How Does Growing Up Separate From Natural Environments Affect Childhood Development?

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Abstract

After much nature-nurture research and debate it is generally agreed that both the genes you are born with and the environment you develop in contribute to shaping you as an individual. This paper looks at what effect separation from the natural world has on children and what the benefits of spending time in natural environments may be.

A cultural shift is identified that has resulted in a significant reduction in the amount of time children are spending outdoors in comparison to their parents and grandparents. The question of whether this is a cause for concern is raised. The effects of spending time in natural environments are then considered from research in several disciplines, primarily Geography, Psychology and Physiology. The research strongly suggests that there are significant psychological, physiological and social benefits to childhood development.

Given the rate at which green-space is being developed, although more research is required to quantify the positive impacts of childhood exposure to nature, there is incentive to act fast. Suggestions for future research and steps to raise awareness of this issue are made.

1. Introduction

The environment in which one grows up undoubtedly influences aspects of development. It has been observed that children are spending progressively less time directly engaging with natural environments as opposed to built environments. Given that humans evolved in such environments and that up until recent decades a significant proportion of children's time was spent outdoors, the possible effects of this lifestyle change are largely unknown. The terms *nature* and *natural environments* can be defined and understood in many different ways. For the purpose of this dissertation, I will use these words to refer to 'green space', typically areas which have grass, or other low-growing plants, and trees. This includes spaces such as gardens and parks. When referring to more expansive natural areas such as *woodlands* or those wilder and far removed from civilization such as areas of *wilderness* I will use these more specific terms. Multiple key speakers (Louv, R; Young, J; Bird, W) when talking about children's changing relationship to nature ask: if children are not making meaningful connections with nature, then who in the next couple of decades is going to care about species on the edge of extinction, deforestation, development of local woodlands and parks, and how clean our air and water is? In addition to these concerns, there are health implications associated with reductions in the amount of time children are spending in natural environments.

Much consideration has been given to what role our evolving in a natural world has to play in our current relationship to the natural world (Kellert SR and Wilson EO, 1993), however this will not be a focus of this dissertation. I will begin by looking at how children's relationship to nature in the developed world has changed over the past few generations and I will consider possible contributing factors

to these changes. I will then explore what research has been carried out regarding the psychological, physiological, social health implications of such changes and then discuss the findings of this broad body of research. In addition to impacts on individuals, I will briefly address how these effects on individuals influence us all at a societal level.

When referring to growing up *separate* from natural environments I am referring to a lack of awareness of nature as well as to a lack of access to natural spaces. For example it can be argued that even in the biggest cities we are not separate from nature with sightings of large predators such as red-tailed hawks in Manhattan being unsurprising to some likewise, urban foxes are commonly seen in London. However it is unusual for those without an interest, those who do not pay attention to such aspects of their environment, to be aware of the presence of animals and birds in cities. Thus perhaps without engagement and exploration of natural spaces from a young age, regardless of living in a city or a wilder environment, we may not be physically separate from nature but can still become psychologically separate from nature. We can thus believe we are separate from nature or even grow up with a lack of awareness of how we are connected to nature and natural cycles.

1.1 Methodology

It is helpful to draw on a variety of disciplines when looking at this changing relationship between children and natural environments and its effects. Especially useful in responding to these questions are geographical, psychological, physiological and public health perspectives. The fact that so many different disciplines are carrying out directly related research in itself suggests that there is value in not only each of their individual approaches to this topic but also in

collating their findings to gain a holistic understanding of whether there are implications and if there is cause for concern.

This is a very topical area in multiple disciplines. In scientific disciplines, relevant papers in the past year have been published in academic journals including Environment and Behavior and Journal of Environmental Psychology. In the area of public health this topicality is seen with an article on 'Landscape and Well-Being: a Scoping Study on the Health-Promoting Impact on Outdoor Environments' published in International Journal of Public Health earlier this year. Also the topic of children interacting less with nature is increasingly arising in the popular media with headlines such as "No Outdoor Play 'Hurts Children'" (BBC news, 2007) and "Is it Time to Let Children Play Outdoors Once More?" (Asthana and Revill, 2008).

In order to compile and integrate such a broad body of interdisciplinary research, from classical to current, I have used various methods. Primarily I carried out literature searches using library-based searches through UCL as well as online searches using resources such as the Web of Science and the Web of Knowledge. Relevant papers arose from such searches using key words including: nature, children, health, outdoors and development. I then reviewed the increasing base of relevant research by selecting appropriate references that these papers had used, in addition to looking at papers that have since cited these where possible. Secondarily I had the opportunity to attend a very relevant conference on this topic organised by the Countryside Recreation Network: 'Growing up Outdoors the Next Steps: Children's Health and the Outdoors' in Dec 2009. This not only opened my eyes to more areas of primary research, but also gave me the opportunity to talk to key speakers in the field and gain the benefit of their opinions in how to approach

these questions. Thirdly I was able to interview Thomas Schorr-Kon, founder of Trackways Ltd. and talk with Jon Young founder of the Wilderness Awareness School, both of whom have worked with children outdoors for a significant period of their adult life where connecting with nature is a focus. This was a valuable qualitative addition in enabling me to add their observations of how children from different backgrounds engage with natural environments. It was also helpful in gaining advice and an overview of areas of research to explore.

1.2 Children and Research

Within the literature that addresses the overall topic of children and nature, many reports address issues around conducting primary research with children as well as the issue of what childhood is. It is therefore worth briefly acknowledging that there are important ethical and methodological considerations when conducting research involving children. Sinclair clarifying that (1996:89) "it is important that social researchers who work directly with children do so within clearly articulated and understood ethical standards and that opinions are accurately recorded through appropriate methodologies." It is noted by Veitch *et* al. (2007) that all disciplines struggle in ethics clearance regarding research with children. Despite these obstacles, there is a wide body of research that has been conducted with children and some applicable studies involving adults within the topic of their relationship to nature and its impacts.

Within this range of studies, some are more scientific in their methodologies than others. As adults looking at and assessing childhood, a potential confounding factor is that we will reflect back on our own childhoods and thus might have tainted viewpoints. It is common for adults to remember the more positive times from their

childhoods and idealize what childhoods should be like (Jones, 2008). Jones (2008) poses a challenge, questioning adults' and academics' research and portrayal of children's perspectives. Some studies acknowledge this point and suggest ways that they as researchers have been able to overcome this issue while others leave it unmentioned. The cases where it is most likely to be a confounding factor though is where studies are based on the results of questionnaires answered by adults regarding their own childhood (England Marketing, 2009).

Adults have been observed to connect childhood with rural scenes, perhaps because of a connection between the perceived innocence of nature and that of children (Jones, 2008). Jones explores the concept of childhood days spent discovering the natural world, climbing trees, catching frogs, throwing pebbles in lakes, as a socially constructed ideal. It is then questioned by Valentine (1997) as to whether the reality experienced by children and parents of rural location is near to the romanticised notion. Despite varying socially constructed ideals being present in each of us, this social idyll being built and reinforced by our own experiences, media, our language etc., even though the vast majority of parents in the UK express a desire for their children to spend more time outdoors (England Marketing, 2009), the current generational trend is that children are spending progressively less time outdoors.

2. The Changing Relationship of Children and Nature

"The geographical literature on children has emphasised the importance of play to children's quality of life…There is contemporary popular concern however that children's ability to play outdoors independently is being eroded." (Valentine and McKendrick, 1997: 223)

It is documented by many (Louv, 2005; Valentine and McKendrick, 1997) from interviewing parents, that they often relish memories of roaming areas close to their homes during their childhood. However it is evident from England Marketing's recent report to Natural England on Childhood and Nature: A Survey on Changing Relationships with Nature Across Generations (2009), that the area children play in most nowadays is indoors either at home or at a friend's home Figure 1. This survey found that "Children spend less time playing in natural places, such as woodlands, countryside and heaths; less than 10% play in the natural places compared to 40% of their parents and grandparents when they were young."

Despite the results from the Childhood and Nature survey (England Marketing, 2009) showing that more (41%) of the children participants saying their favorite place to play was 'at home or my friend's home indoors', the second highest category was in the garden (17%) as seen on Figure 2. Although gardens are a great space for outdoor play for all those privileged enough to have one, many children live in flats, and high-rise buildings where this is not an option. The more classic works of Moore (1986) investigated the play habits and lives of urban 8-12 year olds in the UK found that open lawn areas (e.g. in parks) were most frequently referenced in children's drawings of their favorite places. This would make sense

with the majority (77%) of adult's responses in the Childhood and Nature survey who recalled their favorite childhood places of play as being outdoors in some form and only 16% answered that it was 'at home or my friend's home indoors' in comparison to the 41% of children asked Figure 2. Their favorite places to play largely correlated with where they play(ed) most often in both the cases of the children and the adults. These findings, along with others (Clements, 2004; Wridt, 2005; Karsten, 2005), strongly imply that there has been a change in the environments that children play in during the last generation.

The reality now in the UK is that 38% of children spend under an hour a day outdoors (England Marketing, 2009). Those observing and researching in this field have come up with phrases to describe this change in childhood such as 'the extinction of experience' (Pyle, 2002) and 'environmental generational amnesia' (Kahn, 2002). Although various suggestions have been put forward as to why these changes have occurred it is mostly accepted that there is a variety of contributing factors. The most commonly mentioned factors which we will go on to consider are: limited access to natural spaces that are appropriate for play, our culture's growing obsession with safety (Guldberg, 2009) and children's preferences.

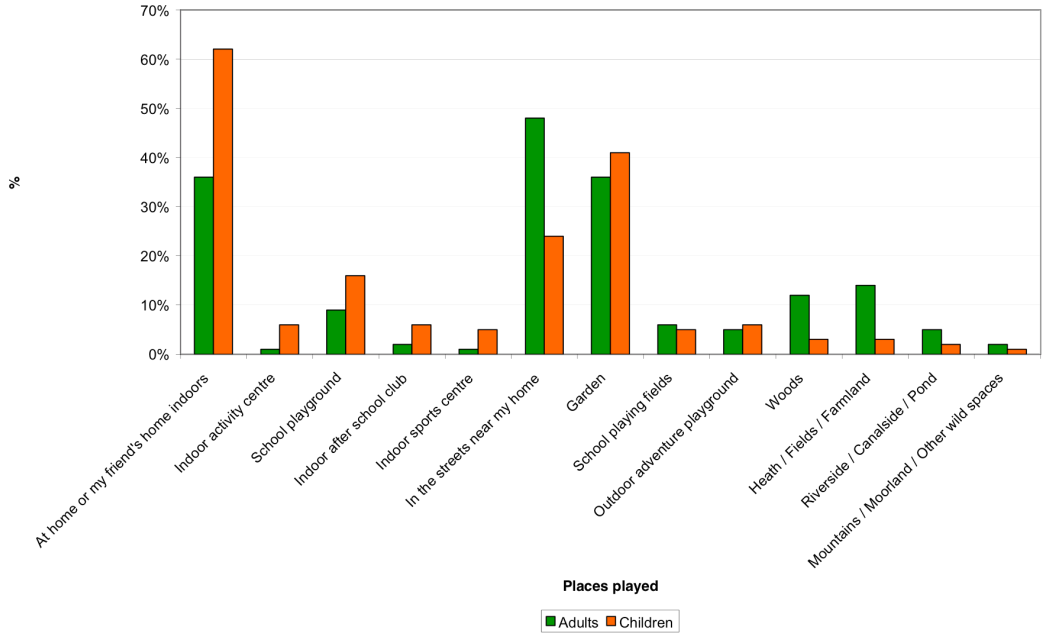


Figure 1 (England Marketing, 2009) Where adults played the most when they were young compared to children (The figures have been derived by providing a score for each activity out of a total possible score based on the first, second and third rankings)

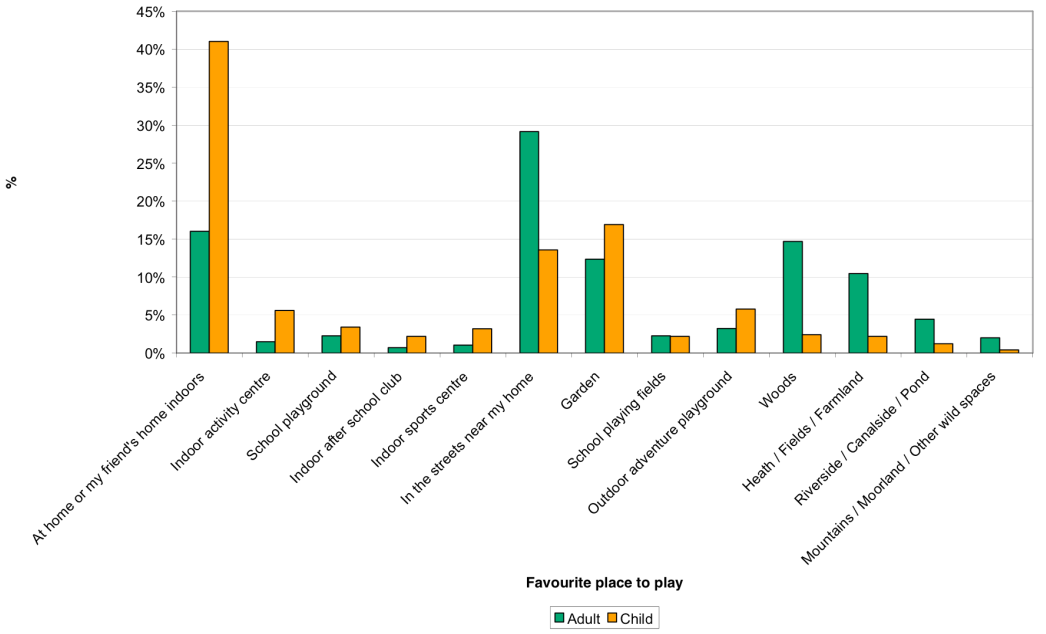


Figure 2 Favourite places to play: adults v children (England Marketing, 2009)

Veitch et al. (2007) looked into how children perceive the use of public open spaces for active free play and through the use of discussion groups found that children reported "their use of public open spaces was influenced by a combination of intrapersonal, social and environmental factors including; a lack of well-resourced local parks, time constraints, parental restrictions on children's independence, urban design features, social aspects and personal motivation."

2.1 Play Spaces

The reducing prevalence of parklands in many urban areas is imposing limitations on children's interaction with nature. Katz has drawn attention to what space is available to youth in cities and the changes that are occurring. She observes that "public parks and playgrounds suffer disproportionately in times of fiscal crisis compared with other aspects of urban life," (Katz, 2006:112). Veitch *et al.* (2007) note that "we are living in times of tremendous social and environmental change and therefore it is important to facilitate urban planners, public-health professionals, government bodies, and parents to work together to ensure children are allowed the opportunity to play safely in public open spaces." Then there are studies that suggest that even the spaces that do exist for children and those being intentionally designed into urban areas are not what children would want. "Many new commercial playgrounds provide primarily for the needs of adults to have a break from children, rather than to stimulate children themselves" (McKendrick *et al.,* 2000). Such playgrounds often do not provide opportunities to play with elements, for building relationships to natural things, such as plants and animals, and often do not allow for children to transform the space to meet their needs or create their own space (Fjortoft and Sageie, 2000; Moore, 1986). Sibley and James (1991) states that

there is often a mismatch between the spaces provided for children to play in and what children actually want, what stimulates them. So access to outdoor spaces designated for children, in addition to the appropriateness of these spaces are both factors which limit children's interaction with natural spaces (Veitch *et al.,* 2007).

2.2 Parental Concerns

Louv found (from interviewing American parents) that the most frequently cited reasons for the natural world becoming less familiar to young people, was parental "fear of strangers, as round-the clock news conditions them to believe in an epidemic of child-snatchings." (Louv, 2009). The western culture's perception of 'risk' has changed rather dramatically in the past couple of decades and parental and institutional concerns around making everything safe has resulted in terms such as 'cotton-wooled generation' (Freeman, 2007) and 'risk-averse society' (Adam *et al.,* 2002). Virtual risks, those which are socially or culturally constructed and may or may not be real but where beliefs about them result in consequences (Adam *et al.*, 2002), significantly impact opportunities children get to access independent play (Valentine and McKendrick, 1997). Along with parental concerns around risks, other parental influences such as not wanting their children to get dirty add limitations to their children's experience of natural environments. With 62% of parents worrying that if their children had dirty clothes on they would be considered worse parents, 72% of children said they would be worried about being told off if they were to get dirty (Persil, 2005).

2.3 Children Don't Want to Go Outside?

Although Morre (1986) found that just over two decades ago, children's favorite place was frequently depicted as parks, with the aforementioned generational changes occurring, a common question

from parents is: how do I get my children off the computer or away from the TV to get outside? Where children have the option of whether to play outside, as their parents would have, or sit in front of a screen (TV, computer, X-box etc), many children would probably choose the latter nowadays. Orr *et al.* (2002) accuse capitalism for this changing trend suggesting that capitalists are making children averse to authentic nature experiences as, for capitalism to work best, it requires children to stay indoors both in shops and at home in front of TV's or computers. He points out that capitalism looses its grip on this demographic of consumer if children discover rich enjoyment in experiences that cannot be bought. Along with discouraging media input, children witness adults' fears of perceived risks involved with their playing outdoors. "Rather than projecting fears and uncertainties onto children adults need to allow children to grow and flourish, balancing sensible guidance with youthful independence. This means we need to chill out a little: allowing children to play, experiment and mess around, without adults hovering over them, and giving them the opportunity to get themselves out of difficulties they may get themselves into and to resolve their own conflicts." (Guldberg, 2009). Despite accounts of children not wanting to go outside or being scared of playing outside, there are contrasting findings from other studies suggesting that many children would choose to spend more time outdoors if they had the opportunities (Maxey, 1999). Of those children that completed England Marketing's questionnaire (2009), 81% said they would like to play outside more often without adult supervision.

2.4 Cause for Concern?

The implications and effects of the changing nature of childhood will be considered in detail in the next part of this paper. Rises in many childhood disorders have been linked to aspects of these cultural

changes (Louv, 2005). Academic reports as well as the rapid growth in popular media on the topic have stimulated much debate, with the development of several initiatives and movements in recent decades. These include 'No Child left inside' Act of 2009 in America, Natural England's 'One Million Children Outdoors' and 'Play naturally' all of which aim to increase children's opportunities to play in and engage with natural environments.

3. Effects of Spending Time in Natural Areas

It is intuitively obvious that spending time outdoors is good for our health. In many disciplines recently, especially in the field of ecopsychology but also in geography, psychology, urban planning and public health, it is being stated that a lack of contact with nature compromises mental and physical health. In turn it is being progressively recognized in these fields that time spent in nature is beneficial (Frumkin, 2001; Louv, 2005).

There are a couple of classic studies that Pretty (2007) notes, that along with Ulrich's earlier work, have inspired research in this area. One study was an analysis of the frequency of sick-cell visits that prisoners in Michigan had depending on the view from their cells. Those in cells that faced farmland and trees had a quarter lower visits than those in cells that faced the prison yard. A second was a study of post-operative patients in Pennsylvania which found that those with views of greenery and trees had significantly faster recovery times compared to those with views of brick walls, along with less medication and fewer negative comments in nurses' notes.

Although there are studies presenting findings directly relating to what impacts natural environments have on children, there is a larger body of research that focuses on adults' responses to varying degrees of interaction with natural environments. Some of the studies that I talk about have been carried out using adults rather than children however it is very likely that the findings would also apply to children.

It is worth being aware that there are varying levels of engagement with natural environments that have been used in such research (Pretty, 2004):

- Viewing a natural environment through a window (Ulrich, 1984; Kaplan, 2001)
- Being in the presence of a natural environment where this is incidental such as reading in a garden or walking through a park
- Actively engaging with nature, such as gardening, camping, playing (Frumkin, 2001).

3.1 Psychological Effects

Childhood is a key developmental time with many of the neuronal pathways we are born with atrophying depending on their stimulation. Jones (2008:208) summarises Suton-Smith's explanation that "the brains of very young children (at 8 months old) have 1000 trillion synaptic connections, but by the age of 10 'a child typically has only about 500 million connections' (p.225). The very young child is born with a vast capacity of mental processing to face any possible future, and as life settles out and routines and environment become familiar, the brain works/ strengthens certain neural pathways while many others fall into disuse …As our experience grows we become defined, even confined by it."

According to the Department of Health, 10% of children have a diagnosable mental health condition (Department of Health, 2010). In Europe, mental ill health accounts for nearly 20% of the problem of disease, affecting one in four people at some time in their life (WHO, 2009). The Mental health foundation (1999) makes the broad statement that playing out in natural space contributes to positive mental health.

Psychological effects of environments is a huge topic, there is a wide range of research, however there are particularly convincing studies

indicating natural environment's positive influence on attention, cognition, stress and depression. The relationship between exposure to natural environments and these four aspects of psychology will be addressed next. Different methodologies are used in different studies and some are more quizzical than others. In all cases, confounding factors and reliability must be taken into account and some do so more rigorously than others.

3.1.1 Attention

The affects of natural environments on attention has been researched for the past few decades with Kaplan's studies in 1984. Since these studies, there have been many that support the case of natural environments having a restorative affect on our attention. Kaplan's attention restoration theory (ART) identifies certain aspects of environments as helping to restore our attention after day to day mental fatigue experienced by many living a more industrialized lifestyle. They identify how the demands for high levels of information processing from frequently encountered stimuli such as traffic, phone calls, decision making, conversations and problem solving all contribute to mental fatigue (defined as an "overworked capacity for mental attention") and that certain environments have restorative effects (Kaplan and Kaplan, 1989; Kaplan, 2001). Environments that effectively contributed to this restorative effect offered:

- Opportunity for escape, fulfilling a desire or need to get away from one's normal context. It is acknowledged that this can be conceptual.
- Opportunity for another context, perception of an imagined or real "other world". A source of interest or fascination that attract people's attention without having an exhaustive influence

- Complimentary environment to one's purposes and interest, they let you do what you want.

These bullet points outline the main components of effective restorative environments in general, notably natural environments were significantly more effective than other environments tested.

There is a growing body of research into the effect of natural environments on attention and it is pointed out that the diversity of methodologies used within these studies makes the positive findings from the vast majority of this research all the more compelling (Kuo and Taylor, 2004). There are however a few studies that concluded insignificant results. I have also come across one study, which found a negative relationship between nature and effectiveness when investigating if plants in the workplace influence productivity, attitudes and perceptions (Larsen *et al.* 1998). It is worth noting that this study is questionable due to confounding factors of physical obstruction plants posed to office workers. A simple point, which is in favor of ART is that people *prefer* natural environments such as woodlands, beaches, streams in order to recover from mental fatigue (Korpela *et al.,* 2001).

Kuo et al. (2001) and Kuo and Taylor (2004, 2009) describe the benefits of playful contact with natural space for children with attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD). Their findings from some of these studies are more scientifically reliable than others. Their 2004 paper, which was conducted as a national survey has been criticised as being "rife with methodological limitations" due to trusting parental reports over the internet rather than professional diagnosis of ADHD in their children along with a lack of controls (Canu and Gordon 2005). A more scientific methodology was employed during Kuo and Taylor's study (2009) in which they found that children with ADHD

taking a walk in a park had an approximately equivalent effect to two typical ADHD medications (methylphenidate and concerta). It was found that in an indoor setting following time outdoors in a natural environment, children with ADD were more able to focus. This suggests a directional relationship between nature and attention suggesting it is "more plausible that participation in green activities causes improved attentional functioning than that improved attentional functioning causes participation in green activities" (Kuo *et al.* 2001:71). It is worth noting that although this study was carried out with subjects who have been diagnosed with ADD, the authors suggest this nature-attention relationship would be applicable to all children. Taylor *et al.* (2002) found that girls had improved self-discipline (children's concentration, inhibition of initial impulses and delay of gratification) in relation to nature near their home, with insignificant relationship found for boys. Their preferred suggestion for the lack of relationship found in boys was that they tended to have a much farther range in the area near home that they played in so had access to more natural areas even when they were not classified as near to home. This study had children participants from very low-income African American children who had a normal attentional ability, supporting Kuo *et al.*'s suggestion that the nature-attention relationship would apply to children without ADD. Kuo's 2001 publication suggested that in addition to enhanced attentional functioning, nature in the form of trees and grass in residential areas improves effectiveness and contributes to lower levels of anxiety and potentially could help people cope with poverty. We will return to this in *Social effects*.

Other studies supporting Kaplan's attention restoration theory (ART) include (Hartig *et al.,* 1991, 2003; Hartig, 2008; Tennessen and Cimprich, 1995; Laumann *et al.,* 2003). Hartig, referring to adults, (2008) states "The relative attractiveness of green spaces for

walking varies as a function of the need for restoration, and the expectation of restoration in a given environment is positively associated with its attractiveness as a place for walking". Likewise, Hartig *et al.* (2003) found that taking walks in a natural environment had stronger positive effects on ability to concentrate than those in an urban environment. Laumann *et al.* (2003) researched selective attention and heart rate responses to stimuli of natural and urban environments in the form of video viewing. This study (employing Posner's attention-orienting task) found that following the video viewing, the nature group had no difference in the speed that they detected targets presented regardless of spatial location. They also found significantly lower heart rate in those in the group viewing the nature video following the viewing. These findings support ART showing how nature stimuli enhance involuntary attention that according to Lacey and Lacey (1970) is a state of sensory intake that will result in lower heart rate. One such stimulus, for example, could be hearing birds sing. The affect nature experiences and stimuli have on heart rate will be addressed in the next section, Physiological effects.

To summarise, there are a range of studies, which all indicate that natural environments enhance our attention, possibly through sensory stimulation having restorative effects on mental fatigue.

3.1.2 Cognition

Despite what SAT results may indicate, research funded by ESRC (Economic and Social Research Council) carried out by Shayer on 11- and 12- year-old children in the UK contradicts the notion of a rising intelligence in youth (Shayer, 2009). Shayer used Piaget's model of development to conclude that this age group are now on average between two and three years behind where they were 15 years ago in terms of cognitive and conceptual development. Shayer postulates

that reasons for this decline in relative cognitive and conceptual development are "the lack of experiential play in primary schools, and the growth of a video-game, TV culture. Both take away the kind of hands-on play that allows kids to experience how the world works in practice and to make informed judgments about abstract concepts." This links into what was mentioned earlier about sensory intake being increased in natural environments and the benefits of having more opportunities to explore your environment through touch, smell, sound and sight. Multiple studies (Rissotto and Tanuucci, 2002; Cornell *et al.*, 2001; Hillman, 1990; Bingley and Milligan, 2007; Wells, 2000) with differing approaches have correlated exposure to natural areas, especially play in natural areas, with increased cognitive and conceptual development in children (Crace, 2006).

Cornell *et al.*'s study (2001) looks into how children's home range and self initiated movements and exploration are important for developing analytical and strategic thinking. This links back to the observed generational changes to childhood with decreasing home-ranges and less freedom of independent movement. They observed how two different age groups paid attention to landmarks in finding their way around, how scanning patterns were used and developed and selective attention to reliable environmental cues. "In sum, the results provide examples of three broad categories of strategy change identified to be core components of cognitive development (Rittle-Johnson & Siegler, 1999)" (Cornell *et al.* 2001: 229).

Following on from the reduction in recent decades of children's freedom to explore the environment surrounding their homes is the role that sense of place and way-finding ability have in cognitive development. It has been found that children who walked to school on their own performed best in mapping their routes and in

accurately recalling landmarks (Rissotto and Tanuucci, 2002). The idea has been explored by several (Sobel, 1977; Cobb, 1977; Moore 1986), that having unsupervised play time in natural settings is crucial for children to feel 'at home away from home' and that with it comes a natural tendency to manipulate their environment and create a 'special place' or a 'den' of their own.

Wells' study (2000) looks at the affect aspects of nature in living situations have on cognition. They compared cognitive functioning and attention capacity in children from a poor urban area after relocating their residency with a range of greenness in their new homes. Their results found those whose homes had the biggest improvement in terms of greenness following this relocation had the greatest gain in cognitive functioning after the move. When researching how the environment around where people live affects them psychologically, there is the obvious confounding factor of socio-economic status. Due to the methodologies of this study, a noted strength being the premove/postmove longitudinal design, they were able to rule out potential confounding factors including a variety of individual characteristics notably socioeconomic status and age (Wells, 2000). The choice of an observational method used to measure ability of children to direct their attention is noted as a potential weakness of the study. However a standardized instrument was used to measure their cognitive functioning. Overall their findings suggest, "the effects of natural elements within the home environment have a profound effect on children's cognitive functioning." (Wells, 2000:790). Another possible explanation is that the improved housing enhanced cognition. However, this was tested and not found to be a statistically significant predictor of directed attention capacity so was dismissed.

A variety of studies exist that examine different aspects of cognition and different levels of engagement with nature. Cornell's more general lifestyle change (reduction of independent movement), along with Risotto and Tanuucci's identification of independent journey specifically affecting mapping abilities, indicate some of the knock-on effects of generational changes. Wells' study represents one of those more directly linking greenness to cognitive functioning. All the studies found in my research supported the theory that cognitive development is enhanced by proximity to and engagement with natural environments.

3.1.3 Stress

In alignment with studies finding natural environments to have restorative effects on mental fatigue, studies have also found they reduce stress. Stress is our body's response to any stimulus that creates an imbalance in our internal environment (inside our body). There are physiological stresses with stimuli that can be from the external environment (outside our body) such as loud noises, lack of oxygen or from our internal environment such as low blood glucose levels. Stress can also result from psychological stimuli in our social environment (Tortora and Grabowski, 1996). Our body responds to most stresses quickly to restore balance within our body through neuro-endocrine regulation of homeostasis (Vander *et al.*, 2001). As stress impacts a variety of our bodies systems it can be measured in a range of physiological ways primarily heart rate, muscle tension and blood pressure as well as hormone levels, the most well known ones being adrenaline and noradrenaline and another key player being cortisol. In addition to this, studies have often asked participants to give a verbal account of their mood. Response to stress often results in emotions of fear, anger, sadness or even numbness as a coping response (Ulrich *et al.,* 1991). With such a wide range of responses, it has been advised that when researching

stress responses, multiple modes of stress symptoms should be analysed. So if it is evident that stress levels change both from physiological and psychological responses then there is convergent validity, which improves the reliability of the findings. With different methods for recording different stress indicators, this also makes sense as measuring physiological changes such as heart rate can be carried out continuously whereas asking the participants to reflect on how they feel is not continuous and is subjective rather than numerical.

Many of the early studies relating the influence of natural scenes on stress and recovery involved work by Ulrich who is perhaps most known for his observations of faster recovery in hospitals of patients with a view of a natural landscape (1984). Ulrich has continued research into the links between nature and health to date. Stress recovery is improved by looking at an image of a natural landscape that is perceived as pleasant (Ulrich *et al.*, 1991) providing that there is sufficient complexity and richness such as vegetation or waters (Hartig *et al.,* 1991). Stressful thoughts are replaced by positive, relaxing ones and an interest in the image, that in turn lowers the body's responses to stress (blood pressure, muscle tension etc.). As a different mode of engaging with nature, Wells and Evans (2003) found that children who were living in areas with higher levels of nearby nature had a lower impact of life stress than those with lower levels of nearby nature. When researching the outcomes of 'green exercise' Pretty *et al.* (2005) found that both pleasant rural and urban scenes enhanced participants moods and self esteem when exercising in comparison with their control group who didn't have a visual stimulus. Interestingly they found that although, both rural and urban unpleasant scenes had a negative effect on mood and self-esteem during exercise in comparison to their control, this negative effect was more significant with the rural unpleasant

perhaps due to a response to nature being threatened.

Ulrich (1981) may have been the first to note another quantitative finding of nature stimuli on human psychology in a change that occurs in our brainwaves. In correlation with participants' descriptions of feeling more relaxed when looking at a pleasant natural scene, the proportion of different wavelengths in their brains were measured and there was an increase in the number of alpha waves in relation to beta waves. Brainwaves are measured by a machine called an electroencephalogram (EEG) which measure the frequency of electrical signals that our brains constantly transmit. There is a whole spectrum from 1.5-30Hz in humans (Wagner,1975) and they are generally categorised into Delta which are the slowest (deep sleep), Theta (light sleep), Alpha (daydreaming, meditation) and Beta which are the fastest (alert and outwardly directed attention) (Anderson, 2005). So Alpha brainwaves which have been associated with relaxed wakefulness and which increase with nature stimuli are slower than Beta ones which are most abundant in our day to day life.

3.1.4 Depression

Depression is becoming more common with about 15% of people suffering from severe depression at some point in their lives (NHS, 2010). The amount of green space in the area surrounding residencies has been correlated with prevalence of depression. Maas *et al.* (2009) used classified morbidity records of over 300,000 people and correlated these with the percentage of green space within 1km of each person's postcode. For 15 of the 24 classifications, the annual prevalence rate was lower for those in close proximity to more green space. Of the classifications, the prevalence of mental disorders (anxiety disorder and depression) was most affected by greenness. This relationship was found to be stronger in children as well as

people with a lower socio-economic status. This suggests that the amount of time children experience in green space could significantly influence their mental well-being.

Thus the findings from studies reviewed provide evidence for lower levels of stress and depression in people who have greater access to nature.

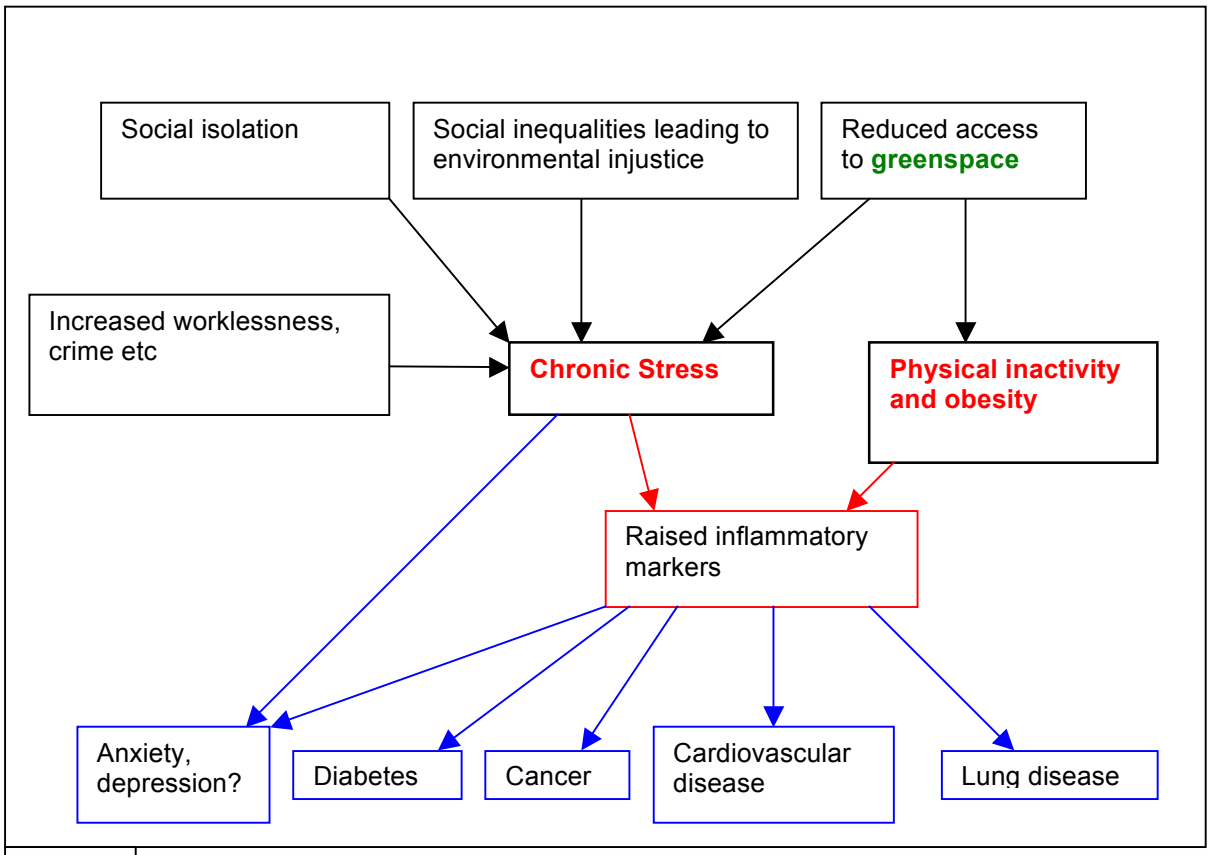
To summarise this section, there is evidence that supports varying degrees of engagement with nature (from looking out of a window at a natural area to being in direct contact with a natural environment) all have positive effects on one's psychological well-being.

3.2 Physiological Effects

There are challenges in studying what the physical consequences of a lack of exposure to nature are as so many variables exist that cannot be controlled. However, much research has been carried out to address the connection between physical health and nature, and it seems a lot has been said about the positive effects exposure to nature has. Some have suggested that a lack of time spent outdoors correlates well with increases in certain conditions. Louv (2005) claims that nature deprivation can result in 'cultural autism', but there are many other lifestyle changes that have been occurring along with a reduced time spent outdoors which could be confounding factors. For example increased blood pressure could be contributed to by reduced time spent in natural settings but it is contributed to by other factors, namely changes in diet and exercise. It is interesting though that spending time outdoors seems to alleviate symptoms of some such conditions. In looking at the physiological effects exposure to nature has we will address the physiological impacts of stress, physical activity, pain and how greenness affects overall health inequalities.

3.2.1 Physiological Consequences of Reduced Stress

We have already discussed research that supports stress reduction in relation to time spent in natural areas and here we will briefly address the physiological influences and the health implications that stress has. Stress, can be seen as a major public health problem. This is visually displayed in a re-creation of the flow diagram Bird presented below (Box 1), showing a overview of how reduced access to green space as a contributing factor to chronic stress, has significant health implications. Box 1 shows chronic stress as a contributing factor to the UK's top killers (Cardiovascular disease, Cancer). Thus the link of nature exposure to stress reduction would arguably be worth consideration for health policies. In parallel to the prior section on stress, Bird stated (2009) that it is now well documented that exposure to nature or even natural stimuli (such as audio recordings of birds and flowing water or having a view of a natural setting) reduces blood pressure, heart rate and muscle tension (Bird, 2007; Kaplan 1993; Pretty *et al.* 2005; Laumann *et al.*, 2003), all of which are indicators of stress.



Box 1

Physical Activity

There are significant numbers of children in the more developed countries, who are not sufficiently physically active (Currie *et al.* 2008). In 2008, boys aged 2 to 15 were more likely than girls to meet the recommended levels of physical activity with 32% of boys and 24% of girls reporting taking part in 60 minutes or more of physical activity on each of the seven days in the previous week. (NHS Information Centre, 2010)

It is noted that one of the most consistent ways to predict children's physical activity is the time they spend outside (Veitch *et al.,* 2005). Insufficient physical activity is of public health concern due to the knock-on effects it has (some of which are displayed in Box1). The British Medical Association's (BMA) 2005 paper, *Preventing Childhood Obesity,* identifies physical activity and changing eating

patterns as the two primary aspects to be tackled for reducing childhood obesity. Obesity and overweight are clinical classifications of excess body fat often determined by measuring one's body mass index (BMI). The Health Survey for England (2008) reported levels of obesity of 14% in boys and 13% in girls aged 2-10 years in their 2008 publication on the topic. As in Box 1, the knock-on effects of both chronic stress and physical inactivity are severe and influence a number of our physiological systems as well as having effects on our mental well-being (such as depression). In addition to decreasing these knock-on effects, physical activity in childhood also lowers risk of osteoporosis in later life due to the physical stresses in childhood increases bone mineral density (BMA, 2005).

Increases in physical activity have been linked to green areas in several ways through various studies. Bell *et al.* (2008) conducted a study to test if there were independent associations with greenness and residential density associated with 2-year changes in the body mass index (BMI) of children and youth. They found that lower BMI scores were significantly associated with higher greenness regardless of residential density and that, regardless of the level of greenness, residential density was not associated with BMI scores. Interestingly they also found that there was less chance of individuals increasing their BMI in areas of higher greenness. Bell *et al.* also suggest that environmental approaches taking greenness into account may be effective as a preventative measure to childhood obesity.

A much smaller scale study looked into the effects of having 'forest school' days in comparison to typical school days in a primary school in Scotland. During these days, which were in a natural outdoor setting, both the intensity and duration of physical activity was significantly greater than during the typical school days (even those

with scheduled physical activity) (Lovell and Roe, 2009). There are many associated health benefits from sustained activity. Physical activity of course helps maintain a healthy weight relative to your body size and is thus a preventative to obesity in our culture where there is an abundance of food, it helps reduce one's risk of coronary heart disease, stroke, diabetes, high blood pressure, some types of cancer (e.g. colon cancer) and even depression and anxiety (Pretty *et al.* 2005). Physical activity also increases self-esteem, is described as more energizing, improves sleep and helps individuals cope with stress and anxiety. In addition to studies that have correlated proximity to green areas with higher physical activity, others have been carried out to detect whether the environment that activity occurs in has an impact on the positive outcomes of exercising. Pretty *et al.* (2005) found that there are synergistic benefits of carrying out physical activities whilst being exposed to nature via a view of nature. These benefits included reduced blood pressure, increased self-esteem and improved mood. Thus pleasant rural and urban scenes significantly enhanced the positive effects that exercise alone had on self-esteem.

Physical activity is therefore found to increase with time spent outdoors and with residential proximity to green-space.

3.2.2 Motor Functioning

When in a natural environment rather than a man-made one, there is a greater variability in terrain as a result of loose parts, such as rocks, sticks, roots, and animal homes etc. This inconsistency is thought to be the reason for greater physical motor development and balance in children who have grown up spending more time in natural environments than those growing up in urban environments. Fjortoft and Segeie's (2000) and Fjortoft's (2001, 2004) research examined how children's motor co-ordination and functioning was

affected by different outdoor play settings. Having controlled for potential confounding factors of socio-economic status and level of parental education, they concluded that children's motor abilities were improved through physical play in forest environments.

Physical activity alone enhances children's physical growth as well as their social and mental well-being (BMA, 2005). Not only is there an increase in the amount of physical activity engaged in as a result of improved access to green areas, but also research suggests that these positive effects are amplified when physical activity occurs in a natural environment.

This brings me back to the point made by Lacey and Lacey (1970) of attributing the quality of sensory intake to why natural environments have such a significant positive effect on so many aspects of our health. Hughes (2001) talks of a form of 'sensory deprivation' resulting from a lack of sensory interaction with the world with vastly reduced outdoor play. Although the development of nerve cells in our brains (neurons) starts well before birth, sensory experiences have a significant input to neuronal development that occurs post-birth. Experiments with various species of animals have found that several structures of the brain, which we previously thought were unaffected by sensory input, were affected by alterations in sensory experience (Tian and Copenhagen, 2003; Grubb and Thompson, 2004).

3.2.3 Pain

Interestingly, studies have found a link between aspects of natural environments and bodily sensations. Several studies show faster recovery times for patients with views of nature and other, more specific studies show reduced levels of pain experienced with nature stimuli.

In alignment with Ulrich's observation of faster recovery in hospitals when patients had a natural view, several studies have found that using natural stimuli as a distraction from certain medical procedures decreases the patient's experience of pain. Diette *et al.* (2003) compared patients undergoing flexible bronchoscopy where some patients had a nature scene mural placed beside their bed and were offered a tape of nature sounds to listen to before, during and after the procedure. Those in the control group were not offered either. They found that those with the natural stimuli experienced significantly reduced pain. They acknowledge that further investigation is required to shed light on how this effect is achieved, but recommend consideration of this strategy for patients undergoing such procedures.

Ulrich *et al.* (2003) looked at how modest changes to environment of the waiting area of blood donations effected donors' stress levels (inferred by physiological measures of blood pressure and pulse rate). They compared donors whose waiting room environment included a TV with the variable being what the TV was showing. There were four variables: TV off, showing daytime TV, showing continuous natural environments (savanna-like or park-like with no people) or showing urban environments (either no pedestrians but with traffic or with pedestrians). They found stress was lower in donors during the nature rather than urban videotape. This was also the case for the comparison of no TV with daytime TV. So both environments they classified as low stimulation environments (when the TV was off and when the TV showed natural environments) contributed to comparatively lower stress levels. The findings of the self-reported states were however insignificant for this study.

The findings of this research thus support the hypothesis that our body's control or experience of pain may be alleviated by stimuli with strong associations to nature such as flowing water and bird sounds. This is in addition to the reduction of stress experienced.

3.2.4 Health Inequalities

With an understanding that green-space has an independent effect on health, Mitchell and Popham (2008) hypothesized that health inequalities related to income would be less prominent in populations where there is more access to green-space. They carried out an observational population study. They were able to classify people's residency as having varying exposure to green space using Lower Level Super Output Areas as geographical units to do so. There were approximately 20% of the study population in each of the 5 groups of greenness and those included in the study were younger than retirement age as health inequalities are more pronounced in those of working age. Due to obtaining individual mortality records from the Office for National Statistics, the sample size for this study was large (almost 400,000 in their smallest group: most deprived but in an area classified as most green). They found that "the income deprivation related inequality in all-cause and circulatory disease mortality is lower among populations resident in the most green areas." (Mitchell and Popham, 2008: page 9). Figure 3 depicts the trend for all-cause mortality and Figure 4 depicts the trend described for circulatory disease mortality. In parallel with studies suggesting that green space induces physical activity, circulatory disease showed the strongest reduction of inequality in the greenest areas in comparison with the other two cause-specific mortality measured analysed (lung cancer and deaths from intentional self-harm. This study is one of the most convincing as by looking at health inequality many of the socio-economic factors, which have varying confounding influences on other studies, are overcome.

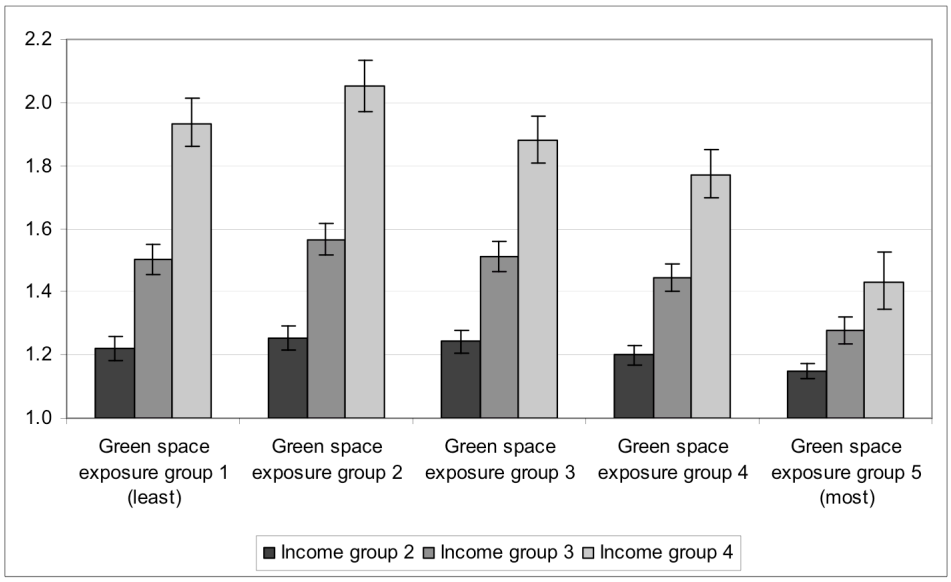


Figure 3 Incidence rate ratios (with 95% confidence intervals) for all-cause mortality in income deprivation quartiles 2-4, relative to income deprivation quartile 1 (least deprived), stratified by green space exposure group (Mitchell and Popham, 2008).

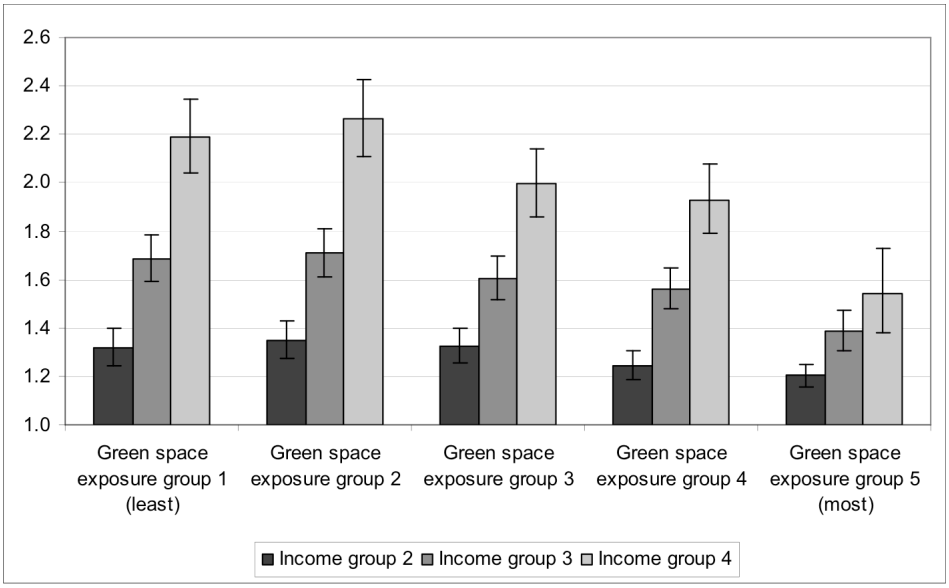


Figure 4: Incidence rate ratios (with 95% confidence intervals) for deaths from circulatory disease in income deprivation quartiles 2-4, relative to income deprivation quartile 1 (least deprived), stratified by green space exposure group (Mitchell and Popham, 2008).

There are therefore convincing studies supporting the hypothesis that there is an association between physical health and interaction with nature. These studies vary from indicating that in the short term our body may be more relaxed and even experience less pain when in the presence of nature stimuli to the positive longer term effects of living in areas with greater exposure to green space.

3.3 Social Effects

From the research on the psychological and physiological effects on an individual spending time in natural environments, it follows that there are also social implications. These include both changes in the individual's social skills and behavior as well as wider impacts at a community level.

The body of research I'm about to discuss implies that impacts for the individual include improvement in the development of social skills, as well as a reduction in violent behavior, reduction in anger levels, and enhanced mood. Many outdoor activities are shown to bring people together and strengthen communities but in addition to this, lower levels of violence and crime have been found in greener areas where socio-economic inequalities have been taken into consideration thus suggesting 'greenness' has a significant societal influence (Kuo and Sullivan, 2001).

3.3.1 Social Skills

Having unstructured time in outdoor environments naturally invites children to explore and play. Natural environments, in comparison to traditional tarmac playgrounds with play features such as swings, have been found to encourage positive interpersonal relationships among children (Pyle, 2002; Moore, 1986; Bixler *et al.,* 2002). In addition to enhancing the development of social skills (especially language and communication abilities as well as positive

relationships) natural areas have been found to decrease violence and bullying among children (Malone & Tranter, 2003) and enhance creative and imaginative play (Taylor *et al.,* 1998).

3.3.2 Violence

Convincing studies by Kuo and Sullivan (2001) found that varying levels of greenness (grass and trees) nearby to where people live impacts on levels of domestic violence. Following Kaplan's (2001) theory that an outcome of mental fatigue may be an increased tendency to express anger and violence, and the aforementioned restorative effects of natural environments on mental fatigue, research into a relationship between nearby nature and violence was undertaken. 145 female urban public housing residents were randomly assigned to buildings (architecturally identical) that had varying amounts of nature nearby, thus alleviating confounding factors of socio-economic status. Aggression levels were then compared for these individuals with those living in buildings with more surrounding greenery reporting lower levels of violence than those in more barren buildings. In order to measure aggression, they used the Conflict Tactics Scale that has been widely used and accepted as having good reliability to assess levels of aggression and violence within families. They attribute the underlying mechanism that is reducing the levels of violence to residents living in greener settings having better attentional functioning (lower mental fatigue) (Kuo and Sullivan, 2001). This is in alignment with findings of ART (Attentional Restoration Therapy).

3.3.3 Anger

The above study gives evidence for greenness reducing mental fatigue in adults that in turn influences their levels of anger and violence experienced. A smaller study carried out on children found similar results, with increased time spent in natural areas (forest

school), as apposed to in typical school, reducing anger in children with varying emotional health (Lovell and Roe, 2009). In this study, forest school also had a positive effect on other mood variables and cognitive restoration although these factors were not statistically significant.

3.3.4 Crime

In addition to the obvious benefits that reduced levels of anger (and violence) have for individuals, these also have positive implications at a community and society level. Kuo and Sullivan found that where residents had been randomly assigned apartments with varying levels of nearby vegetation, fewer crimes were reported where buildings had more greenness surrounding them. This was the case both for property crimes and violent crimes (Kuo and Sullivan, 2001). Once other variables including building height, number of apartments per building, vacancy rate and number of occupied units per building were taken into account, the relationship between crime and vegetation remained. Although this study was again carried out with adults rather than children, the affect environment has on crime could be analogous to anti-social behavior in children.

3.3.5 Enhancing Community

Spaces containing trees consistently attracted more use of outdoor space in youths and adults as well as mixed age groups than areas devoid of nature in two inner-city neighborhoods (Coley *et al.,* 1997). There was increased use (in frequency and numbers of people) the nearer and more easily accessible these areas were to residences and the more trees there were in a given space. As green areas have been found to decrease undesirable societal interactions (crime and violence) and increase desirable societal interactions, this is a significant aspect for urban planners to take into consideration. In

addition to the simple presence or absence of green spaces influencing neighbor interactions, Bird has developed the concept of the Green Gym which has a number of identified positive outcomes one of which is bringing local communities together. Green Gyms give participants active engagement with natural outdoor areas whilst working together on a conservation project (such as building benches, planting hedgerows, creating vegetable gardens) with the additional focus on being active (Bird, 2009)

The reviewed literature provides evidence that supports positive social outcomes of increased engagement with natural environments in the form of improved social skills, reduced levels of violence, anger and crime, as well as enhanced community.

There are therefore studies that provide supporting evidence for increased exposure to natural areas having positive psychological, physiological and social effects at individual, community and societal levels.

4. Suggestions for Future Research

The studies I have drawn upon in this dissertation had varying approaches and methodologies resulting in some being more reliable than others. The growing body of research assessing the affects of nature on childhood development has led to a proliferation of media reports on the topic and expressions of concern at national and international levels. However it is a complex area in which to undertake research as, when assessing environmental effects on development, there are many confounding factors that must be taken into account and controlled where possible.

In order for this body of research to have impacts on policy (health, education or otherwise) further research must take extra care to consider the following:

- Clarity and specificity in defining nature, including what aspects of nature are present in their study environments (for example: trees, flowers, aromatic herbs, animals etc.)
- The level of contact or engagement must be clearly defined (such as viewing, incidentally in the presence of, or actively engaging with the natural environment)
- If aspects of this research were to be drawn upon for the development of health policies then clear health endpoints would need to be defined.
- Clarification is required of what individual and group variations exist in responses to contact to nature. In order to aid this, care must be taken in specifying the populations that are studied and where relevant personal attributes of participants.
- As discussed above, potential confounders must be controlled where possible and thorough consideration of alternative hypotheses. (Frumkin, 2003)

However, the collection of studies reviewed, together strongly suggest that regardless of socio-economic status and race, frequent access to natural areas (in a close proximity to the home or school) can have considerable positive effects on children's psychological, physiological and social well-being.

5. Conclusion

This dissertation has critically discussed the impact of children spending progressively less time outdoors, in comparison to their parents and grandparents when they were children, especially in unstructured activities in natural environments. This change is at least partially due to a cultural shift resulting in increasingly limited access to natural areas, parental fears for children's safety, increased opportunities of indoor independent play and increased indoor-based, sedentary lifestyles of adult role models. The consequences of children spending less time in natural environments are highly significant, having impacts in multiple areas of growth and development and therefore have been studied from various disciplines.

Much of the existing body of research has found positive impacts related to spending increased time in natural environments. Some of these reports have been carried out with adult participants, but it is expected that similar effects would be observed in children, with important long-term impacts on well-being. The existing research strongly suggests that there are positive psychological, physiological and social developmental benefits of spending time in natural environments. Given that the findings support each other and come from such a wide body of research and methodologies, one can conclude that growing up separate from nature is likely to cause a high risk of the development of social, environmental and health problems.

Although some study methods do not fully deal with socio-economic status as a confounding factor, this is addressed by findings that health inequalities are reduced in greener residencies, which thus strengthens this body of research as a whole.

Given the evidence that we have seen, it is concerning that many children nowadays grow up with very little contact with or awareness of the natural world. Where opportunities exist for play and interaction with natural environments, these tend to be discouraged by a significant proportion of parents. This can lead to situations where children do not play outside because they are scared of being told off for getting their clothes dirty. By young ages, reasons such as this can become strong enough that children are not exploring the natural world around them. Their awareness can then become limited and a significant proportion of the current generation of children are growing up with very little understanding of the natural world compared to their grandparents.

Regarding environmental conservation and sustainable development, it is common sense that human beings will only respect and care for what they know and understand and what is immediately relevant to their lives. Children who grow up disconnected from natural environments inevitably have limited understanding of our natural resources and are less interested in environmental conservation and concepts of sustainable living than children who experience significant amounts of work and play in natural environments.

It has been found in some animal species that environmental influences in one generation during developmental phases can significantly impact the way the next generation is brought up. With regard to humans, we do not know what the long-term consequences of these current changes in lifestyle will be. The effects could potentially be devastating. Given that the current research has found many positive effects and no detrimental ones, why wait until the research is unequivocal? Green spaces are far harder to reclaim

once they have been developed. If the increases in childhood disorders continues to rise and it is affirmed that a major contributing factor is reduced contact with green spaces, will there still be enough green spaces in cities that can be revived and made more child-friendly?

From the findings of this research we could respond beyond 'damage control' of attempts to increase the time children spend out in natural spaces with a view to lowering prevalence of disorders and look at how this research could be used to enhance society with projects such as the Green Gym.

In order to make play and unstructured time in natural environments more accessible to children, a first step to raising awareness of this issue could be informing Local Development Frameworks (LDFs) with this research. In addition, these findings must be drawn to the attention of parents, teachers, youth workers and policy makers of education and urban planning.

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