

An Investigation into the Impact of Outdoor Space and Exercise on the Attention of Primary School Children

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Abstract

Attention Restoration Theory (ART) proposes that exposure to natural, outdoor environments can increase attentional functioning. Indoor, organised exercise as a separate concept has also been shown to provide children with attentional benefits. The present study investigates the synergistic combination of these aspects in an attempt to reveal their true impact on attention restoration in primary children and the potential long term benefits they may provide. To do this, the present study compared children's attention after 3 conditions; sitting in a classroom, organised exercise in the school gym hall and free play in a park. Attention tests were carried out for a second time after a 1 hour lesson. A Digit Backward Span (DBS) test was used to measure children's attention and a Likert Scale was used to rate children's experiences of each condition. Three 2 x 2 mixed -design between-within ANOVAS were conducted for each condition showing no significant gender differences and a significant decrease in DBS scores over time after exposure to the park condition. Additionally, a one way ANOVA was conducted which revealed the superiority of the park condition over the other two, indoor conditions. The lunch break in the park was also rated most positively. Half an hour free play in a natural setting, therefore, is enough to enhance a child's attentional functioning, only in the short term. Directions for future research in addition to implications for practice are discussed.

Introduction

The present study is an investigation into the psychological impact of outdoor, natural environments and exercise on primary school children; more specifically the impact these have upon attention restoration. A previous maxi project conducted by Valaviciute (2014) studied the impact on attention restoration after children spent their lunchtime within a natural meadow setting, a playground setting and within a classroom. The meadow setting which yielded more aspects of nature was found to significantly increase the attentional capacity of children, over the other two, less natural settings. The current paper view's Valaviciute's (2014) study as a point of departure. In order to sharpen this current area of research, it is appropriate to isolate the myriad of variables present within the green space, to investigate what exactly is causing the significant impact upon attention restoration. In this study, exercise has been isolated, as exercise alone, has been shown to improve the attentional capacities of children.

The Decline of Outdoor Play and the Consequences

Over the past fifty years, a considerable decline has been observed in the amount of time children spend outdoors (Gray, 2011). A recent study involving 1,000 parents of young children in the U.K concluded that a quarter of children spend less than 30 minutes a week playing outdoors and the reasons for this included concerns of children's safety, the weather, television, computer games and a lack of green space (Carter, 2015). In addition Cutler, Glaeser, & Shapiro (2003) also found that the time spent watching TV per day in the U.S increased by forty minutes between 1965 and 1995. Inevitably, the increasingly sedentary lifestyles of individuals across western societies have been found to cause severe physical health implications. Worldwide, obesity has more than doubled since 1980, and in 2013, The World Health Organisation stated that 42 million children under the age of 5 were overweight or obese (World Health Organisation [WHO], 2015).

Less predictably however, the mental health of individuals, notably children, is also suffering as a result of the ever increasing inactive lifestyles of western society. Dunn and Layard (2009) found that between 1974 and 1999 there was a significant increase in the number of children suffering from conduct, behavioural and emotional problems, that they described as an 'epidemic of mental illness' which they believe to be linked to increasing inactivity. Additionally, a report by the National Trust in 2012 suggests children are suffering from a 'Nature Deficit Disorder.' The report states that this is due to a lack of time spent playing outdoors and suggests that greater activity outdoors contributes strongly to a healthy mind (Moss, 2012). Furthermore, psychological disorders such as depression have been found to occur with increased frequency in obese children (Daniels et al., 2005)

Through exploring the impact of natural, outdoor environments and exercise upon the psychological wellbeing of children, the present study, in addition to the current burst of research in this area, aims to find a solution to this very current problem, which fifty years ago, failed to exist. Significant evidence has been gathered within the literature suggesting that nature, and exercise as separate concepts, largely promote good physical and psychological health, more specifically demonstrating benefits on attention restoration. This evidence will be examined below.

Attention Restoration Theory: What Is It?

Attention Restoration Theory (ART) was developed by Kaplan and Kaplan in 1989 and proposes that attention fatigue can be overcome effectively after spending time in a natural environment (Kaplan & Kaplan, 1989). This theory is built upon previous findings that there are two types of attention (Berman, 2008); directed attention and involuntary or automatic attention (Kaplan, 1995). Directed attention requires an individual to shut out distractions in order to concentrate fully on the task at hand. This can prove to be tiring and effortful. Directed attention is compulsory for various aspects of learning that require cognitive functioning, for example studying, writing and taking exams (Felsten, 2009). DeMarco and Lister (2013) found that in an office environment, individuals can take up to 15 minutes in order to achieve this state of concentration, and in a second it can be destroyed by a distraction, such as a telephone call. As one can imagine, within a classroom setting for younger individuals, this state of concentration must take an exceedingly large amount of effort as distractions are plentiful in such an environment. When directed attention is placed under continual demand, people begin to suffer “directed attention fatigue” which can cause: poor perceptual abilities, unclear thought processes, irritability, a lack of patience and distractibility (Kaplan, 1995). These impacts lead to poor task performance. Therefore, it is important that directed attention is restored to allow for further effective work to be carried out and Kaplan (1995) suggests that this can be done through the means of resting one’s directed attention span and employing involuntary attention. Involuntary attention occurs when individuals automatically attend to things which are inherently intriguing or eye catching. As our attention is drawn involuntarily, no great amount of effort or energy is required to suppress distractions, providing a rest period for the directed attention system. Several studies (Kaplan, 1995; Felsten, 2009) suggest that this can be achieved by spending time within a natural environment.

However, Kaplan (1995) proposes that there are four crucial aspects that a natural setting must possess in order for restoration from directed attention fatigue to occur. These are ‘being away’, ‘fascination’, ‘extent’, and ‘compatibility’. ‘Being away’ refers to the idea that the setting is removed from an individual’s usual environment within which directed attention is used. Kaplan (1995) suggests that although places such as the seaside, lakes, mountains, forests and meadows are

exceptionally effective for the restoration of attention, it is not necessary to travel a large distance to achieve these effects. The sense of ‘being away’ can be achieved in a nearby natural setting, merely by changing the context which ultimately leads to directed attention fatigue. As previously stated, nature is abundant with fascinating objects which capture peoples’ involuntary attention. More specifically however, natural settings should offer ‘soft’ fascinations e.g. clouds and sunsets. Therefore the natural setting captures individuals’ attention in a non-alarming fashion (Kaplan, 1995). Kaplan (1995) suggests a sense of ‘extent’ within a natural setting is paramount in order for attention restoration and a large area of land is not necessary in order to provoke a sense of extent. It is suggested that a long trailing path through an area of land, miniaturization and historic artefacts can create a feeling of extent. Finally, ‘compatibility’ is necessary within a natural setting to achieve attention restoration. This means that the environment must not go against the wishes and interests of an individual. If an environment or activity is not enjoyable to the person, the environment will ultimately fail to be restorative. It is thought that ‘soft fascination’ plays the key role within the environment, and with the aid of the other three properties, fascination can be enhanced and sustained. Thus, if all four of these criteria are met, an environment should provide effective attention restoration for an individual. Although these aspects can be found in alternative environments, Kaplan and Kaplan (1989) suggest that benefits are optimum when they are expressed within a natural environment.

Evidence for Attention Restoration Theory

Research into the Attention Restoration Theory continues to be expanding, with a growing body of evidence supporting the notion that natural environments have the ability to provide individuals with restorative effects.

An early paper by Kaplan and Talbot (1983) was the first to demonstrate the psychological benefits of wilderness experience by the means of taking students (from both rural and city schools) on week-long wilderness trips. Kaplan and Talbot (1983) stated that the newly perceived environment caused students to perceive themselves in a new light, and that they feel “calmer, at peace with themselves, ‘more beautiful on the inside and unstifled.’ (p. 178)

More focussed studies thereafter have consistently shown improved attention and mental restoration when individuals are exposed to actual natural environments (Hartig, Mang, & Evans, 1991; Ottosson & Grahn, 2005; Mårtensson et al., 2009), in addition to less intense exposures. More recently, a study by Berto (2005) found that participants who were exposed to photographs of restorative environments improved their performance on the final attention test more so than participants exposed to non restorative environment images or geometrical patterns. These results are not only in agreement with Kaplan’s (1995) but they suggest that being exposed to a photograph of a natural environment is enough to allow for restoration from mental fatigue. Additional research consisting of less intense

exposures to natural environments have been found to have similar results, in particular studies focussing on the psychological benefits of natural views from a window (Tennessen & Cimprich, 1995; Kaplan, 2001; Kuo & Sullivan, 2001).

Although research exploring the comparison of simulated natural and simulated urban environments is plentiful (Ulrich et al., 1991; Laumann, Gärling, & Stormark, 2003), studies surrounding the comparison between natural versus simulated environments is extremely limited. However, one study by Kjellgren and Buhrkall (2010) based in Sweden found actual natural environments to yield superior restorative benefits to those found after exposure to the simulated environment.

Evidence Supporting ART in Childhood Research

However, children also experience directed attention fatigue. The pressure to complete school work within a classroom environment with so many active distractions is likely to lead to directed attention fatigue (Faber Taylor, Kuo, & Sullivan, 2001b). Shaffer (1985) suggests that children may find the fighting off of distractions more challenging than adults due to their attention not being fully developed.

A number of studies have demonstrated the restorative benefits on attention which natural environments have upon children. Mårtensson et al. (2009) assessed eleven playgrounds of typical schools in Stockholm and concluded that the restorative potential of green outdoor environments also applies to preschool children after it was found that children who played in open and integrated outdoor spaces containing lots of trees, shrubbery and hilly terrain demonstrated fewer levels of behaviours of inattention.

Findings by Faber Taylor, Kuo, and Sullivan (2001a) found similar results to those studies based on adults; children too, benefit from green space, even if only viewed from a window. It was concluded that the more natural a girl's view from home is, the better her concentration, impulse inhibition and delay of gratification. No relationship was found for boys between green space and the performance on tasks testing for each of the three forms of self-discipline. It was proposed that the reason for the gender differences may be due to the fact that boys spend less time playing in and around their homes.

Children with Attention Deficit disorders have also been observed to have improved attention and self-discipline after spending time within natural environments (Kuo & Faber Taylor, 2004; Taylor & Kuo, 2009; Faber Taylor & Kuo, 2011). The high demand for an alternative to drug treatments for ADHD was a catalyst for the surge in papers surrounding the efficacy of natural green spaces in reducing the symptoms of the disorder. More specifically, Kuo and Faber Taylor (2004) found that children of all genders and income groups with ADHD who play regularly in green spaces have milder symptoms than children who play in built up outdoor areas and indoor settings. The

contrasting results found between genders within this area of research, highlight the importance of the inclusion of this variable within similar studies.

It is clear from the evidence provided that exposure to natural environments is psychologically beneficial, specifically in terms of attention restoration, for a wide variety of individuals.

Methodological Considerations of Current Research in ART

It is apparent that there is widespread use of qualitative methods within the literature surrounding the effect of outdoor, natural environments on children (Handy, Cao, & Mokhtarian, 2008). Most prominently, interviews and questionnaire methodologies have been employed within such research (Prezza, 2007). For example in Neuwelt and Kearns' (2006) study which looks at the link between walking to school and health. These methods effectively deliver a detailed understanding of the decision making process which is involved in the use of outdoor environments, as well as exposing the many ways in which children experience the outdoors (Greene & Hill, 2005). However, strong quantifiable evidence is lacking within the literature to support the idea that outdoor natural spaces are physically and psychologically beneficial. It is advised that further more in depth and qualitative methodological approaches to such research should be undertaken in the future to ensure that this limitation is addressed.

An additional methodological limitation of previous research into the effect of outdoor space on children is the lack of focus on the long term benefits such an environment may provide. A recent paper by Oppezzo and Schwartz (2014) conducted 4 experiments to test the effects of exercise versus sitting both indoors and outdoors on creative performance. It was found that both exercise indoors and outdoors yielded high performance rates on creativity tasks, however no long term benefits were found to be present minutes after the exposure. The short term findings were the focus of the paper; however the lack of long term benefits were barely discussed, despite the important nature of such a discovery for both future research and the implications for practice.

The current study takes into account both of these limitations and has employed a quantitative measurement of attention in the form of the Digit Backward Span (DBS) test in addition to a Likert Scale questionnaire to assess children's ratings of their lunch time environments. This study also employs a long term measurement of attention, as DBS scores are taken for a second time after a one hour lesson has taken place.

However, in order to move this area of research further even more, as previously stated, the investigation into the myriad of variables present within the green space is vital. By isolating these variables, it may be possible to reveal which aspects of the natural environment are causing these psychological benefits, more specifically the increase in the attentional capacity of children.

Some Variables to Consider

It is impossible to list each and every variable which is present within a natural environment, as each space is unique and ever changing. As previously discussed, Kaplan (1995) proposes that there are four crucial aspects that a natural setting must possess in order for restoration from directed attention fatigue to occur; ‘being away’, ‘fascination’, ‘extent’, and ‘compatibility’. An extensive number of additional variables are present within a natural environment and one in particular that has acted, unintentionally, as a confounding factor in research comparing individuals’ reactions to urban and natural environments is water. White et al. (2010) found that images of “built” environments containing aquatic elements were generally rated just as positively as natural green environments. Although this experiment only made use of photographs of such environments and not the real thing, this finding indicates that specific elements of natural spaces may be what cause the restorative benefits and not the green, natural space as a whole.

The current study isolates the variable ‘exercise’ as both natural environments and exercise as separate concepts have been shown to improve attention restoration in children. The significant literature looking at exercise as a mechanism for attention restoration will be reviewed below.

Exercise as a Mechanism for Attention Restoration in Childhood Research

The majority of research into the effect of exercise on the attention of children has been carried out on children with Attention Deficit Hyperactivity Disorder (ADHD) (Tantillo, Kesick, Hynd, & Dishman, (2002); Medina et al., 2010; Pontifex, Saliba, Raine, Picchietti, & Hillman, 2013) again due to the high prevalence of ADHD and the overwhelming demand for alternative non drug based treatments. However, within these studies, it has been found that not only do children with ADHD appear to benefit a great deal from exercise, but the control groups containing children without a diagnosis of ADHD appear to benefit greatly too. Pontifex et al., (2013) found that in a sample of children aged between 8-10 years of age, a 20 minute single bout of exercise indoors on a motor driven treadmill was enough to enhance attention in both children diagnosed with ADHD in addition to healthy match controls. The latter finding was an unexpected result, as this single bout of exercise was not thought to be influential enough to yield such results for persons without ADHD.

Such findings lead us to question the benefits of exercise on children without a diagnosis. In 2009 the first study to focus solely upon the link between a single acute bout of exercise and the enhancement of cognitive function specifically on children was published by Hillman et al. (2009). A sample of 20 children (aged 8- 12yrs) revealed that after walking on a treadmill for a 20 minute period, participants performed better on an inhibitory control task than after a 20 minute resting period. They also found that children performed better on an academic achievement test after the treadmill condition.

However, the external validity of this study is questionable as most children do not tend to carry out physical activity on a treadmill.

A more recent experiment based in Scotland was conducted by Hill et al. (2010) which involved six main stream primary schools located in Aberdeen, Scotland (1224 children, aged 8 to 11 years). This is the first study to date which has included such a large sample size, creating a highly representative sample. It was discovered through the means of a DBS test that a series of indoor exercises lasting 10-15 minutes was enough to increase the attention of children. This external validity of this experiment is high as the exercises carried out were created by physical education teachers and can easily be carried out within a classroom.

Thus, it is clear from this evidence provided, that organised exercise indoors may be sufficient enough to provide effective attention restoration for children within a school setting.

Free Play versus Organised Exercise

It is important to note the distinction between free play and organised exercise. Although there is evidence within the literature which has been previously discussed suggesting that organised exercise indoors provides restorative benefits in terms of children's attention, Kaplan and Kaplan (1989) suggest contrastingly that free play is vital within the green space for attention restoration to occur. Free play means allowing your child to play in a way in which he/she wants to. This is thought to relax one's directed attention, and make use of one's involuntary attention to ultimately allow for restoration to take place.

Within the present study, free play took place within the park condition however; organised exercise was required within the gym condition, in order to best match the level of free play which took place within the park setting, to control effectively for exercise.

Green Exercise

The synergistic combination of exercise and exposure to natural environments could potentially be the key to the fight against the rapidly increasing sedentary lifestyles of the western world and the detrimental physical and psychological consequences these carry. More specifically, the overwhelming evidence for both exposure to natural environments and exercise in the restoration of children's attention, suggests that the marrying of these approaches could enhance the attention of children even further, leading to more effective learning and education within schools. One theory which has derived from a combination of the Attention Restoration Theory (ART) and the overwhelming evidence for the psychological benefits of exercise is the idea of Green Exercise (GE). GE refers to exercise which takes place within natural environments (Mackay & Neill, 2010).

Although this theory has been found to yield significant psychological benefits for adults (Pretty, Peacock, Sellens, & Griffin, 2005; Hug, Hartig, Hansmann, Seeland, & Hornung, 2009; Thompson et al., 2011; Barton, Griffin, & Pretty, 2012) no studies to date, to the best of my knowledge, have questioned the link between GE and attention restoration in children. This is surprising considering that separate studies of ART and exercise, have found to hold exceptionally positive restorative powers from directed attention fatigue.

The Present Study

As previously discussed, exercise and outdoor, natural spaces as separate concepts have both yielded positive physical and psychological benefits in children. The synergistic combination of these concepts may provide hope in the battle against the ever increasingly sedentary lifestyles of children today, in addition to the physical and psychological consequences produced by such an epidemic. More specifically however, the marriage of these concepts may benefit the attentional demands of children today within classroom settings.

The present study will extend upon research into the Attention Restoration Theory and Green Exercise Theory in many ways. Primarily, it will investigate whether organised exercise indoors during a lunch break yields similar attentional benefits to those held by a matched amount of free play outdoors. This study will further extend upon the current literature by using a sample of Scottish children living in a rural environment, as much of the previous literature is based on urban children from abroad (Faber Taylor & Kuo, 2004). Additionally, exposing children to real environments instead of simulations, will not only sharpen the current research which largely consists of simulated environments and exercise machines due to their convenient nature, but will allow for a more accurate understanding of the benefits of such a space. This study also will take into account the potential long term benefits on attention restoration of the three conditions, by testing subjects 1 hour after exposure, something which, to the best of my knowledge, has not been conducted previously. Finally, this study will further expand on current research by controlling for gender.

Taking all of this into account the present study will compare children's attention through the use of a standardized test of attention, after spending their lunch break within 3 conditions; free play outdoors in a park, organised exercise indoors and sitting in a classroom. Children's attention will then be tested for a second time after a one hour lesson has been carried out by the class teacher within the participants' usual classroom setting.

Hypotheses:

1. The outdoor, free play condition will yield more attentional benefits than either of the other two, indoor less natural conditions.

2. Digit Backward Span scores will remain higher in the long term after exposure to free play within the natural environment in comparison to either of the other two indoor conditions
3. Girls will benefit more than boys from exercise within the natural setting as determined by the standard measure of attention.

Methods

Site & Design

In order to test for the changes in attention and the experiences had by children during their break time experience, three conditions were set up within which the children would spend their lunch break- indoors in the classroom, organised exercise in the school gym hall, and free play in the park. Each condition was carried out twice to increase the reliability of the results and the order of conditions was as follows: C, G, P, C, G, P. All subjects experienced the same conditions in the same order. A within subjects design was used, however gender was also accounted for within this design due to previous finding by Bentsen, Jensen, Mygind, & Randrup, (2010) which suggests that there is a difference between males and females sensitivity to exposure to natural environments. Therefore, this served as a between- subjects factor.

Park

The park condition took place in Pikes Pool Heritage Park, which sits directly beside Kirkliston Primary School, only a two minute walk away. The physical characteristics of Pikes Pool Heritage Park make it an ideal space within which to test the effects of nature and exercise on psychological wellbeing due to its abundance of lush green grass, fast flowing and trickling streams of water, tall trees and a great deal of foliage. There are very few man made features present for children to play on aside from a few small logs located on the grass, and a path which runs all the way down through the spacious grassy slope. The sky is extremely open within this space; therefore it is an especially light environment.

This green space delivers a more diverse and luscious environment in contrast to a similar maxi project carried out last year by Valaviciute (2014). Valaviciute (2014) used the North Kelvin Meadow in Glasgow to test for the attentional benefits this area may have on children. Although this space encompassed all four components of a restorative environment proposed by the Attention Restoration Theory, the environment within the present study goes above and beyond, providing a vast array of natural features. Table 1 contains a comparison between the features present within the green outdoor space used within this study and the space used by Valaviciute (2014) highlighting the key differences between sites.

Aspect of Natural Space	2014 Study	2015 Study
Long Grass	N	Y
Flowers	Few	Y
Pond/ Stagnant Water	N	Y
Vigorously Running Water	N	Y
Bark	N	Y
Animals (larger)	N	Y
Vision	Limited (less than 50 yards)	Extensive (approx. 1 mile)
Ground	Flat	Slight incline
Long, Trailing Path	N	Y
Fences	Y	N
Walls	Y	N
Buildings	Y	N
Short Grass	Y	Y
Vivid Green	Y	Y
Trees with Leaves	Y	Y
Trees without Leaves	Y	Y
Dirt	Y	Y
Insects	Y	Y
Play Area	N	N
Unlikely Play Areas	-Flower beds - Tree house - Man made benches	- Logs -Small bridge
People	Few	Few

Table 1: Comparison between natural spaces of Valaviciute (2014) and present study, where Y= yes and N= no.

Gym

The gym condition took place within Kirkliston Primary School gym hall. This is a large, open space with plain white walls and one large window which faces out to the gravel playground and the built up area of houses beyond. No equipment was present during the condition, such as the climbing frame, as this session was organised by the Head Teacher, in order to best match the level of exercise to that which took place in the green space condition.

Classroom

The classroom within which the indoor condition took place was a large, earthy coloured room, with paintings and educational posters on the walls. Desks and chairs which were organised into various groups took up much of the space within the classroom, in addition to the teacher's desk located at the far end of the room. Large windows were present on both walls, one which looked out over the gray, gravel playground and the built up housing area just outside and the other which looked over the grassy area within which the park condition took place.

Participants

The participants that took part in this study consisted of 27 pupils from primary four at Kirkliston Primary School. The sample included 13 girls and 14 boys. The average age of the children was 8.07, with a standard deviation of 0.4. All participants lived locally within or near to the rural town of Kirkliston. Exclusion criteria included the failure to receive consent from parents acknowledging the participation of pupils, the voluntary withdrawal from the study by pupils and absence during both of the testing occasions in at least one of the conditions. This resulted in the exclusion of 2 participants, taking the total number of participants down to 25 with a ratio of 12 females to 13 males. Data regarding any co-morbid conditions of the pupils was not gathered and participation in this study was entirely voluntary.

Measure

A Digit Backward Span (DBS) test was used within this experiment to assess changes in participants' attentional abilities. The standard testing procedures for the DBS used in this study were first described by Wechsler (1955). The DBS test is a widely used, standardized measure of concentration (Tennessen & Cimprich, 1995) and highly depends on directed-attention abilities as participants are required to move items in and out of their attentional focus (Cowan, 2001). This test has also been proven to be effective within the research concerning the importance of the type of environment required in order to gain psychological restoration (including attention) effects from exercise (Bodin & Hartig 2003). The DBS test requires the examiner to read aloud a list of numbers to one single participant (e.g. 5-9-2), at the speed of approximately one digit per second. The participant is then

asked to relay these numbers verbally, in reverse order. Once the participant has successfully responded, he/she is then given a new sequence that includes an additional digit. These sequences of numbers increase in length by one digit as the test continues until an incorrect response occurs; after which respondents are given another sequence of numbers of the same length. The overall score for that individual is the number of digits in the longest sequence successfully reversed following two consecutive failed trials (Wechsler, 1955). The DBS test is sensitive to deficits in attention and executive functioning, to such an extent that researchers have suggested that it be used in diagnosing Attention Deficit Hyperactivity Disorder (ADHD) (Hale, Hoeppner, & Fiorello, 2002).

The second measure used within this study was a Likert scale, to measure children's experience of their lunch break. The procedure used to carry out a Likert scale was first described by Likert (1932) and has recently been shown to be representative of individuals' opinions within research surrounding the psychological benefits of outdoor versus indoor spaces (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007). The Likert scale has also been found to be preferred by children over a Visual Analogue Scale (VAS) and a numeric VAS. In addition, children found it to be easier to complete (Laerhoven, Zaag- Loonen, & Derkx, 2004). This is a popular and reliable measure of individuals' attitudes and opinions that allows researchers to uncover degrees of opinion, unlike a simple yes/no questionnaire. Within the present study, the scale involved participants rating to what extent they found their break to be boring, relaxing, interesting and fun. These were rated using a Likert scale from 1 to 3, where 1 indicated not at all, 2 - a little and 3- very much. As the participant sample included children aged between 7-9 years of age, a 3 point scale was used in this study, to ensure that children fully understood the nature of the task. A more in depth understanding of the task by children allows for more accurate ratings of participants' lunchtime experiences.

Procedure

Permission for this study was obtained by the Head Teacher of Kirkliston Primary School. Ethical approval was obtained from the School of Psychology Ethics Committee at the University of Glasgow. Permission was also obtained from the parents/ guardians of participants via permission slips (see appendix E). This study took place over a period of two weeks with a total of six visits to Kirkliston Primary School, two visits for each of the three conditions. The study took place during the first two weeks in February. The Head Teacher, alongside two teaching assistants assisted the researcher in the testing of children at all times. These individuals were fully briefed on the nature of the experiment, its aims and the tests used before testing was carried out with the participants and practice sessions also took place beforehand in order to familiarise testers with the tests and gathering of data. Additionally, each tester was provided with an instruction sheet (see appendix A) to have with them at all times. The presence of multiple testers allowed for groups of participants to be tested simultaneously ensuring that the effects of the condition carried out in the pre lesson testing session

would not wear off or be interfered with by any other possible factors. Testers also rotated between different children in order to avoid tester effects.

Before any conditions took place, the researcher and helpers were introduced to the class and then the children were briefed on what to expect from the experiment and why it was being carried out. This was done in a manner in which children would fully understand so that they could make an effective decision regarding whether or not they felt comfortable taking part, as participation was entirely voluntary. The word “test” was changed to “game” in order to prevent anxiety or worry presenting itself in any of the children.

Children ate their lunch in the school lunch hall before each of the conditions took place, and then gathered at the entrance to the school. They were then guided to one of the three environments; depending on which condition was taking place that day. Participants would then spend 30 minutes in that condition and then be directed back to their classroom. Testers would then gather their assigned group and test each individual one by one. Children were taken in groups to various quiet areas around the school in order to eliminate the majority of distractions during testing.

The child sat in front of the tester and was briefed on what was going to be asked, the DBS test itself and the Likert Scale questionnaire. Then the child was asked whether he/she was happy to proceed. During the first testing session, the children were asked for their age and the DBS test was fully explained, in addition to one or two examples, to ensure the child fully understood the process. Once the tester was confident that the child understood, the participant was notified that that was then the beginning of the test. The digits to be repeated in reverse were read out loud in a slow pace (1 digit per second) with the same intonation each time. Once the DBS test was complete, the child was then asked four questions concerning their break time experience. They were asked to indicate to what extent they found their break to be- boring, relaxing, interesting and fun. All answers were recorded using a Likert questionnaire scale from 1 to 3, where 1 indicated– not at all, 2 – a little and 3 – very much. Once the child had completed all the requirements for that sitting, the next child was called and the procedure was then repeated. This is known as the pre lesson testing condition. Then, a one hour lesson was conducted by the class teacher. During this hour the class teacher was asked to write down any observations she had concerning the children’s attention. The children were then tested as described above for a second time (post lesson testing time) in order to assess for any long term benefits. A previous maxi project by Valaviciute (2014) provided children with a fun sticker at the end of every task, taking the idea from Taylor and Kuo (2009). In contrast, a reward was not presented during this experiment due to findings of various studies showing that rewards and reinforcers produce complex and undesirable motivational side effects (Deci & Ryan, 1985; Deci, Koestner, & Ryan, 1999; Kohn, 1999). More recently, Warneken and Tomasello (2014) found that a child’s motivation to repeat a task is lowered after receiving a reward for the task initially.

Within the classroom setting, children chatted to each other for the entire lunch break in their usual learning environment. Very little movement was involved in this condition and although a teacher was present, she did not interfere with pupils at all.

The gym condition however, was led by the Head Teacher, in order to best match the level of exercise that took place within the park condition. This condition took place for half an hour and began with 5 minutes of stretching, 15 minutes of dodge ball, 10 minutes of organised exercises such as star jumps, running on the spot and skipping in addition to a final 5 minutes of cooling off stretches. The weather was consistent during both conditions, cloudy but drizzly. The children were then lead back to their classroom through the gravel playground and the process of testing described above was carried out.

Previous to the park condition being carried out, a risk assessment was completed by the Head Teacher of the school. The park was located directly next to the school grounds and the walk between the classroom and the park took approximately 3 minutes. The children were accompanied by the researcher, the head teacher and two teaching assistants. Therefore the ratio of adults to children was approximately 6:1. The walks between the school and park were conducted in the same weather conditions (cloudy but dry) and at relatively the same pace each time. Once the children reached the park, they were given half an hour of free play. They were provided with a football, 4 hoops and 2 ropes. They were then guided back to their classroom and the process of testing was carried out as previously described.

Results

It has been hypothesised that children's attention span scores measured using the Digit Backward Span (DBS) test would vary significantly depending on which environment they were exposed to during their lunch break. More specifically, it was hypothesised that after taking part in free play outdoors, children's DBS scores would be higher than after exposure to either of the indoor conditions. It was also predicted that attention span scores would remain higher in the long term after exposure to the natural environment in comparison to either of the other two indoor conditions. Finally it was hypothesised that girls would benefit more than boys in terms of restorative effects of exposure to the natural setting and exercise.

Three 2 x 2 mixed -design between-within ANOVAS were conducted, one for each of the three conditions; classroom, gym and park. By focussing upon each condition separately, it was possible to observe the changes in DBS scores over time for each of the three conditions whilst also taking into account the between subjects variable of gender. The within subject variables were the three conditions and the short versus long term effects of the DBS scores (pre and post lesson testing times).

Condition	Pre Lesson Mean	Post Lesson Mean
Classroom (1)	5.52	5.32
Gym (2)	4.88	5.15
Park (3)	6.28	5.45

Table 2: Table of DBS score means for each condition

Condition 1: Classroom

A mixed between- within subjects analysis of variance was conducted in order to assess the impact on children's scores on the Digit Backward Span test across two time periods (pre lesson and post lesson) after spending their lunch break indoors within a classroom. There was no significant interaction between time and gender, $F(1, 23) = 3.042, p=.095, \eta^2 = .117$. It was also found that there was no main effect for time, $F(1, 23) = .926, p=.346, \eta^2 = .039$. However, there was no statistically significant main effect of gender, $F(1, 23) = 1.409, p=.247, \eta^2 = .058$. This tells us that in general, both boys and girls performed similarly across both time periods and thus, for this condition, the predicted gender difference was not evident in the classroom condition.

Condition 2: Gym

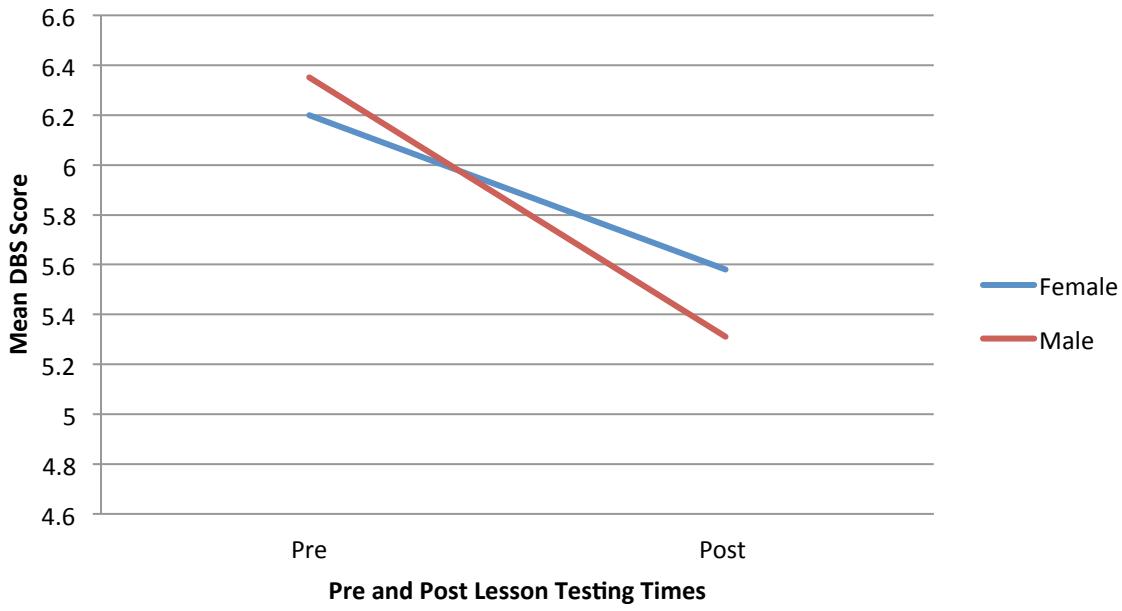
A second 2x2 mixed between- within subjects analysis of variance was conducted in order to assess the impact on children's scores on the Digit Backward Span test across two time periods (post intervention and post lesson) after spending their lunch break carrying out organised exercise within the school gym hall. Within this condition, there was no significant interaction between time and gender, $F(1, 23) = .258, p=.617, \eta^2 = .011$. Additionally it was found that there was again, no main effect for time, $F(1, 23) = 1.473, p=.237, \eta^2 = .060$. However, there was no statistically significant main effect of gender $F(1, 23) = .637, p=.433, \eta^2 = .027$. This finding indicates that again, both girls and boys performed similarly across both time periods and thus, much like for condition 1 (within the classroom), condition 2 (organised exercise within the gym) failed to demonstrate the gender differences which were previously predicted.

Condition 3: Park

A third 2x2 mixed between- within subjects analysis of variance was conducted to assess the impact on children's scores on the Digit Backward Span test across two time periods (pre lesson and post lesson) after spending their lunch break taking part in free play within a natural environment. In this condition, there was no significant interaction between time and gender, $F(1, 23) = 1.031, p= .320$,

$\eta^2 = .043$. However, a significant main effect of time was found for this condition, $F(1, 23) = 16.691$, $p < .001$, $\eta^2 = .421$, with both boys and girls showing a significant reduction in DBS scores over time (see graph 1). This strongly suggests that although the attention scores are higher than in previous conditions immediately after exposure, the scores significantly decrease when children are tested after the 1 hour lesson, indicating that although the initial benefits of green space and exercise appear to increase attentional ability, no long term effect can be observed. However, there was no statistically significant main effect of gender $F(1, 23) = .024$, $p = .879$, $\eta^2 = .001$. Again, this finding indicates that both girls and boys performed similarly across both time periods, as this was the case consistently between the three conditions, ultimately the hypothesis that that girls would benefit more than boys in terms of restorative effects of exposure to the natural setting is not supported.

Effect of Park Setting on Attention



Graph 1

After discovering that there was no significant main effect of gender in either of the three conditions, and having looked at the potential long term attentional benefits within each condition, gender and the post lesson scores were eliminated and using a one way within subjects ANOVA we looked at the main effect of the lunch time conditions at pre lesson testing time only. A statistically significant main effect was found between the types of environment participants experienced during their lunch break where $F(2, 48) = 13.781$, $p < .001$.

Bonferroni follow up pairwise comparisons were carried out in order to further investigate the superiority of the park condition. The park condition was found to yield significantly higher results

($m= 6.28$) than the classroom condition ($m= 5.52$, $p<.05$) and the gym condition ($m= 4.88$, $p< .001$). However there was no significant difference found between the classroom and gym condition ($p=.095$).

In addition to the DBS test, children also completed a Likert Scale questionnaire. This was an important aspect of the testing procedure as the Attention Restoration Theory predicts that outdoor natural settings will not only increase one's attentional abilities but also be rated as more restorative. In order to compare children's ratings of their experiences within each lunch break condition, a one way between groups ANOVA with post hoc tests was ran. Four aspects of the lunch break condition were included in the Likert scale; relaxing, interesting, fun and boring; where 1= not at all, 2= a little and 3= very much. It is important to note, that the boring scores were reversed using SPSS, in order to allow for easier interpretation of output (1=very much, 2=a little and 3=not at all).

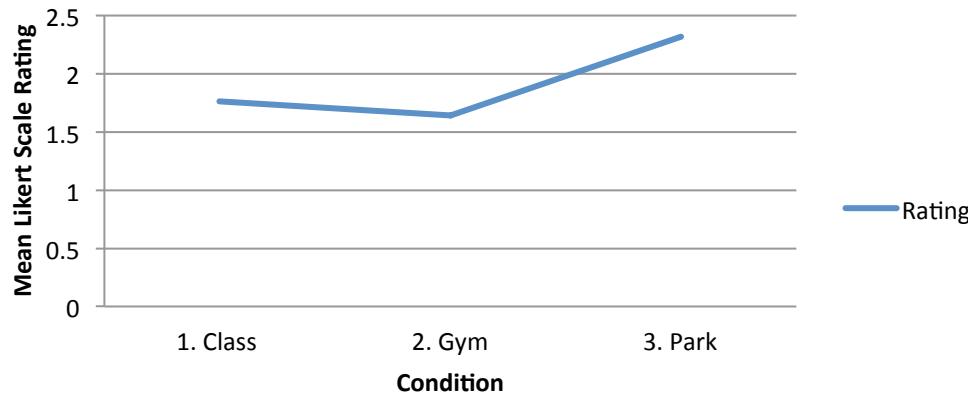
<i>Condition</i>	<i>Relaxing</i>	<i>Interesting</i>	<i>Fun</i>	<i>Not Boring</i>
Classroom (1)	1.76	1.4	1.72	1.8
Gym (2)	1.64	1.6	1.88	2.12
Park (3)	2.32	1.83	2.81	2.73

Table 3: Table of Likert score questionnaire means

Relaxing

There was a statistically significant overall effect for relaxing at the $p<0.005$ level between the three conditions $F(2, 69)$, 7.137, $p<0.005$. The effect size, calculated using eta squared was 0.1714. Post hoc comparisons using the Tukey HSD test indicated that the mean score for condition 1 (classroom) ($m=1.76$, $SD=.6633$) was significantly different from condition 3 (park) ($m=2.32$, $SD=.6463$). This tells us that the park setting was rated as significantly more relaxing than the classroom setting, thus more restorative. Additionally, condition 2 (gym) ($m=1.64$, $SD=.6377$) was found to differ significantly from condition 3 (park) ($m=2.32$, $SD=.6463$) meaning that the gym setting was rated as significantly less relaxing than the park condition, again indicating that the park setting was more relaxing and therefore restorative than the gym setting. However, no significant difference was found for relaxing between condition 1 (classroom) ($m=1.76$, $SD=.6633$) and condition 2 (gym) ($m=1.64$, $SD=.6377$).

Likert Scale Rating of 'Relaxing' Over Three Conditions

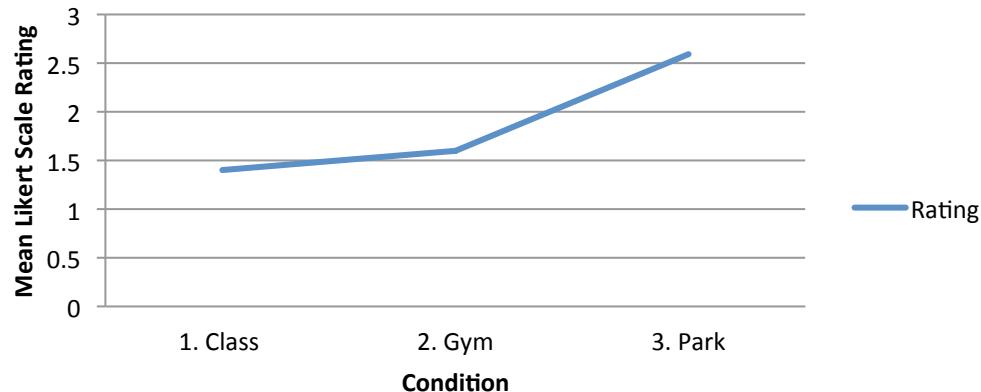


Graph 2

Interesting

In addition, there was also a statistically significant overall effect for interesting at the $p<.001$ level between the three conditions $F(2, 69)$, 30.233, $p<.001$. The effect size, calculated using eta squared was 0.467. Post hoc comparisons using the Tukey HSD test indicated that the mean score for condition 1 (classroom) ($m=1.40$, $SD=.50000$) differed significantly from condition 3 (park) ($m=2.591$, $SD=.50324$). This finding suggests that the park setting was rated as more interesting than the classroom setting, thus acting as more restorative. There was also a significant difference in the mean score between condition 2 (gym) ($m=1.60$, $SD=.64550$) and condition 3 (park) ($m=2.591$, $SD=.50324$). Again, this indicates that the park condition was rated as significantly more interesting than the gym condition, suggesting that the outdoor, natural environment was rated as more interesting than either of the indoor, less natural environments. However, there was no significant difference found between condition 1 (classroom) ($m=1.40$, $SD=.50000$) and condition 2 (gym) ($m=1.60$, $SD=.64550$).

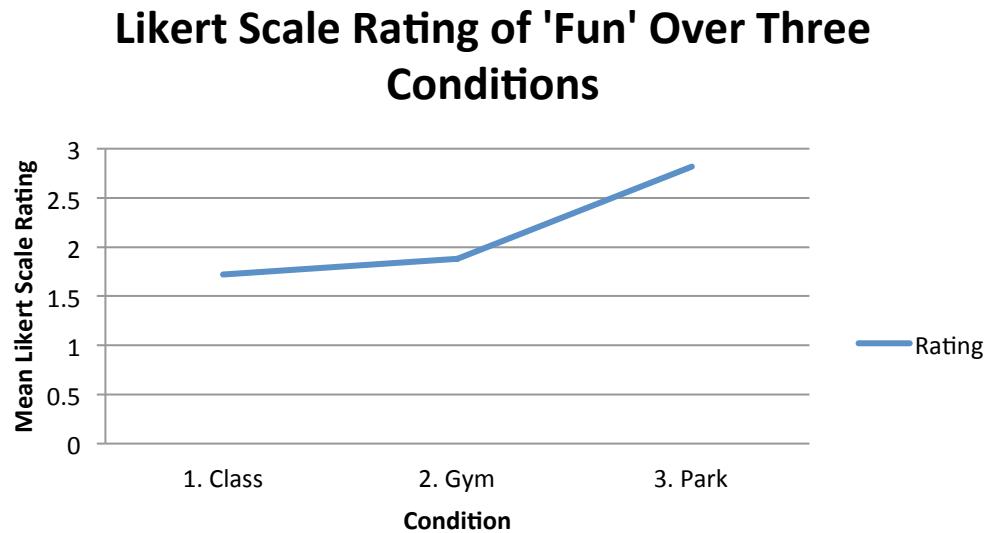
Likert Scale Rating of 'Interesting' Over Three Conditions



Graph 3

Fun

There was also a statistically significant overall effect for fun at the $p < .001$ level between the three conditions $F(2, 69)$, 19.254 , $p < .001$. The effect size, calculated using eta squared was 0.3581 . Post hoc comparisons using the Tukey HSD test indicated that the mean score for condition 1 (classroom) ($m = 1.72$, $SD = .6782$) was significantly different from condition 3 (park) ($m = 2.82$, $SD = .39477$). This tells us that the park was rated as significantly more fun than the classroom setting. The mean score of condition 2 (gym) ($m = 1.88$, $SD = .78102$) was found to significantly differ from condition 3 (park) ($m = 2.82$, $SD = .39477$) which indicates that the park was rated as significantly more fun than the gym condition. These findings again, suggest that the outdoor natural environment possessed more restorative power and was enjoyed more by participants than either of the indoor, less natural settings. However, there failed to be any significance between the mean score of condition 1 (classroom) ($m = 1.72$, $SD = .6782$) and condition 2 (gym) ($m = 1.88$, $SD = .78102$).

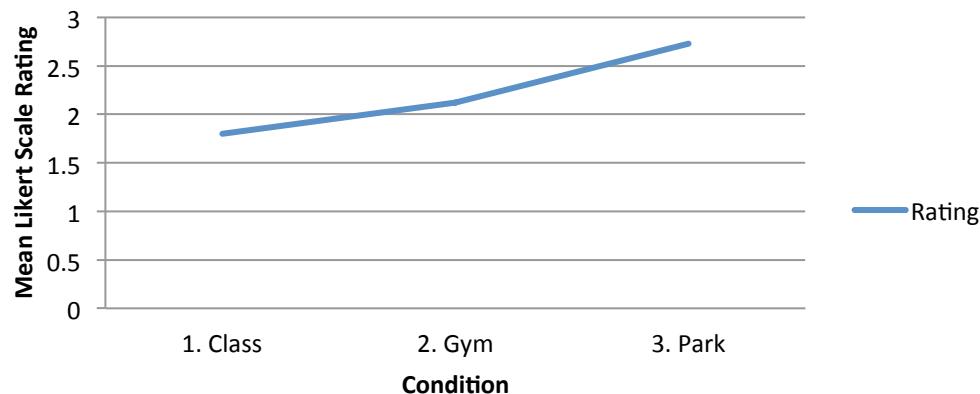


Graph 4

Boring

Additionally there was a statistically significant overall effect for Boring at the $p<.001$ level between the three conditions $F(2, 69)$, 12.221, $p<.001$. The effect size, calculated using eta squared was 0.02616. Post hoc comparisons using the Tukey HSD test indicated that the mean score for condition 1 (classroom) ($m= 1.80$, $SD=.76374$) significantly differed from condition 3 (park) ($m= 2.73$, $SD=.4584$). This means that the park was rated as significantly less boring than the classroom condition. In addition, the mean score for condition 2 (gym) ($m= 2.12$, $SD=.66583$) was found to differ significantly from condition 3 (park) ($m= 2.73$, $SD=.4584$). This finding shows that the park condition was rated as significantly less boring than the gym condition. However, there was no significant difference found between mean scores between condition 1 (classroom) ($m= 1.80$, $SD=.76374$) and condition 2 (gym) ($m= 2.12$, $SD=.66583$).

Likert Scale Rating of 'Not Boring' Over Three Conditions



Graph 5 (Note: Ratings were originally taken for 'boring' however boring scores were reversed using SPSS, in order to allow for easier interpretation of output (1=very much, 2=a little and 3=not at all). Therefore high ratings here signal 'not- boring')

Discussion

This study investigated the short and long term effects of three different lunch time conditions on primary school children's attentional functioning; sitting in a classroom, organised exercise within a school gym hall and free play in a park setting. Results indicated that there was a significant decrease found in DBS scores after exposure to the park setting from testing pre lesson to testing post lesson. This indicates that the effect of the outdoor space had vanished by the end of a 1 hour lesson, which casts doubt over whether this condition yields any educational benefits. This contrasts greatly to the hypothesis made, that outdoor, natural free play would demonstrate long term attentional benefits in comparison to the other two, less natural conditions. However, the park condition was found to yield significantly higher DBS scores than the classroom condition and the gym condition for pre lesson scores, demonstrating a short term benefit, for the outdoor, natural condition. Furthermore, a significant difference was not found in DBS scores between the classroom and the gym condition, suggesting that exercise fails to yield more attentional benefits than merely sitting indoors.

Unfortunately, contrary to what was hypothesised, this study failed to find significant gender differences within any of the three conditions. This finding is in line with what Valaviciute (2014) found in a similar maxi project last year.

Children also rated the park setting as significantly more relaxing, fun and interesting over the two, less natural indoor conditions. Additionally, the park condition was rated as significantly less boring than the classroom and gym environments.

Relation to Previous Theory and Research

In the short term, the DBS test scores for both boys and girls were found to be significantly higher after exposure to free play in the outdoor environment, than after exposure to either of the other two indoor, less natural settings. This finding is consistent with the Attention Restoration Theory proposed by Kaplan and Kaplan (1989). The theory would predict that exposure to the natural environment would enable children to rest their directed attention (which requires effort to shut out distractions in order to concentrate) and instead, use their involuntary or automatic attention due to the 'soft fascinations' present in such an environment, thus proving more restorative than either of the indoor conditions. Therefore the findings of this paper add to the existing body of knowledge, supporting the Attention Restoration Theory proposed by Kaplan and Kaplan (1989). In addition, these findings are in line with a previous maxi project based in Scotland carried out by Valaviciute (2014), who also found the outdoor, natural space to yield superior results in the DBS test over a playground setting and an indoors, classroom setting for urban based children. A large body of research is already present, providing support for this theory (Hartig et al. 1991; Ottosson & Grahn, 2005; Mårtensson et al., 2009), however, the majority of these studies are from abroad and the present study extends this

research by demonstrating that the Attention Restoration Theory continues to apply to rural based children from Scotland.

More specifically, the significant difference found between the DBS scores collected straight after exposure to the outdoor free play condition and the indoor organised exercise condition are surprising. Moreover, there was no significant difference found between the indoor conditions. These findings suggest that free play outdoors yielded significantly higher attentional benefits than exercise indoors, and furthermore, children performed relatively similarly on the DBS test after exposure to organised exercise in the gym and after sitting in a classroom. Hill et al. (2010) carried out a Scottish based study in various schools which found that 10-15 minutes of organised aerobic exercise indoors increased children's performance on the Digit Backward Span test. This may also have been the case within the current study; however a baseline DBS score before exposure to each condition was not carried out. Instead, the present study moved this research forward, and compared DBS scores after each exposure across conditions. Therefore, it is now possible to conclude that free play in outdoor, natural spaces yielded higher attentional benefits than organised exercise indoors, comparisons which Hill et al. (2010) failed to take into account.

However, there was no significant difference found in DBS scores at pre lesson testing between the classroom and the gym setting within the present study. This finding contrast greatly to those which have demonstrated an attentional benefit for children after carrying out organised exercise indoors for both children with ADHD (Tantillo et al., 2002; Medina et al., 2010, Pontifex et al., 2013) and without (Pontifex et al., 2013; Hillman et al., 2009; Hill et al. (2010). Kaplan and Kaplan's (1989) Attention Restoration Theory (ART) would predict the poor results yielded in the DBS test by the gym session to be a result of the organised and structured nature of the exercise. As previously stated, the ART recommends that free play is necessary for effective attention restoration to take place, as it is paramount to provide rest for one's directed attention. Thus, the theory would predict that the organised nature of the exercise task which took place within the gym setting required children to make use of their directed attention, rather than resting it and allowing for involuntary attention to take place. This may explain the lack of attentional benefit yielded by the gym condition.

The low DBS scores gathered immediately after exposure to the classroom setting in comparison to the park setting is also an unexpected finding of this study. The classroom used within this experiment has a large, landscape window, which looks out onto the green, natural space used in the park condition of this study. Not only have adult based studies found attention to be significantly better after viewing green space from a window, (Tennessen & Cimprich, 1995; Kaplan, 2001; Kuo & Sullivan, 2001) but Faber Taylor et al., (2001a) found that children too, benefit from green space, even if only viewed from a window. Previous research has demonstrated that simulated natural

environments (recordings shown on a TV or pictures) are not as effective at providing restorative benefits (Berigan & Pielage, 2013; Kjellgren & Buhrkall, 2010). Therefore the current study built upon previous research by comparing DBS test scores after rural children were exposed to a view of a natural green space and after they had carried out free play within a real natural environment. Ultimately, it was revealed that free play within a real natural environment produces significantly greater DBS scores, and therefore more attentional benefits, than after viewing the same green space from a window for rural children in Scotland.

One of the most unanticipated results found within this study and which appears to be the most relevant is the significant decrease in male and female scores of the DBS test over time after exposure to the natural environment. This contrasts greatly with the hypothesis that was previously generated which stated that the outdoor environment would provide children with more long term attentional benefits over the other two indoor settings. Contrastingly however, unanimous observation notes taken by the class teacher reported that children appeared significantly more focussed throughout the 1 hour lesson after exposure to the park condition. The observation notes written by the class teacher are not included in the main body of this paper due to the word count restrictions, however they can be found in appendix D. The contrasting data of the DBS scores and the observations may indicate that the DBS test does not produce an accurate representation of children's attentional abilities. Future research should make use of both quantitative and observational data in order to compare and contrast between measures.

Finally, the findings which revealed that the Likert scale ratings followed a similar pattern to the DBS scores reveal the importance of 'compatibility' within a natural setting as proposed by Kaplan (1995). The children were found to score higher on the DBS test directly after exposure to the park setting, which was also rated as more enjoyable overall.

Strengths and Limitations of the Present Study and Suggestions for Future Research

An obvious strength within this study is the methodological approach taken. Exposing participants to a real green space which is naturally rich in vegetation is more likely to provide results which are an accurate representation of the effects such an environment has in comparison to simulated environments, which have been used all too often due to their convenient nature (Berto, 2005). Additionally, the quantitative measures used in this study provide strong quantifiable evidence of the effects of outdoor space on children, in comparison to the qualitative measures used so often within the literature, such as self reports and interviews which can potentially prove to be bias. The Digit Backward Span test has been used to gather data within psychological research for a number of years and on a large number of adult samples (Wechsler, 1955; Lezak, 1983). It is vital that future research

follows in the footsteps of this current study, and uses real environments within their experiments, in addition to quantitative measures, in order to gain the most accurate representation of the benefits such spaces provide.

Yet another strength which this study possesses is that there was not an extensive walk required to get from the school to the park. A 3 minute walk was required of children in order to get to and from the school and the green space in comparison to a 15 minute walk required in a maxi project last year by Valaviciute (2014). This may have caused children to be extremely tired by the time the DBS and Likert scores were taken, which may have been the reason why children evaluated the meadow condition as ‘just as boring’ as the playground condition within Valaviciute’s (2014) study. In the present paper, children rated the park condition as significantly less boring than either of the other two, less natural conditions. However, future research should not view distance as a barrier to green spaces, as Valaviciute (2014) still found the green space to be highly beneficial for attention restoration in children.

An additional step forward that this study made from Valaviciute’s (2014) maxi project is that children were tested within quiet rooms, with very few distractions, in comparison to all children being testing within a noisy classroom environment. This would have provided many distractions which children would have had to work hard at to repress during the DBS test. By placing groups of children into quiet rooms around the school, and providing a silent drawing task for children whilst each individual was being tested, there was little demand for children to repress distractions within the current study, allowing them to perform to the best of their abilities on the DBS task, ultimately providing a more accurate representation of the attentional benefits of environments.

One of the most notable strengths of the current paper however, is the use of rural children in the sample. The majority of studies have used urban based children within their sample, and therefore this is a huge step forward within the literature as it expands our knowledge, and demonstrates that the effect of free play and the outdoor environment is just as strong for children who are more commonly exposed to it in their everyday lives.

Finally, the fact that the potential long term benefits of outdoor space on attentional functioning were taken into account was a considerable strength of this study. The significant decline in DBS scores over the space of 1 hour after being exposed to an outdoor, natural environment suggests that there may not be any educational benefits of children spending their lunch break within a natural environment. Future research is strongly encouraged to further investigate the long term effects of outdoor, natural environments on the attention of children using quantitative measures, as this study only takes the first few steps into this area of research.

However, it is vital to acknowledge the potential limitations of this study which in turn, provide various interesting avenues for future research.

One procedural limitation this study presents is that there were only four testers who were required to test all 25 participants. Children were split into 4 groups and each group was taken to a quiet room located within the school with 1 tester. Therefore some children were tested straight after the lunch break finished whilst others were tested 10-15 minutes after. Due to the lack of long term benefits observed in this study (most significantly in the park condition), the effect of the lunch break may still have been strong for those tested first, however the effects may have slightly worn off 10- 15 minutes after the exposure took place. It is also possible that the children tested first may have been more apprehensive than the children tested last. Both of these possibilities may have had a statistically significant effect on the results gathered. Future research should partially solve this problem by testing children in a random order each time. Ideally, there would be one adult to one child, to ensure each child is tested simultaneously, however this method is challenging due to the number of testers required.

A second limitation of this study was that, much like Valaviciute (2014), the experiment took place during winter months, in this case the first two weeks of February. Although there was still a great deal of luscious green grass, tall trees and running water, the vegetation was not as luscious and rich as it would be during the spring and summer months. Future research should consider questioning whether there is more of an effect of the outdoor natural environment on children's attention in the spring and summer months in comparison to the winter months, due to the presence of richer vegetation, as well as improved and calmer weather conditions.

Implications for Practice

It is apparent, that we are not in a good position to make policy recommendations. Before this is possible, it is imperative that future research is conducted focussing more on the long term benefits that are yielded by free play within outdoor, natural environments.

However, the findings of the DBS scores gathered at pre lesson testing times provide promising empirical evidence for the short term restorative benefits of free play within an outdoor, natural environment and the observations by the class teacher suggest that there may be long term attentional benefits of natural space, even if not reflected in the DBS scores. The ratings gathered by the Likert Scale also suggest that children enjoyed free play outdoors more than taking part in organised exercise indoors or sitting in a classroom environment. Therefore, schools should most definitely encourage and implement more time within the curriculum for free play within natural, outdoor environments, not only due to the possible attentional benefits which the outdoor space may serve, but for the mere enjoyment and fun that children experience within such an environment. The happiness of children at

school is arguably, the most important thing, as if children enjoy going to school, they are more likely to attend, and therefore learn.

As Kaplan (1995) states, a green space does not need to be geographically distant from a school in order to achieve the feeling of ‘being away.’ If exposure to natural, green spaces is not a possibility every day, as Valaviciute (2014) suggests, schools should aim to implement nature within their playground, by planting trees, shrubs, flower beds and vegetable gardens. These elements will not only increase pupils’ attentional functioning but may also serve a variety of educational purposes (Rich, 2007; Shibata & Suzuki, 2001, 2002, 2004). However, the increasingly tighter budgets provided to Scottish public schools by the government, may mean that redesigning the playground is not a possibility. A cheaper alternative would be to implement aspects of nature into the classroom. This may involve slight changes such as green plants, flowers and even opening the window to provide a slight breeze. Valaviciute (2014) suggests that this idea may provide children with a sense of ‘being away’, ‘extent’ and possibly even ‘soft fascination’ (Gulwadi, 2009) which are necessary aspects proposed by Kaplan (1995) to ensure successful attention restoration from directed attention fatigue occurs. Future research should also consider the role that indoor, natural aspects have in providing children with longer lasting attentional benefits after exposure to natural, green space.

Conclusion

To conclude, the findings indicate that free play within a natural, outdoor environment provides children with more benefits in attentional functioning in comparison to indoor organised exercise or sitting in a classroom environment. However, although this is the case short term, the second testing session after a 1 hour lesson conducted by the class teacher revealed a significant decrease in attention scores, revealing that outdoor, natural environments may not serve any lasting attentional benefits for rural children. This study therefore is the first of its kind to demonstrate the lack of long term benefits of outdoor free play. Further research is necessary to conclude that outdoor, natural space yields no long term benefits in terms of attention restoration in children, in addition to investigating ways in which the initial benefits immediately after exposure can be encouraged to last, such as plants incorporated into classroom settings as well as other natural aspects. Despite this finding, schools should still ensure that children are exposed to natural environments on a daily basis as children rated the park as being significantly more enjoyable than either of the other indoor, less natural conditions.

Instructions provided to testers

1. Child sits down, ask if he/she is happy to proceed
2. Write down initials, gender, and age
3. Brief the child on the DBS task, even giving a few examples if necessary until you feel that they have fully grasped the concept.

The DBS task instructions

The DBS test involves reading out loud a sequence of digits to an individual participant (e.g. 3-1-8) and asking them to repeat the sequence aloud in reverse order (e.g. 8-1-3)

After a correct response, participants are given a new, longer sequence with series' length increasing as the test proceeds; after an incorrect response, respondents are given a new, same length sequence to attempt.

The overall test score of the DBS test is the number of digits in the longest sequence successfully reversed following **two consecutive failed trials**.

The DBS test requires sustained attentional effort because the participant must move digits in and out of their attentional focus by having to mentally hold and recite the items in reverse order.

4. Carry out the DBS task
5. Write down their score on the sheet provided
6. Then state that you are going to ask them a few questions about how much they enjoyed their lunch break today.
7. Carry out the Likert Scale Questionnaire.

The Likert Scale task instructions

To what extent did you find your break to be...

- i. Boring
- ii. Relaxing
- iii. Interesting
- iv. Fun

Where...

1= not at all

2= a little

3= very much

Please write their Likert scale rating number beside the correct term on the sheet provided.

8. Finally, thank the child for their participation.

Appendix B

The random number sheet used for Digit Backward Span test.

4

4 3

8 8 3

7 1 9 6

1 1 1 7 5

4 8 5 5 8 9

6 3 4 4 8 6 9

5 2 7 5 4 8 3 6

6 6 4 2 4 1 4 5 2

9 5 6 2 9 4 1 3 9 8

5 1 8 5 4 3 1 9 7 3 9

3 4 7 4 6 7 7 7 9 3 2 9

2 6 3 9 3 6 5 9 3 7 7 1 6

6 3 9 3 5 3 9 4 1 4 7 7 6 7

7 5 9 2 7 5 2 9 9 2 7 5 6 7 5

4 4 7 8 7 7 1 1 4 1 8 2 8 1 8 2

1 9 8 8 7 8 6 8 7 1 3 4 2 9 5 4 9 9

5 2 4 4 8 7 2 4 2 8 3 1 7 1 2 5 6 8 5

Appendix C

An example of how raw data was gathered. Each group was provided with one of these before each testing session.

Condition:

Group:

Initials	Gender	Age	DBS Score	Likert
				i. ii. iii. iv.

Appendix D

Observations made by class teacher during the 1 hour period after exposure to each of the three conditions.

Condition 1: Classroom

“Children appeared distracted throughout the lesson, as they usually do after a ‘wet lunch time’ which also involves staying indoors during their lunch break. Staring out of windows, failing to complete tasks effectively and excessive talking were all behaviours which I observed throughout the hour. I feel that the children are bursting with energy, just dying to let it all out, so trying to focus their attention upon a reading task proved challenging”

Condition 2: Gym

“I was surprised to notice that children seemed equally distracted after taking part in exercise indoors. I had expected them to be more settled, but instead, appeared distracted. Their telling behaviours included fidgeting, talking and careless mistakes within the writing task which was assigned to them throughout the hour”

Condition 3: Park

“The children had been really looking forward to going to the park, as it is an area within which they are not usually permitted to go, let alone carry out free play in. During the 1 hour lesson, children were more settled, quieter and more content. The majority of individuals completed their set writing task to a high standard and the teaching experience for me was much less of a battle. If I could take the children to the park everyday for their lunch break, I would.”

Appendix E
Consent Letter Sent To Parents



Carmel Road Kirkliston West Lothian EH29 9DD

Tel 0131 333 3260 Fax 0131 335 3582 E-mail:admin@kirkliston.edin.sch.uk

Head Teacher: Mrs Lynn Paterson

26.1.15

Dear parents/carers

I have received a request by Lucy Paterson, an undergraduate student to undertake a research project which looks at the impact of outdoor space and exercise on the attention of primary school children.

This will involve the children spending two lunchtimes in each of the following places: Green space (Allison Park); in the classroom; and in the gym hall with the same organised play and exercise as in Allison Park. After the children have spent their lunchtimes in each of these conditions, the children will undertake a short individual memory test (remembering numbers from a given list and then repeating them backwards.) The children will also be asked for their opinion on their experience of the activity. After the memory test, the children will continue with their class learning. After one hour the children will be tested again in the same manner to see if there is any long-term impact that the outdoor space and exercise or lack thereof, has on the children's attention.

The children will be fully briefed on the project before they start and be aware of the plan for the day. They will also be asked to give their consent and they will be made aware that they can withdraw their participation at any time throughout the process.

This research is an interesting addition to the current investigation into attention within the classroom. Miss McCammon and myself are very excited about the project and it's results.

Please do not hesitate to contact me if you would like any further information.

Yours sincerely

Lynn Paterson

Head Teacher

Please complete the tear-off slip below, delete as required and return to school by Friday 30th January.

Name of child: _____

I wish/ do not wish my child to be involved in this activity.

Signature of parent: _____

Date: _____

References

- Barton, J., Griffin, M., & Pretty, J. (2012). Exercise-, nature-and socially interactive-based initiatives improve mood and self-esteem in the clinical population. *Perspectives in public health, 132*(2), 89-96.
- Bentsen, P., Jensen, F. S., Mygind, E., & Randrup, T. B. (2010). The extent and dissemination of udeskole in Danish schools. *Urban forestry & urban greening, 9*(3), 235-243.
- Berigan, H., & Pielage, N. (2013). A Good Study Break: Effects of Nature versus TV on Attention. *Journal of Undergraduate Research XV*.
- Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological science, 19*(12), 1207-1212.
- Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of environmental psychology, 25*(3), 249-259.
- Bodin, M., & Hartig, T. (2003). Does the outdoor environment matter for psychological restoration gained through running?. *Psychology of Sport and Exercise, 4*(2), 141-153.
- Carter, C. (2015, Feb 24). Children spend less than 30 minutes playing outside a week. *The Telegraph*, Retrieved from <http://www.telegraph.co.uk/lifestyle/10747841/Children-spend-less-than-30-minutes-playing-outside-a-week.html>
- Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioural and Brain Sciences, 24*, 87-114.
- Cutler, M.D., Glaeser E.L., & Shapiro, J.M. (2003). Why Have Americans Become More Obese? *Journal of Economic Perspectives, 17*(3), 93-118.
- Daniels, S. R., Arnett, D. K., Eckel, R. H., Gidding, S. S., Hayman, L. L., Kumanyika, S., ... & Williams, C. L. (2005). Overweight in children and adolescents pathophysiology, consequences, prevention, and treatment. *Circulation, 111*(15), 1999-2012.
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological bulletin, 125*(6), 627.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Springer Science & Business Media.

- DeMarco, T., & Lister, T. (2013). *Peopleware: productive projects and teams*. United States of America: Addison-Wesley.
- Dunn, J., & Layard, R. (2009). *A good childhood: Searching for values in a competitive age*. London, England: Penguin UK.
- Faber Taylor, A., Kuo, F. E., Sullivan, W. C. (2001a). Views of nature and self-discipline: evidence from inner-city children. *Journal of Environmental Psychology* 22, 49-63.
- Faber Taylor, A., Kuo, F. E., Sullivan, W. C. (2001b). Coping with ADD: the surprising connection to green play settings. *Environment and Behavior* 33, 54-77.
- Faber Taylor, A., & Kuo, F. E. M. (2011). Could exposure to everyday green spaces help treat ADHD? Evidence from children's play settings. *Applied Psychology: Health and Well-Being*, 3(3), 281-303.
- Felsten, G. (2009). Where to take a study break on the college campus: An attention restoration theory perspective. *Journal of Environmental Psychology*, 29(1), 160-167.
- Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of green space increase with biodiversity. *Biology letters*, 3(4), 390-394.
- Gray, P. (2011). The Decline of Play and the Rise of Psychopathology in Children and Adolescents. *American Journal of Play*, 3(4), 443-463.
- Greene, S., and [Hill, M.](#) (2005). Researching children's experiences: methods and methodological issues. In: Greene, S. and Hogan, D.(eds.) *Researching Children's Experiences: Methods and Approaches*. Sage: London, UK, pp. 1-21. ISBN 9780761971023
- Gulwadi, G. B. (2009). Restorative home environments for family caregivers. *Journal of Aging Studies*, 23(3), 197-204.
- Hale, J. B., Hoeppner, J. A. B., & Fiorello, C. A. (2002). Analyzing digit span components for assessment of attention processes. *Journal of Psychoeducational Assessment*, 20(2), 128-143.
- Handy, S., Cao, X., & Mokhtarian, P. (2008). Neighborhood design and children's outdoor play: Evidence from Northern California. *Children Youth and Environments*, 18(2), 160-179.
- Hartig, T., Mang, M., & Evans, G. W. (1991). Restorative effects of natural environment experiences. *Environment and behaviour*, 23(1), 3-26.

- Hill, L., Williams, J. H., Aucott, L., Milne, J., Thomson, J., Greig, J., ... & MON-WILLIAMS, M. A. R. K. (2010). Exercising attention within the classroom. *Developmental medicine & child neurology*, 52(10), 929-934.
- Hillman, C. H., Pontifex, M. B., Raine, L. B., Castelli, D. M., Hall, E. E., & Kramer, A. F. (2009). The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children. *Neuroscience*, 159(3), 1044-1054.
- Hug, S. M., Hartig, T., Hansmann, R., Seeland, K., & Hornung, R. (2009). Restorative qualities of indoor and outdoor exercise settings as predictors of exercise frequency. *Health & place*, 15(4), 971-980.
- Kaplan, R. & Kaplan, S. (1989). *The Experience of Nature: A Psychological Perspective*. New York: Cambridge.
- Kaplan, S. (1995). The restorative benefits of nature: toward an integrative framework. *Journal of Environmental Psychology* 15, 169-182.
- Kaplan, S. (2001). Meditation, restoration, and the management of mental fatigue. *Environment and Behavior*, 33(4), 480-506.
- Kaplan, S., & Talbot, J. F. (1983). Psychological benefits of a wilderness experience. *Behavior and the natural environment*, 6, 163-203. doi: 10.1007/978-1-4613-3539-9_6
- Kjellgren, A., & Buhrkall, H. (2010). A comparison of the restorative effect of a natural environment with that of a simulated natural environment. *Journal of Environmental Psychology*, 30(4), 464-472.
- Kohn, A. (1999). *Punished by rewards: The trouble with gold stars, incentive plans, A's, praise, and other bribes*. United States of America: Houghton Mifflin Harcourt.
- Kuo, F. E., & Faber Taylor, A. (2004). A potential natural treatment for attention-deficit/hyperactivity disorder: evidence from a national study. *American journal of public health*, 94(9), 1580-1586.
- Kuo, F. E., & Sullivan, W. C. (2001). Environment and crime in the inner city does vegetation reduce crime?. *Environment and behavior*, 33(3), 343-367.
- Laerhoven, H. V., Zaag-Loonen, H. V. D., & Derkx, B. H. F. (2004). A comparison of Likert scale and visual analogue scales as response options in children's questionnaires. *Acta paediatrica*, 93(6), 830-835.

- Laumann, K., Gärling, T., & Stormark, K. M. (2003). Selective attention and heart rate responses to natural and urban environments. *Journal of environmental psychology*, 23(2), 125-134.
- Lezak, M. D. (1983). *Neuropsychological assessment*. New York: Oxford University Press.
- Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, 22, 140.
- 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(3), 238-245.
- Mårtensson, F., Boldemann, C., Söderström, M., Blennow, M., Englund, J. E., & Grahn, P. (2009). Outdoor environmental assessment of attention promoting settings for preschool children. *Health & Place*, 15(4), 1149-1157.
- Medina, J. A., Netto, T. L., Muszkat, M., Medina, A. C., Botter, D., Orbetelli, R., ... & Miranda, M. C. (2010). Exercise impact on sustained attention of ADHD children, methylphenidate effects. *ADHD Attention Deficit and Hyperactivity Disorders*, 2(1), 49-58.
- Moss, S. (2012). Natural childhood. *RSPB, Sandy*.
- Neuwelt, P. M., & Kearns, R. A. (2006). Health benefits of walking school buses in Auckland, New Zealand: perceptions of children and adults. *Children Youth and Environments*, 16(1), 104-120.
- Oppezzo, Marily; Schwartz, Daniel L. (2014). Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40(4), 1142-1152. Retrieved from: <http://dx.doi.org/10.1037/a0036577>
- Ottosson, J., & Grahn, P. (2005). A comparison of leisure time spent in a garden with leisure time spent indoors: on measures of restoration in residents in geriatric care. *Landscape Research*, 30(1), 23-55.
- Pontifex, M. B., Saliba, B. J., Raine, L. B., Picchietti, D. L., & Hillman, C. H. (2013). Exercise improves behavioral, neurocognitive, and scholastic performance in children with attention-deficit/hyperactivity disorder. *The Journal of pediatrics*, 162(3), 543-551.
- 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.
- Prezza, M. (2007). Children's independent mobility: A review of recent Italian Literature. *Children, Youth and Environments*, 17(4), 293-318.

- Rich, D. L. (2007). *Effects of exposure to nature and plants on cognition and mood: A cognitive psychological perspective*. Ithaca, NY: Cornell University
- Shaffer, D.R. (1985). *Developmental psychology: Theory, research, and applications*. Monterey CA: Brooks/Cole
- Shibata,S., & Suzuki, N. (2001). Effects of indoor foliage plants on subjects' recovery from mental fatigue. *North American Journal of Psychology*, 3, 385-396
- Shibata,S., & Suzuki, N. (2002). Effects of the foliage plant on task performance and mood. *Journal of Environmental Psychology*, 22, 265-272
- Shibata,S., & Suzuki, N. (2004). Effects of an indoor plant on creative task performance and mood. *Scandinavian Journal of Psychology*, 45, 373-381.
- Tantillo, Mary; Kesick, Christina M.; Hynd, George W.; Dishman, Rod K. (2002). The effects of exercise on children with attention-deficit hyperactivity disorder. *Medicine & Science in Sports & Exercise*, 34(2), 203-212. Retrieved from: <http://dx.doi.org/10.1097/00005768-200202000-00004>
- Taylor, A. F., & Kuo, F. E. (2009). Children with attention deficits concentrate better after walk in the park. *Journal of attention disorders*, 12(5), 402-409
- Tennessen, C. M., & Cimprich, B. (1995). Views to nature: Effects on attention. *Journal of environmental psychology*, 15(1), 77-85.
- Thompson Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., & Depledge, M. H. (2011). Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. *Environmental science & technology*, 45(5), 1761-1772.
- Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of environmental psychology*, 11(3), 201-230.
- Valaviciute, I. (2014). *Investigation of the potential impact of outdoor play on attention in primary school children*. Unpublished undergraduate maxi project, Psychology Department, University of Glasgow.
- Warneken, Felix; Tomasello, Michael. (2014). Extrinsic rewards undermine altruistic tendencies in 20-month-olds. *Motivation Science*, 1(S), 43-48. Retrieved from: <http://dx.doi.org/10.1037/2333-8113.1.S.43>

Wechsler, D. (1955) *Manual for the Wechsler Adult Intelligence Scale*. New York: The Psychological Corporation.

White, M., Smith, A., Humphries, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*, 30(4), 482-493.

World Health Organisation (2015, January). Fact sheet N°311. Retrieved from

<http://www.who.int/mediacentre/factsheets/fs311/en/>