years	**9 Years**	**10 Years**	**11 Years**	**12 Years**	**13 Years**
11% (n = 40)	18% (n = 63)	26% (n = 91)	30% (n = 106)	13% (n = 46)	1% (n = 4)

Table 2

Class Level of Participants

3rd	4th	5th	6th
19% (*n* = 67)	17% (*n* = 58)	34% (*n* = 120)	30% (*n* = 105)

One hundred and twenty four participants were enrolled in a designated DEIS school, while the remaining participants were enrolled in non-DEIS designated schools. A DEIS school is one which is designated as disadvantage by the Department of Education and Skills (2005) under the 'Delivering equality of opportunity in schools: action plan for inclusion' which aims to address the educational needs of children from disadvantaged communities.

Statistical Analysis

Gathered data were inputted to SPSS for statistical analysis. Data were analysed according to a multi-level model. Field (2018) suggests that multilevel models should be used to analyse data that have a hierarchical structure, such as patients who see different therapists in different clinics, or, as in this research, students, within class groups, within schools. Individual-level analysis within hierarchically structured data neglects the likelihood that a shared environment results in individuals being more similar to each other than to individuals in a different environment. Ignoring the nested structure of a dataset, such as children in class groups, in schools, can have notable negative consequences (Kahn, 2011). As many traditional statistical tests assume independence and nested data structures violate this assumption, omission of group-level analysis can produce excessive type 1 errors and biased parameter estimates (Kahn, 2011; Peugh, 2010). By applying a multi-level model, the risk of erroneous or misleading statistical outcomes is reduced (Peugh, 2010).

In the context of school based-research, multi-level modelling has principally been applied to the analysis of school effectiveness, examining the role of inputs and processes at the classroom and school level in determining achievement outcomes (Rumberger & Palardy, 2004). Multi-level modelling applied to repeated measures research allows for questions regarding within-person variability and change to be addressed (Kahn, 2011; Peugh, 2010). For the purposes of this study, multi-level

modelling was employed to investigate responses to intervention at the individual and class group level.

Multi-level modelling applied to repeated measures research allows for questions regarding within-person variability and change to be addressed (Kahn, 2011; Peugh, 2010). For the purposes of this study, multi-level modelling was employed to investigate responses to intervention at the individual and class group level. Building on analysis of response to condition and individual response, intraclass correlation indicates the proportion of total variability in the outcome which is attributable to membership of a particular class group (Field, 2018).

Ethical Considerations

This research was designed and implemented in adherence with the Psychological Society of Ireland's Code of Professional Ethics (2010). In addition, the research was reviewed by the Research Ethics Committee of the Doctorate in Educational and Child Psychology, Mary Immaculate College. Approval for the study was granted in May 2018.

Results

Response to intervention was analysed through multilevel modelling. Multilevel modelling examines predictors of post-intervention response at the individual level (level one) and class level (level two). Mood measure items and pre and post-intervention measures, including attitude to walking, attitude to being outdoors, perception of intervention activity and enjoyment of environmental setting, were explored through factor analysis. Exploratory factor analysis provided insight into the underlying relationships between measured variables, informing dimension reduction prior to further analyses.

Exploratory Factor Analysis

Exploratory factor analysis (EFA) was carried out on the adapted mood measure and on other measured covariates. As the mood scale was adapted from the FACE scale (Kennedy et al., 2015), EFA allowed for the adapted measure to be assessed for dimensionality. EFA was carried out on pre-intervention mood items as this was considered to provide a 'baseline' value reflective of usual patterns of well-being. The following mood measure items were reverse-coded prior to EFA: pre-intervention worry, post-intervention worry, pre-intervention sadness, post-intervention sadness, pre-intervention anger and post-intervention anger.

Analysis of Pre-Intervention Mood Measure. Pre-intervention scores on the 6 items of the mood measure were subjected to Principal Axis Factoring using IBM SPSS version 25. With the assumption that a correlation between factors would be present, oblique rotation was employed (Field, 2018). As shown in Table 3, inspection of the correlation matrix revealed the presence of a number of coefficients of .3 and above. However, determinant of the R-matrix (correlation matrix) was .36, greater than the recommended .00001 (Field, 2018), indicating that multicollinearity is not present. Kaiser-Meyer Olkin values for individual items were above .5 and the Kaiser-Meyer Olkin value for the factor analysis was .71, exceeding the recommended value of .5 (Kaiser & Rice, 1974). Additionally, Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Table 3

Correlation Matrix for Pre-Intervention Mood Variables

Correlation Coefficients						
Item	Worry	Sad	Angry	Happy	Relaxed	Energetic
Worry	1.000	**.378***	.195*	.164*	.150*	.157*
Sad	**.378***	1.000	**.396***	.267*	.158*	.210*
Angry	.195*	**.396***	1.000	.265*	.101*	.159*
Happy	.164*	.267*	.265*	1.000	**.443***	**.520***
Relaxed	.150*	.158*	.101*	**.443***	1.000	**.395***
Energetic	.157*	.210*	.159*	**.520***	**.395***	1.000

Note. Correlation Coefficients over .30 appear in bold.
*$p < .001$

Principal axis factoring revealed the presence of two components with eigenvalues exceeding 1, explaining 39% and 20% of the variance respectively. To aid in the interpretation of these components, direct oblimin rotation was performed. The rotated solution revealed the presence of a simple structure (Thurstone, 1947) with both components showing a number of strong loadings and all variables loading strongly on only one component (Table 4). Factors loadings above 0.4 were retained for interpretation, as recommended by Stevens (2002). Interpretation of the two components shows positive affect items loading strongly on component 1 and negative affect items loading strongly on component 2. Previous research on the FACE scale also identified two main factors; one included mood states of sadness, confusion and anger and the other included energy states of anxiety, energy and tired (Kennedy et al., 2015). The results of this analysis support the use of the positive affect items and negative affect items as separate scales.

Table 4

Pattern and Structure Matrix for Principal Axis Factoring with Oblimin Rotation – Pre-Intervention Mood Variables

Item	**Pattern Coefficients**		**Structure Coefficients**	
	Factor 1	Factor 2	Factor 1	Factor 2
Worry	.031	**.422**	.222	**.436**
Sad	-.108	**.904**	.301	**.855**
Angry	.057	**.442**	.257	**.458**
Happy	**.747**	.060	**.773**	.398
Relaxed	**.590**	-.028	**.578**	.239
Energetic	**.675**	.002	**.675**	.307

Note. Factor loadings above .40 appear in bold.

Analysis of Pre and Post-intervention Variables. Covariates measured at pre and post-intervention were also subjected to principal axis factoring. EFA informed further statistical analyses and supported model parsimony. These covariates comprise results of four items measured at pre-intervention and three items measured at post-intervention.

Following assessment for suitability, principal axis factoring was conducted on four items with oblique rotation (direct oblimin). Two factors had eigenvalues over Kaiser's criterion of 1 and in combination explained 73.68% of the variance. While the scree plot is ambiguous (Figure 2), the level of variance explained by the two factors which met Kaiser's criterion and Jolliffe's criterion warrants retention of two factors (Jolliffe, 1972; Kaiser, 1960). The items which cluster on the same factor suggest that factor 1 represents situational factors and factor 2 represents attitudinal factors. Factor 1, situational factors, comprises variables measured at post-intervention; enjoyment of the intervention setting and aesthetic pleasure taken from the intervention setting. Factor 2, attitudinal factors, comprises variables measured pre-intervention: attitude to walking and attitude to being outdoors. These results are presented in Table 5.

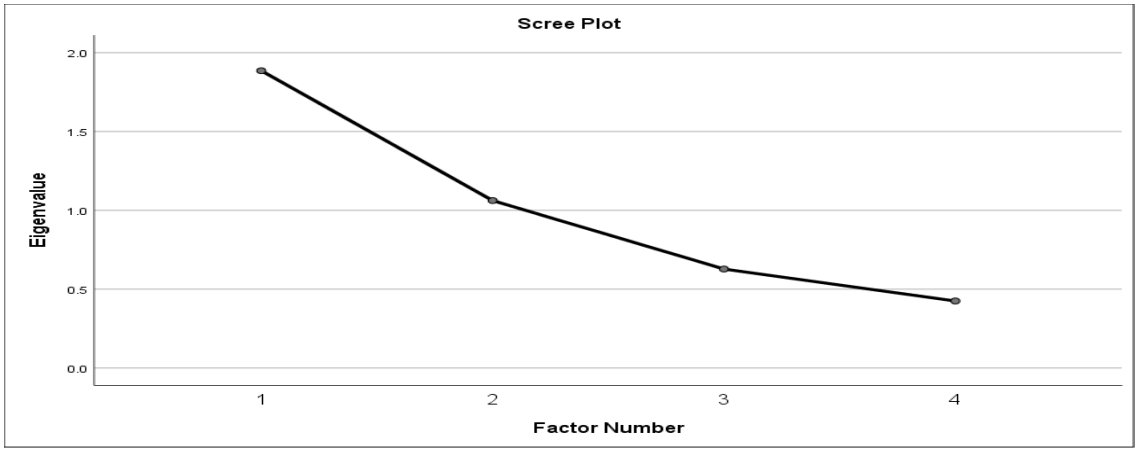


Figure 2. Scree Plot for Factor Analysis of Pre and Post-Intervention Covariates.

Table 5

Pattern and Structure Matrix for Principal Axis Factoring with Oblimin Rotation

Item	Pattern Coefficients		Structure Coefficients	
	Factor 1	Factor 2	Factor 1	Factor 2
Attitude to Walking	.121	**.578**	.350	**.626**
Attitude to Exercise	-.064	**.591**	.171	**.566**
Enjoyment of Setting	**.734**	.011	**.739**	.302
Aesthetic Pleasure	**.778**	-.001	**.778**	.307

Note. Factor Loadings above .40 appear in bold

Exploratory Factor Analysis – Summary. From EFA of items measuring mood, a two-factor solution emerged. Positive affect comprises the emotional states of happy, relaxed and energetic. Negative affect comprises the emotional states of angry, worried and sad. With consideration of these results, subsequent analyses treated pre and post-intervention mood measures as two separate variables (positive affect and negative affect). Additionally, from EFA of items measured at pre and post-intervention, two factors emerged, comprising four covariates. Situational factors comprises variables measured post-intervention; enjoyment of intervention setting and aesthetic pleasure taken from intervention setting. Attitudinal factors comprises variables measured pre-intervention; attitude to walking and attitude to being outdoors. The role of these factors in predicting response to intervention is explored in subsequent analyses.

Preliminary Analyses

Between-Subjects Analysis. An independent-samples t-test was carried out to compare the pre-intervention mood scores (positive affect and negative affect) of those participating in the exercise-only and in the exercise+connectedness condition. As shown in Table 6, no significant differences in mood were evident across the two groups. Additionally, an independent-samples t-test was conducted to assess score differences on pre-intervention covariates for those in each experimental condition (exercise-only; exercise+connectedness). There was no significant statistical differences in attitudinal factors between the exercise-only group (M = 5.04, SD = .95) and the exercise+connectedness group (M = 4.95, SD = .99); t (625) = .75, p = .45. These results indicate that there were no statistical differences on measured variables between these groups, prior to engaging with the intervention.

Table 6

T-test Results Comparing Pre-Intervention Mood Variables between Exercise-only and Exercise+Connectedness Groups

Mood Variable	Exercise-Only Mean (SD)	Exercise+Connectedness Mean (SD)	t-test	P
Positive Affect	10.75 (2.97)	10.75 (3.11)	.01	.99
Negative Affect	14.05 (1.74)	14.16 (1.52)	-.84	.40

Within-Subjects Analysis. A paired-samples t-test was carried out to assess attitudinal factors recorded by participants pre intervention in the green and urban environment. There was no statistically significant difference in attitude to walking and attitude to outdoors reported prior to participation in the green environment (*M*=5.05, *SD*=.95) and prior to participation in the urban environment (*M*=5.01, *SD*=.99), *t* (279) = .64, *p* <.52 (two-tailed).

A paired-samples t-test was conducted to evaluate the impact of the intervention in each environmental setting on participants' mood (Table 10). Examining effects of the intervention in the green environment, there was no statistically significant change in pre to post-intervention scores of negative affect. Changes to pre to post-intervention positive affect scores were approaching statistical significance (*p* = .051), in the direction of increased positive affect post-intervention in the green environment. No statistically significant changes to positive or negative affect occurred following intervention in the urban environment.

Table 7

T-test Results Showing Changes to Affect Post-Intervention in Green and Urban Environments

Type of Affect	Pre-Intervention Green	Post-Intervention Green	t-test	*P*	Pre-Intervention Urban	Post-Intervention Urban	t-test	*P*
	M (SD)	M (SD)			M (SD)	M (SD)		
Positive Affect	10.89 (2.91)	10.50 (3.39)	1.96	.051	10.55 (3.13)	10.53 (3.56)	.15	.88
Negative Affect	14.12 (1.54)	13.92 (2.07)	1.71	.09	14.07 (1.71)	14.02 (1.79)	.48	.64

Between-Within Subjects Analysis. In order to ascertain the potential impact of the order in which participants visited each environmental setting on the aforementioned situational factors, a mixed between-within subjects analysis of variance (ANOVA) was conducted. The ANOVA assessed whether visiting a green environment first, or an urban environment first, affected the rate of enjoyment and aesthetic pleasure taken from the setting. There was no significant interaction between order and situational factors, Wilk's Lambda = .99, F (1, 276) = 2.42, p = .12, partial eta squared = .01. As indicated by t-tests reported above, there was a main effect for environment on situational factors, Wilk's Lambda = .84, F (1, 276) = 52.58, p <.001. Partial eta squared = .16, indicating a large effect size (Cohen, 1988), with higher scores on situational factors following the green condition, for both groups (Table 8). The main effect comparing the order of environmental settings was not significant, F (1, 276) = 3.10, p = .08, partial eta squared = .01. This suggests that order effects did not impact on participants' enjoyment or aesthetic pleasure taken from the setting.

Table 8

Situational Factors Scores for Green First and Urban First Groups

Environmental Setting	**Green First**	**Urban First**
	M (SD)	M (SD)
Green Environment	5.35 (1.43)	5.77 (1.33)
Urban Environment	4.79 (1.58)	4.90 (1.39)

Preliminary Analyses – Summary. Inferential statistics show no significant difference on baseline scores of mood or attitudinal factors between participants in the exercise-only and exercise+connectedness conditions. Further inferential tests outline that participants' reported attitude to walking and attitude to being outdoors were not significantly different prior to engagement in the green and urban environmental settings. Assessing change to participants' mood scores post-intervention, no significant change to positive or negative affect post-intervention in either environment was identified. Change to positive affect post-intervention in a green environmental setting was approaching significance. Within-subjects analysis of reported enjoyment of setting and aesthetic pleasure taken from setting shows significant difference following engagement with a green environmental setting.

Controlling for order effects, with regard to which the order in which each participant visited each environmental setting, this difference remained constant.

Multilevel Modelling

Having met the assumption of multicollinearity and performed grand mean centring on predictor variables, multilevel modelling was conducted in order to explore the following research questions:

1. What is the effect of exercise in a natural, green environment on the mood state of primary school-aged children?
2. What is the interaction, if any, between a nature connectedness activity and green exercise, on the mood state of primary school aged children?

Positive Affect – A Multilevel Model. Steps of model-building are outlined in Table 9. Levels of variance explained by the final model are detailed.

Fit diagnostics indicate that Model 9 is the best-fitting model, according to -2 log likelihood (-2LL) and Akaike's Information Criteria (AIC); *-2LL* = 2808.3, *AIC* = 2834.3.

Table 9

Hierarchical Structure of Model of Post-Intervention Positive Affect

Model Number	Parameters
Model 1	Intercept + Pre-Intervention Positive Affect
Model 2	Model 1 + Environment
Model 3	Model 2 + Condition + Condition*Environment
Model 4	Model 3 + Random Effects of Condition by Class
Model 5	Model 3 + Random Effects of Environment by Participant
Model 6	Model 5 + Attitudinal Factors
Model 7	Model 6 + Situational Factors
Model 8	Model 7 + Age + Gender
Model 9	Model 7 + Frequency of Exercise + Day So Far + Perception of Activity

Note. Model 5 is based on Model 3 due to non-significant random effects of parameters introduced to Model 4.

In the final model, levels of positive affect pre-intervention significantly predicted post-intervention levels of positive affect $F(1, 588) = 84.44$, $p<.001$. The environmental setting and intervention condition variables were coded numerically. With regard to environmental setting, the green environment was coded as '1' and

the urban environment was coded as '2'. Similarly, for intervention condition, exercise-only was coded as '1' and exercise+connectedness was coded as '2'. Environmental setting significantly predicted post-intervention levels of positive affect $F(1, 315) = 7.67$, $p=.006$. The direction of this effect was positive, indicating that the urban environment had greater positive impact on positive affect than did the green environment. However, intervention condition, that is exercise-only or exercise+connectedness activity did not significantly predict post-intervention positive affect $F(1, 299) = 2.50$, $p=.115$. Equally, no significant interaction effect between environment and condition was evident $F(1, 305) = 2.01$, $p=.157$.

Participants' enjoyment of the environmental setting and aesthetic pleasure taken from the environmental setting significantly predicted levels of positive affect post-intervention, $F(1, 590) = 172.31$, $p<.001$. The effect direction was positive, indicating that higher levels of these situational factors predicted higher levels of positive affect post-intervention. In contrast, attitudinal factors, comprising participant's attitudes towards exercise and attitude towards being outside did not significantly predict post-intervention levels of positive affect. Participants' age was not a predictor in determining post-intervention levels of positive affect, however gender did significantly predict positive affect levels post intervention; $F(1,321) = 4.77$, $p = .030$. As males were coded as '1' and females as '2' within the gender variable, the positive direction of this effect indicates that females were higher in positive affect post-intervention. Frequency of exercise and report of how a participant's day was going 'so far', introduced to the final model, were significant predictors of post-intervention positive affect. Reports of greater participation in exercise on a weekly basis predicted higher levels of positive affect; $F(1,450) = 11.98$, $p = .001$. More positive reports of 'day so far' also predicted higher levels of positive affect at post-intervention; $F(1,581) = 4.83$, $p = .028$.

With regard to random effects at level two (class level), the relationship between class group and effects of participating in the exercise-only or exercise+connectedness group (condition) did not show significant variance in intercepts across classes, Var $(\mu_{0j}) = 2.48$, $p = .140$. In addition, the slopes did not vary significantly across class group, Var $(\mu_{1j}) = .58$, $p = .307$. Slopes and intercepts negatively covaried, though not significantly, Cov $(\mu_{0j,}\ \mu_{1j}) = -.94$, $p = .303$. Random effects of class group on experimental condition (exercise-only or

exercise+connectedness) were introduced at model 4. As no significant random effects were found, the parameter was removed from later models.

Exploration of random effects at level one (individual-level) found that the relationship between post-intervention positive affect and environmental setting showed significant variance in intercepts across participants, Var (μ_{0j}) = 8.16, $p <$ .001. In addition, the slopes and intercepts negatively and significantly covaried, Cov (μ_{0j}, μ_{1j}) = -3.26, $p <$ .001. A test statistic for variance of slopes could not be meaningfully computed which may indicate minimal variation in slope. The negative direction for covariance shows that as individual's pre-intervention positive affect score is higher, there is less of an effect shown post-intervention.

Fixed effects and random effects estimates for models of predictors of post-intervention positive affect are shown in Table 11.

4.4.5 Negative affect – a multilevel model. Steps towards building the final model are outlined in Table 10. Levels of variance explained by the final model are detailed.

Fit diagnostics indicate that Model 8 is the best-fitting model, according to -2 log likelihood (-2LL) and Akaike's Information Criteria (AIC); -2LL = 2267.97, AIC = 2293.97.

Table 10

Hierarchical Structure of Model of Post-Intervention Negative Affect

Model Number	Parameters
Model 1	Intercept + Pre-Intervention Negative Affect
Model 2	Model 1 + Environment
Model 3	Model 2 + Condition + Condition*Environment
Model 4	Model 3 + Random Effects of Condition by Class
Model 5	Model 3 + Random Effects of Environment by Participant
Model 6	Model 5 + Attitudinal Factors
Model 7	Model 6 + Situational Factors
Model 8	Model 7 + Age + Gender
Model 9	Model 7 + Frequency of Exercise + Day So Far + Perception of Activity

Note. Model 5 is based on Model 3 due to non-significant random effects of parameters introduced to Model 4.

Levels of negative affect pre-intervention significantly predicted post-intervention levels of negative affect, $F(1, 497) = 89.33$, $p<.001$. Higher levels of pre-intervention negative affect were associated with higher levels of post-intervention negative affect. As stated above, the environmental setting and intervention condition variables were coded numerically. With regard to environmental setting, the green environment was coded as '1' and the urban environment was coded as '2'. Similarly, for intervention condition, exercise-only was coded as '1' and exercise+connectedness was coded as '2'. Neither environmental setting or condition (exercise-only or exercise+connectedness) significantly predict levels of post-intervention negative affect; $F(1, 297) = .58$, $p=.447$ and $F(1, 293) = .03$, $p=.875$ respectively. Further, no significant interaction effect between environment and condition was evident, $F(1, 286) = .04$, $p=.833$.

Participants' enjoyment of the environmental setting and aesthetic pleasure taken from the environmental setting significantly predicted levels of negative affect post-intervention, $F(1, 548) = 52.80$, $p<.001$. The effect direction was negative, indicating that higher levels of these situational factors predicted lower levels of negative affect post-intervention. In contrast, attitudinal factors, comprising participant's attitudes towards exercise and attitude towards being outside did not significantly predict post-intervention levels of negative affect, $F(1, 485) = .60$, $p = .440$. A participant's age was not a significant predictor in determining post-intervention levels of negative affect. *F* score for age was $F(1, 296) = 2.25$, $p = .120$. However, gender played a significant role in predicting levels of negative affect experienced post-intervention, $F(1, 292) = 3.97$, $p = .047$. As stated, the gender variable was coded numerically (1=Male; 2=Female), thus the negative direction of the effect indicates that lower levels of negative affect were reported by females post-intervention. In contrast to positive affect, exercise frequency and reports of 'day so far' did not significantly predict post-intervention negative affect levels.

With regard to random effects at level two (class level), the relationship between class group and effects of participating in the exercise-only or exercise+connectedness group (condition) did not show significant variance in intercepts across classes, Var (μ_{0j}) = .23, p =.294. Slopes and intercepts negatively covaried, though not significantly, Cov ($\mu_{0j,}$ μ_{1j}) = -.02, p = .714. A slope statistic could not be meaningfully computed. Random effects of class group on experimental

condition (exercise-only or exercise+connectedness) were introduced at model 4. As no significant random effects on negative affect were found, the parameter was removed from later models.

At level one (individual level), exploration of random effects found that the relationship between post-intervention negative affect and environmental setting showed significant variance in intercepts across participants, Var (μ_{0j}) = 4.40, $p <$ .001. In addition, the slopes and intercepts negatively and significantly covaried, Cov (μ_{0j}, μ_{1j}) = -1.64, $p < .001$. As in the positive affect multilevel model, a test statistic for variance of slopes could not be computed, suggesting minimal variation in slope. The negative direction for covariance shows that as individuals pre-intervention negative affect score increases, there is less of an effect shown post-intervention.

Fixed effects and random effects estimates for models of predictors of post-intervention negative affect are shown in Table 12.

Table 11

Fixed Effects and Random Effects Estimates for Models of the Predictors of Positive Affect Post-Intervention

Parameter	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
Intercept	10.53 (<.001)	10.18 (<.001)	8.52 (<.001)	8.82 (<.001)	8.60 (<.001)	8.86 (<.001)	7.99 (<.001)	5.99 (<.001)	6.15 (<.001)
Fixed effects									
Pre-intervention positive affect	.57* (.04)	.57* (.04)	.57* (.04)	.55* (.04)	.52* (.04)	.49* (.04)	.41* (.04)	.43* (.04)	.38* (.04)
Environment		.23 (.24)	1.01 (.75)	.87 (.71)	.96 (.63)	.71 (.64)	1.45* (.57)	1.44* (.57)	1.57* (.57)
Condition			1.13 (.77)	.89 (.75)	1.07 (.69)	.91 (.7)	.87 (.62)	.91 (.62)	.98 (.62)
Environment*Condition			-.53 (.49)	-.43(.46)	-.50 (.41)	-.33 (.41)	-.42 (.37)	-.42 (.37)	-.52 (.37)
Attitudinal factors						.56* (.13)	.18 (.12)	.17 (.12)	.06 (.12)
Situational factors							1.02* (.08)	1.02* (.08)	1.00* (.08)
Age								.12 (.1)	.10 (.09)
Gender								.52* (.24)	.52* (.24)
Exercise frequency									.42* (.12)
Perception of activity									-.08 (.06)
Day so far									-.45* (.20)
Random Effects									
Variance of intercept for Condition by Class (Level 2)				2.48 (1.68)					
Variance of slope for Condition by Class (Level 2)				.58 (.57)					
Covariance of slopes and intercepts for Condition by Class (Level 2)				-.94 (.91)					
Variance of intercept for Environment by Student (Level 1)					10.80** (1.62)	9.88** (1.58)	8.51** (1.25)	8.01** (1.23)	8.16** (1.21)
Covariance of slopes and intercepts for Environment by Student (Level 1)					-4.06** (.50)	-3.85** (.49)	-3.37** (.38)	-3.21** (.38)	-3.26** (.37)
-2*Log-likelihood	3092.37	3091.49	3088.43	3045.97***	3056.6***	2992.93***	2830.92***	2825.12	2802.30***
AIC	3098.37	3099.49	3100.43	3063.97	3074.6	3012.93	2852.92	2851.12	2834.30

Note. Model parameter estimates are unstandardised beta coefficients. Standard errors are in parentheses. *p<.05; ** p<.001; ***Significant improvement to model, measured against critical value for chi-square statistic (p <.01). Model parameters reported in-text are based on the best-fitting model according to -2LL and AIC (Model 9)

Table 12

Fixed Effects and Random Effects Estimates for Models of the Predictors of Negative Affect Post-Intervention

Parameter	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
Intercept	4.03 (<.001)	4.22 (<.001)	4.44 (<.001)	4.28 (<.001)	4.39 (<.001)	5.40 (<.001)	6.71 (<.001)	8.16 (<.001)	8.02 (<.001)
Fixed effects									
Pre-intervention negative affect	.51*(.04)	.51* (.04)	.51* (.04)	.49* (.04)	.42* (.04)	.39* (.04)	.39* (.04)	.39* (.04)	.39* (.05)
Environment		.13 (.14)	-.15 (.44)	-.07 (.42)	-.13 (.38)	-.02 (.38)	-.28 (.38)	-.27 (.36)	-.29 (.36)
Condition			-.15 (.45)	-.05 (.43)	-.14 (.42)	-.05 (.43)	-.04 (.41)	-.06 (.41)	-.07 (.41)
Environment*Condition			.01 (.28)	-.04 (.27)	.01 (.24)	-.07 (.24)	-.04 (.23)	-.05 (.23)	-.03 (.23)
Attitudinal factors						-.23* (.08)	-.07 (.08)	-.06 (.08)	-.04 (.08)
Situational factors							-.35* (.05)	-.35* (.05)	-.35* (.05)
Age								-.1 (.06)	-.09 (.06)
Gender								-.32* (.16)	-.33* (.16)
Exercise frequency									-.09 (.08)
Perception of activity									.02 (.13)
Day so far									.03 (.13)
Random Effects									
Variance of intercept for Condition by Class (Level 2)				.23 (.22)					
Covariance of slopes and intercepts for Condition by Class (Level 2)				-.02 (.07)					
Variance of intercept for Environment by Student (Level 1)					4.56** (.56)	4.75** (.57)	4.57** (.53)	4.40**(.53)	4.39** (.54)
Covariance of slopes and intercepts for Environment by Student (Level 1)					-1.77** (.17)	-1.82** (.17)	-1.70** (.16)	-1.64** (.16)	-1.63** (.16)
-2*Log-likelihood	2401.54	2400.71	2399.84	2380.70***	2364.88***	2327.48***	2274.09***	2267.97	2263.52
AIC	2407.54	2408.71	2411.84	2398.70	2382.88	2347.48	2296.09	2293.97	2295.52

Note. Model parameter estimates are unstandardised beta coefficients. Standard errors are in parentheses. *p<.05; ** p<.001; ***Significant improvement to model, measured against critical value for chi-square statistic (p <.01). Model parameters reported in-text are based on the best-fitting model according to -2LL and AIC (Model 8)

Discussion

Key Findings

Environmental Setting. Environment was a significant predictor of post-intervention levels of positive affect, though not of post-intervention negative affect. The impact of environment, as indicated by multilevel modelling, was contrary to the hypothesised greater benefits associated with the green environment. Results showed that the urban environment was more strongly associated with improved positive affect post-intervention. This finding is somewhat similar to that of Pretty et al. (2005) who found that both rural pleasant and urban pleasant scenes had a positive impact on self-esteem and aspects of mood. In the study by Pretty et al. (2005), it was perceived threats to either environment which diminished the positive effects of exercise on mood and self-esteem. However, studies which did not expose participants to real environments, rather utilising virtual representations of green and non-green environments did find significant positive effects on positive affect post-intervention in a green condition (Kant & Sharma, 2016; Passmore & Holder, 2017). Some insight regarding the greater effect of the urban over green environment in promoting positive affect may be found in research which examines the impact of an urban or rural upbringing on stress processing and environmental identity (Lederbogen et al., 2011; Prevot, Clayton & Mathevet, 2018; Zhu et al., 2017). As three of four of the participating schools were of inner-city locations, an assumption may be made of an urban upbringing for a majority of students. Exploring environmental identity, or nature connectedness, Prevot et al. (2018) found that participants who had a rural upbringing had a significantly higher environmental identity than those who had an urban upbringing. Considering these findings, along with those which highlight children's limited direct experience of the natural world, a stronger association between an urban environment and positive affect may be understood (Charles & Louv; Prevot et al., 2018). Additionally, in identifying no significant increase to self-esteem following exercise in a green environment, compared to an urban environment, Reed et al. (2013) suggest that the lack of impact may be explained by the presence of teachers giving instruction during intervention. The researchers suggest that this presence may have reduced the perception of green exercise as a restorative experience and increased the likelihood of it being perceived as a school activity. Considering the proffered explanation in the context of the

current study, it is recognised that there were teacher(s) present during intervention, that negative interactions between participant and teacher did occur at times, and that teacher's individual approaches may have impacted on outcomes (Coldren & Hively, 2010; Walker, 2009). Additionally, for three of the participating schools, the green environment was an local park which held a playground. Several participants queried whether utilising the playground was permitted and expressed disappointment when advised that the time in the park would be spent either walking or walking while completing a connectedness activity. It may be considered that visiting the green environment was perceived by participants as an opportunity for free-play and the disappointment of engaging with a more structured, adult-led activity impacted on potential benefits to children's mood.

Nature Connectedness. Engagement with either the exercise-only or exercise+connectedness condition was not a significant predictor of post-intervention outcomes, for either positive or negative affect. However, though not significant, the multilevel model indicates that the connectedness activity contributed to greater positive affect and reduced negative affect post-intervention, compared with exercise-only. This finding is in line with results from Richardson and Sheffield's (2017) study which found that noticing three good things in nature each day for five days increased levels of nature connectedness and happiness and increased ability to maintain attention. It may be hypothesised that a more sustained connectedness activity, such as that implemented by Richardson and Sheffield (2017), may contribute to higher impact on well-being attributes. Whereas the aforementioned research was conducted on an adult population, following research on a child population, Duncan et al. (2014) surmised that a generational difference in nature connectedness may account for a disparity in findings between their own and research undertaken with adults. However, it must also be considered that Duncan et al.'s (2014) findings were based on participants' exposure to virtual rather than authentic environmental conditions and on a small sample of fourteen participants. Additionally, recognising the relatively narrow age-range (8-13 years), age did not account for a significant amount of variance in post-intervention affect levels in the current study.

Situational Factors. In contrast to attitudinal factors, situational factors did significantly influence post-intervention affect. Participants' enjoyment of the

environmental setting and the aesthetic pleasure they experienced in the setting predicted levels of positive and negative affect. Inferential tests outline that higher levels of overall scores on situational factors followed intervention in the green environment. It was hypothesised that the green environmental setting would be more impactful on participants' well-being overall, however, multilevel modelling indicates that perception's of the environmental setting, degree of enjoyment taken from each setting and the extent to which each setting was found to be aesthetically pleasing, were not uniform across participants. A potential explanation to this may be found in personality theories, looking to individual differences in openness to experience (Lu et al., 2016; Costa & McCrae, 1978). Where an assumption may be made that a natural, green environment may be more pleasing to each person, the findings of this study indicate that individual differences may mediate this response. Further, significant random effects at the participant level (Level one) suggest that participants differ in their well-being on the basis of environment, as well as on the situational factors of enjoyment of setting and aesthetic pleasure taken from setting.

Methodological Considerations

A strength of the current study lies in the sample size. Though not gender-balanced, the large sample size lends generalisability to this study. Due to the requirements for schools to have appropriate environments in close proximity and the challenge of sourcing schools willing to participate, it was not possible to also select participants on the basis of providing gender balance to the study. The teacher presence during intervention may negatively impact on the restorative impact of particular environments (Reed et al., 2013), however, the presence of teachers was necessary to conduct this research. The health and safety of participants was of primary ethical concern, consequently teacher's willingness to attend and support the experiment was highly valued. Nonetheless, a teacher's differing level of control over students, the preferred level of discipline they create in the school context and the teacher's interpersonal behaviour with students are important aspects of the school environment (Van Petegem, Creemers, Rossel & Aelterman, 2005). Further, it is suggested that a teacher's stress level is likely to influence the quality of teacher-student relationships; teacher's empathy, interaction styles and communication styles are predictors of a positive relationship between a teacher and students (Yoon, 2002). Differing teaching styles were observed over the course of data collection for this

study. Though acknowledged as a potential confounding variable, teacher characteristics are inherent to any school-based intervention. Thus it is considered that the generalisability of the results of this study are not comprised by the presence of teachers during intervention. Further, the absence of a significant effect of random variance between class groups indicates that the influence of teachers on intervention outcomes was, if present, not significant.

The FACE scale was developed by Kennedy et al. (2015) with a view to being an easy to administer, age appropriate, psychometrically sound tool for measuring the effectiveness of hospital and school-based interventions with children (Kennedy et al., 2015). In the context of the current study, the mood measure acted as an easily-administered, child-friendly measure which could be completed in class groups in the school setting, reducing disruption to class time while also providing an effective means of measuring post-intervention change. A considerable strength of this study lies in the statistical methods used to analyse the gathered data. Applying multi-level modelling allowed for the exploration of class-level effects, thus producing more statistically accurate output.

Implications for Research and Practice

Considering the present study's strengths and limitations and its position in the context of foregoing research, directions for future research in this area are suggested. As outlined, the number of green exercise or nature connectedness studies which focus on child populations are few in comparison to adult-based research. Further, for those studies which are child-focused, a number had a small sample size and or had no control condition (Barton et al., 2014; Dowdell et al., 2014; Duncan et al., 2014; Han, 2014; Hignett et al., 2017; McCree et al., 2018; Warber et al., 2015). Given that the current findings indicate a greater association between urban environments and well-being, contrary to adult-based studies, further research focusing on outcomes for children is warranted. Further exploration on outcomes for children would benefit from the presence of a control condition so as to isolate the factors which predict response to intervention. Additional research which engages larger population samples and which incorporates a control condition would provide clarity on the usefulness of exercise and connectedness activity in a green and/or urban environment, as an intervention for supporting children's well-being.

Findings of the current study point to the potential role which personality plays in dictating response to environment. Additional research on effects of green exercise and nature connectedness, which encompass a personality measure, may provide a more in-depth understanding of the aforementioned gender-based differences in outcomes. A more detailed insight into the aesthetic pleasure which an individual experiences in a given setting and an account of the aspects of openness (ideas and feelings) which correspond to this would lend clarity to interpretations of green exercise and nature connection effects.

Educational psychology practice must make use of the best available research evidence and implemented interventions should be evaluated using appropriate outcome monitoring (Passenger, 2013). The adapted FACE measure presents a valuable tool to be utilised by educational psychologists, in the Irish context, for outcome monitoring. A particular usefulness of the measure is found in its accessibility to children and the speed and ease with which it can be administered. These characteristics allow for the adapted FACE measure to be used in school-based practice context and in clinic-based practice to assess changes to children's mood state post-intervention.

Stoner and Green (1992) question what research practices should form the bases of educational psychology and how the knowledge garnered from research can be applied. It is recommended that interventions are implemented and either used continually if successful or discarded, depending on local empirical outcomes, rather than used continually to keep with research literature (Stoner & Green, 1992). The current study is testament to this standpoint, highlighting the need for an intervention approach to be implemented locally and analysed critically in the local context. While adult and adolescent-based research speak to the benefits of the green environment in improving aspects of psychological well-being, the current research outlines the potentially limited generalisability of such findings to children. Assessing whether this limit to generalisability is specific to primary school-aged children or to children attending Irish primary schools or to children in a non-clinical sample requires additional exploratory research to be carried out. Equally, this idiographic-focused perspective is bolstered by the potential role which teacher presence plays in mediating response to intervention. As proposed by research, the impact of an authority figure being present, and the connotations of this for children

engaging in a well-being driven intervention, suggests a requirement to be careful and strategic in the application of interventions to particular real-world practice settings. As any intervention must be monitored systematically and outcomes evaluated accordingly, Stoner and Green (1992) advocate for a move away from investing in one particular intervention that an advocate in literature has stated will work, and thus scientist-practitioners are directed towards the resolution of local issues and concerns and the best interest of the child is placed at the centre of practice.