Exploring the Impact of Diverse Urban Environments on Well-being

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

ABSTRACT

The World Health Organization (WHO) defines health as not simply the absence of disease or infirmity, but a state in which a complete sense of well-being is present (World Health Organization, 2003). A healthy population must, therefore, consist of individuals that display positive attributes associated with well-being and, in circumstances when well-being has diminished, have access to resources that increase it. Evidence has indicated that outdoor recreation in forest environments can help improve well-being (Hartig, Mang, & Evans, 1991; Horiuchi et al., 2013; Lee et al., 2011), but these studies have often relied on large natural parks as the experimental context or setting, and participants are often given prolonged exposure (hours or days) (Hartig et al., 1991; Morita et al., 2007). The goal of this research is to examine the impact of different accessible urban forest environments on the well-being of university students. It focuses on feelings of happiness, vitality, mood and stress reduction, while investigating the link between well-being and nature relatedness. Key measures include the Vitality Scale, the Positive Affect Negative Affect Schedule (PANAS) Scale, Overall Happiness Scale, Profile of Mood (POM) Scale, Nature Relatedness scale, heart rate, and blood pressure. The study uses a pre-test- post-test design and one-way repeated measures ANOVA to analyze results. Results demonstrated that the urban forest environment was associated with elevated levels of happiness, vitality, mood, and decreased heart rate. Minimal differences were found for blood pressure. Similarly, exposure to the forest stream environment showed no significant differences between any of the well-being indicators and the forest environment. The overall results indicated that small accessible urban forest environments can improve well-being, providing support for the biophilia hypothesis, the concept of nature relatedness, and the value of outdoor recreation.

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CHAPTER 1- INTRODUCTION

1.1 Social and Scholarly Contexts

Stress levels are increasing in developed countries (Tsunetsugu, Park, & Miyazaki, 2010) for many reasons including increased workload (Park et al., 2007; Degenhardt, Frick, Buchecker, & Gutscher, 2011), noise, crowding, and air pollution (Ulrich et al., 1991). As a result, people are more frequently dealing with stress related disorders (Valarde, Fry, & Tveit, 2007) such as illness, depression, back problems, and general fatigue (Degenhardt et al., 2011). These ailments contribute to a reduction in well-being and illustrate the potential of stress to inhibit well-being (Laumann, Gärling, & Stormark, 2003; Hartig et al., 1996). This reduction of well-being has also been attributed to growing urbanization and the concomitant disconnect from natural environments. Wilson (2007) argues that this general increase of stress may result from the fact that people have only recently in human history moved from living in nature and hunter gatherer societies to living in urban environments. In his view, humans have not yet adapted emotional responses to this new environment and this unfamiliarity induces stress while decreasing well-being. Concern over stress related problems has caused people to seek new strategies to improve their well-being (Park et al., 2007).

According to the World Health Organization (2003), well-being is a cornerstone of individual health. The WHO's view on health is not simply that it is absence of disease or infirmity, but a state of being in which an individual feels a complete sense of well-being. Thus the maintenance or achievement of optimal health is tied to the aspect well-being. Research has demonstrated that outdoor recreation in natural environments can help increase well-being and

reduce stress (Hartig, Mang, and Evans, 1991; Horiuchi et al., 2013; Lee et al., 2011; Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010). For example, medical evidence from Japan has shown that shinrin-yoku, or bathing in the atmosphere of large rural forests, can significantly reduce stress and increase positive emotions (Parket al., 2010; Horiuch et al., 2013; Park et al., 2007; Tsunetsugu et al, 2007). Previous research regarding nature's impact on well-being has also shown similar positive responses to nature using park lands and rural forests environments (Nisbet et al., 2011; Ulrich et al., 1991; Hartig et al., 1991).

The positive feelings and relaxation associated with being in a forest have been explained through the Biophilia Hypothesis. This theoretical perspective states that humans, who have evolved in nature and only recently stepped out of it, have an inherent need for natural experiences (Wilson, 1984). Biophilia was described by Wilson as "the innate tendency to focus on life and lifelike processes" (Wilson, 1984 p. 1) and "the innately emotional affiliation of human beings to other living organisms" (Wilson, 2007, p. 249). One of the main premises of this hypothesis comes from research regarding natural selection. Some humans may have acquired and retained approaches to survival that involved the identification of competitive advantaged landscapes which included food, water, and shelter (Ulrich, 1993). It is suggested that this produced a higher survival rate among certain groups of humans, allowing them to pass on these survival genes to future generations. These survival oriented populations would have maintained a predisposition to feel relaxed or even happy when in environments that provide competitive advantages and stress in environments of scarcity (Gullone, 2000). The present study defines nature as both urban and wilderness environments that are heavily vegetated and lack manmade structures. Drawing on the biophilia hypothesis, this study will argue that nature increases well-being.

The contemporary problem with accessing environments that foster positive emotional responses and well-being is closely related to a global increase in migration to urban areas. Almost half of the world's population now live in urban environments (United Nations, 2004). Urban environments hinder stress recovery (Ulrich, 1984) and make connecting with nature difficult (Nisbet & Zelenski, 2011). As suburbs expand horizontally to meet the needs of urban centers, roads and parking lots progressively limit the possibilities for accessing natural environments (van den Berg, Hartig, & Staats, 2007: Nisbet & Zelenski, 2011). This limitation of accessibility thereby reduces the possibility of stress reducing strategies and the hedonic benefits of nature. (van den Berg, Hartig, & Staats, 2007: Nisbet & Zelenski, 2011). Accordingly, there is a need to investigate whether small accessible urban forest environments can be used as sources for well-being and stress reduction. Indeed the driving question is: to what extend does the creation of urban forest environments help support a healthier population in ways similar to those in other studies based upon large rural forests (Tsunetsugu, Park, & Miyazaki, 2010).

To demonstrate the importance of increased access to natural environments, researchers have examined health and well-being indicators and benefits of nature in urban environments. For example, Nisbet and Zelenski (2011) and Zelenski and Nisbet (2011) have demonstrated that a physical connection with nature, even in urban environments, can increase positive moods and happiness. They found that university students who walked to their classes using outdoor pathways instead of indoor tunnels became unexpectedly happier than the students who used the tunnels. Nisbet, Zelenski, and Murphy (2008; 2011) focused on a concept called Nature Relatedness (NR), which evaluates an individual's connection with nature and "encompasses one's appreciation for and understanding of our interconnectedness with all other living things"

(p. 304). Nisbet et al. (2011) found that individuals who reported greater connection to nature through exposure to nearby natural environments, also reported higher levels of well-being as indicated by increases in positive affect, vitality, autonomy, personal growth, purpose in life, and life satisfaction. They also found that students who were part of environmental courses had slightly higher vitality levels than those who were not, potentially explained by a closer connection to nature. The biophilia hypothesis is used as one explanation for the higher levels of NR and its correlation to happiness and well-being (Nisbet et al., 2011). The argument here is that by regaining our connection with nature we are fulfilling our need to be in nature, which promotes well-being (Kellert, 1997). Through research that involves increasing people's connection to nature through their NR, it may be possible to understand how to cultivate and sustain positive emotions and reduce negative moods (Nisbet, et al., 2011). Nisbet et al. (2011) also indicated that more research is needed to determine the impact of different types of nature experiences on NR and well-being. Finally, Nisbet et al. (2011) indicated that nature has predominantly been studied as a recovery space as opposed to as a source of well-being. Therefore, this study on urban forests was meant to provide evidence on indicators of negative mood reductions and increased positive emotions that would fill the gap on the role of nature as a support for well-being. The study examined changes in well-being over different environments that contained varied amounts of nature (natural light, fresh air, young dispersed trees, fully encapsulating biodiverse forest, etc) as suggested by Nisbet et al. (2011).

This study assesses the psychological and physical benefits to well-being of nature based outdoor recreation in urban environments. It will focus on intermediate sedentary outdoor recreation in urban environments with a particular focus on forests. Plummer (2009) defined outdoor recreation as a "free time activity that occurs in the outdoors and embraces the

interaction of people with the natural environment" (p.1). Austin and Crawford (2001) add to this definition, arguing that "through recreation people restore themselves" (p. 8). Outdoor recreation has been shown to have a positive impact on the overall health and well-being of individuals (Hartig, 2004). Forest environments are ideal for the study of outdoor recreation because they connect the participants with nature providing restorative benefits (Pretty et al., 2005; Hartig, Mang, & Evan, 1991; Laumann et al., 2003; Kaplan, 2001). For example, Hartig et al. (1991) found that after participants were exposed to a weeklong wilderness trip the participants reported that their happiness levels were sustained long after the trip ended. This suggests that outdoor recreation has the ability to inoculate individuals from reduced well-being. Furthermore many studies on forest therapy in Japan have provided strong evidence regarding the ability for large rural forest environments to increase well-being through positive emotions and stress reduction (Park et al 2007; Park et al 2010). These well-being benefits were all induced by nature based recreation where the primary focus of the activity was to be in nature.

Participating in nature based outdoor recreation has many benefits as advocates have indicated this activity's ability to act as a sanctuary for contemplation and solitude which has been shown to ease strain (Jensen & Guthrie, 2006). Roper-Starch (1999) found that up to 80% of Americans participate in outdoor recreation for its ability to provide a space for relaxation (as cited in Jensen & Guthrie, 2006) with restoration and escape from civilization as other major motivations for outdoor recreation participation (Van den Berg, Hartig, Staats, 2007).The physical activity that usually accompanies outdoor recreation also helps to provide this benefit as exercise in nature has been known to "tranquilize the mind and yet enliven it, and create the effect of both rest and invigoration to the whole system" (Jensen & Guthrie, 2006, p. 41).

Many of the articles reviewing the psychological and physical benefits of outdoor recreation in nature have had participant's physically activity during the study. For example many have participants walk through large forests for hours or days on wilderness trips to inducing positve changes in well-being (Hartig et al. 1991; Park et al 2007; Tsunetsugu et al., 2013). Indeed outdoor recreation in nature has consistently shown to increase positive well-being in terms of faster stress recovery rates with reduced heart rate and blood pressure, and higher rates of positive emotions and vitality (Park et al, 2011; Hartig, Evans, Jamner, Davis, & Garling, 2003).

While the research cited above demonstrates the benefits of active wilderness experiences in outdoor recreation, the current study looks to show that the recreational benefits can be achieved using intermediate recreation areas such as urban forests for a sedentary observation experience. The concept of using intermediate recreation, that is, recreation done in relatively natural accessible areas adapted and controlled by people is important because there have been many studies conducted on the use of nearby outdoor recreation areas (parks or walking paths adjacent to overgrown natural vegetation) showing the benefits they have on well-being (Nisbet et al., 2011; Barbara, Degenhardt, & Buchecker; Martens, Gutscher, & Bauer, 2011), but few defined the characteristics and size of the beneficial environments. Furthermore, the intermediate recreation area was expected to provide well-being benefits as Martens, Gutscher, and Bauer (2011) found that positive moods increased further when participants were walked through tended forest instead of the wild forest.

Finally **t**he study uses environmental psychology, which is the study of how environments affect people (Kaplan & Kaplan, 2009) to understand how the participants experience the effects of the study. This area of psychology is different from other areas of

psychology because it focuses on how the environment impacts the participants and not how particular populations or psychological processes change the persons experience (Kaplan & Kaplan, 2009). Kaplan and Kaplan (2009) suggest environments are patterns of information that are inextricably linked to people's cognition and emotions. Kaplan and Kaplan (2009) argue that if patterns in environments can be understood and positive environments can be located because of these patterns, people who are aware of these positive environmental patterns will have an easier time helping themselves increase their well-being. This is because positive environments play a major role in human health and behavior. The current interest in environmental psychology according to Kaplan and Kaplan (2009) is focused on how environments foster a positive side of humans. Conn (1998) has suggested that environments connecting people to nature have the ability to increase people's happiness and health, so this study focuses on the human nature relationship and how it affects human health.

The academic literature suggests that having a connection to nature, and experiencing diverse natural environments, enriches people's lives through increased happiness, affect, positive moods, vitality, and stress reduction (Kellert, 1997; Nisbet et al., 2009; Fuller et al., 2007). However, while several studies have looked at urban environments versus wilderness type environments, there have not been any that examined the effects of different accessible urban forest environments and how they differentially impact subjective well-being in terms of vitality, happiness, mood, and stress recovery. Other studies that investigated the effects of nearby nature areas and forests did not provide a comprehensive definition of the natural areas studied (Meyer & Burger-Arndt, 2014), making it challenging to assess the impact of these spaces (e.g., based on size or characteristics of these areas) on well-being. For a comprehensive understanding of the specific impacts different nature areas have on well-being, it is clear that more research is needed

to describe the specific natural conditions under which positive effects on well-being occur. In particular, there has been little conclusive evidence supporting the theory that exposure to water features such as streams related to increases in well-being (Velarde, Gry, & Tveit, 2007). Water has mostly been studied as a preferential element of natural environments (Kaplan & Kaplan, 1989) and not as a source of well-being. Accordingly this study will address the gaps in the literature described by Nisbet et al. (2011) pertaining to the effects of different types of environments on well-being; the use of nature as a sources of well-being; and finally how the connection to nature, analyzed by the NR scale, relates to people's positive emotions and reductions in negative moods.

1.2 Research Purpose, Hypotheses, and Study Overview

The purpose of this thesis is to examine the impacts of different accessible urban environments on the well-being of university students, and specifically feelings of happiness, affect, vitality, mood, and stress reduction. NR will be analyzed in conjunction with these measures to provide further explorations into the relationship between nature and well-being. High NR results should correspond to high levels of the well-being indicators. In exploring the impact of four urban environments on well-being, the expectation was that natural forest environments would produce the greatest sense of well-being. The four environments used in the study were an indoor classroom (baseline), a built outdoor environment, a forest environment, and a forest-stream environment with a stream in close proximity that could be heard and seen. The study used: a) physiological and mood measurements used in previous studies that assessed the relationship between well-being and experiences in large rural forest environments (Parks et al., 2007; Tsunetsugu et al., 2013; Morita et al., 2007); and b) happiness and vitality measures

used in previous urban studies that assessed the impact of nearby nature on individual happiness and well-being (Nisbet et al., 2011; Nisbet & Zelenski 2011; Zelenski & Nisbet 2014). Four hypotheses guided the study:

1. Exposure to outdoor environments would be associated with higher levels of well-being within the sample compared to the indoor (baseline) environment.
2. Exposure to the forest environments would be associated with higher levels of well-being within the sample compared to the indoor environment (baseline) and built outdoor environment.
3. Exposure to the forest with audible stream environment would be associated with the highest sense of well-being across the environments.
4. Nature Relatedness would increase as participants are exposed to environments with increasing natural elements in the order of the built environment, the forest, and the forest-stream environment.

To test the hypotheses, the study used a field experiment and exposed participants to each of the environments indoor, built, forest, and forest-stream following methods used in earlier research (Park et al., 2010; Park et al., 2008; Nisbet, Zelenski, & Murphy, 2011). Participants began in an indoor environment (classroom with no windows) for the collection of baseline measures. Participants were then taken to an outdoor environment: either a forest environment first, or a built environment at the University of Waterloo. The built environment surrounded the students with buildings and was in close proximity to a major roadway producing urban noises and smells. The forest environment was comprised of two areas: one centered the students in a forest, and the other had the students in the same forest, but in close proximity to an audible stream that the students could easily hear and see. All students were taken to the indoor, built,

and forest environments, however no student was taken to both forest environments. Therefore the study design used both a within groups (indoor, built, and forest) and between groups (forest or forest-stream) design.

The participants were exposed to 20 minutes of sitting in each environment and then given a survey package to complete that included the measures of well-being. Their blood pressure and heart rate were also recorded at the end of each study environment to measure stress levels. A digital blood pressure cuff was used to take these physiological measurements. In addition, a heart rate monitor was worn for the duration of the study to measure the participant's heart rate throughout the time in the environments.

Indications of increased well-being were examined through measures of vitality, happiness, affect, mood, and stress reduction. Again these were expected to change through a connection to nature and have been used in previous studies such as in Nisbet et al. (2011) and Park et al. (2011). Well-being was measured using these indicators because vitality has been shown to represent energy and wellness (Nix et al., 1999). Happiness is an important element in measuring well-being. Supporting this idea, Ryan and Deci (2001) indicated happiness measured hedonic well-being, so to measure happiness is to measure well-being. Affect is being used because it is a measure of self-rated moods (Watson, Clark, & Tellegen; 1988, 1984) and according to Park (2004) and Diener and Lucas (2000) a measure of subjective well-being as they note it consists of three components: high positive affect, low negative affect, and life satisfaction. Life satisfaction was not measured in this study because the study was done over a short period of time (20 minutes) and it was not anticipated that life satisfaction would be a measurable variations. Instead, both positive affect and negative affect were measured as indicators of well-being. Finally, mood was used to assess well-being as it has been described as

a barometer of our general state of psychological well-being (Berger & Motl, 2000). In addition, Diener and Lucas (2000) describe mood to be a measure of hedonic well-being. These indicators of well-being have all been used in different studies regarding the impact physical environments have on well-being, to indicate the presence of well-being.

The study has conceptualized the concept of well-being as hedonic well-being because measures of hedonic well-being can change quickly in a short amount of time and there is no consensus regarding what components compose well-being, so it was easier to focus on one well defined field of well-being that is measured using indicators that can show change in a limited amount of time. This tradition of well-being is measured by happiness, high positive affect (including positive emotions and mood), and low negative affect (Diener and Lucas (2000). Vitality as a measure of well-being because it is an aspect of positive affect, so it can be used in conjunction with positive affect to substantiate the increases or decreases in well-being. It was also the only aspect of positive affect that was highly correlated with the amount of connection to nature that participants felt in the Nisbet et al. (2011) study. It has therefore been considered an important aspect of positive affect for measurement.

Measuring stress was important in this study because stress is considered an impediment to well-being (Laumann et al., 2003; Hartig et al., 1996). It also serves as an indicator for environments that can reduce physical well-being. Environmentally produced stress factors have been shown to increase mortality rates (measured by high blood pressure) and illness among other physical disabilities (Laumann et al., 2003; Hartig et al., 1996). In order to locate environments that can be used as sources of well-being it is important to locate the environments that keeps stress factors to a minimum. Stress was also used in many other studies conducted on

natures ability to increase well-being (Velarde, Fry, & Tveit, 2007; Park et al., 2010), so it was important to measure to compare the results of this study to others.

Finally the nature relatedness measure was not used to calculate well-being, but rather to calculate people's connection to nature. In this way the study would contributing to the literature regarding the possibility of a relationship between people's connection to nature and their well-being.

Overall, the study took roughly two hours for each participant to complete. Participants were recruited from the University of Waterloo's Recreation and Leisure Studies classes. However, one of the classes that provided the bulk of the participants was an open class, meaning students from all departments were enrolled. This allowed for a diverse sample of students from different faculties. Using students is consistent with many other studies (Nisbet et al., 2011; Park et al., 2011; Park et al., 2008; Park et al., 2007). University students are known to have high stress levels, especially during exams periods and while studying for tests (Abouserie. 1994), so they are a good sample to represent populations that endure high work stress. More than half of the study took place during an exam period, so the study may help provide evidence related to environments that promote stress reduction in highly stressed individuals. Student populations have also shown rates of depression as high as 30.9% (Ibrahim, Kelly, Adams, Glazebrook 2013). It has also been shown that individuals who are more resistant to stress, have higher levels of mental health, are good problem solvers, and perform better at work, are happy and satisfied with life (Frisch 2000; Veenhoven, 1989). These were the expected outcomes of exposure to the forest environments and the outdoors. Moreover the U.S. Department of Education (2007) found that approximately half of the young adult population attend postsecondary education and Kessler et al. (2005) found that most mental health disorders first

appear during these early adulthood years where students are at a critical stage of development. If students had access to environments that promoted well-being the result could be highly advantageous. Addressing, preventing and treating the early-onset mental disorders of early adulthood could have significant positive effects on student's education, economics, and social outcomes providing broad benefits to the future adult population (Zivin, Eisenberg, Gollust, & Golberstein, 2009). Finally many aspects of students' lives exist within the university environment including housing, social networking spots, health care, and provisions of extracurricular activities (Mowbray et al,. 2006) making them ideal places to increase living standards through the provision of environments that increase well-being.

1.3 Anticipated Contributions

The study extends the research of Nisbet and colleagues (Nisbet & Zelenski, 2011; Nisbet, Zelenski, & Murphy, 2009; Nisbet et al., 2011; Zelenski & Nisbet, 2014), which focuses on achieving greater levels of well-being through a connection with nature. The study will build on Nisbet and Zelenski's (2011) study which showed that outdoor campus environments have the potential to increase happiness. However where their work focused on happiness, this study has included other measures of well-being including blood pressure, heart rate, and mood to assess whether these environments could do more than simply increase happiness. Furthermore, the study seeks to build on research by Nisbet et al. (2011) which showed that proximity to nature increases well-being. To further establish nature as a source of well-being and not just a recuperative space, they used well-being indicators similar to those used in this study such as happiness, vitality, and affect. They also employed different types of environments including a university campus environment and a nearby nature area, however, they declined to describe the

characteristics of the physical environment they exposed their participants to. Explicated in the following, this study analyzed participants' levels of NR and well-being to see if there is a relationship as has been suggested elsewhere (Nisbet et al., 2011).

The study will also contribute to research related to Japanese forest bathing (Parks et al., 2007; Horiuchi et al., 2013, and Parks et al., 2010). The present study however focuses on small, accessible urban forest environments near the University of Waterloo, Canada. Techniques similar to those used in shinrin-yoku studies—specifically those focused on mood and stress levels (Park et al., 2010) were employed in the study to gather evidence of the therapeutic effects of urban forests environments. In this regard, the study seeks to contribute to the fields of outdoor recreation by investigating how accessible urban forest environments can be used as a preventative treatment and to increase well-being, positive emotions and stress reduction.

Outdoor recreation has been shown to have a positive impact on the overall health and well-being of individuals (Hartig, 2004). The current study goes beyond simple restoration and seeks to demonstrate a contribution of outdoor recreation to overall well-being with a focus on cognitive, emotional, and physical benefits as some authors found in studies of outdoor recreation (Beard & Ragheb, 1983; Degenhardt & Buchecker, 2008; Manfreedo, Driver, &Tarrant, 1996; and Manning, 1999, as cited in Degenhardt, Frick, & Buchecker, 2011).

Environmental psychology will also be used to assess the outcomes of the study. Currently, contextual models of EP are based on the idea that individuals may be affected by the physical and social context of the environment they are in, which impacts their experiences and behaviors (Winkel et al., 2009). However, there is limited research on this contextual model, so research is currently being conducted on the impact the physical environment has on people and what variable can be used to predict outcomes for individuals. An example of this is a study

conducted by Danielsson and Bodin (2008) where seven different types of offices and their effects on workers' health and job satisfaction was conducted.

The study presented here is situated in this research field as it focuses on the human-environment relation between nature and human health. The study looks at the cognitive role the environment (presenting patters of information) has on participants. The patterns observed in the environments was the amounts of nature (sun light, fresh air, trees, biodiversity, etc). It was expected that increasing the amounts of nature would increase well-being, so environments were used with varying amounts of natural elements to study how they differentially impacted well-being. The study made sure to follow Winkel et al. (2009) instructions on growing the field of ecopsychology enforcing the three conditions they put forth: 1) that the physical environment of interest makes a significant and unique contribution to the changes in the outcome, 2) the results of the physical environments impact cannot be a proxy for another variable which could also explain the outcome (i.e physical activity), 3) assume the physical environment is the main factor effecting the participants, develop a theory as to why this effect is occurring (this study used a theory that already exists the biophilia hypothesis, so it did not develop a theory, but it helped contribute evidence to the hypothesis).The current study attempts to demonstrate that brief exposure to outdoor and forests with passive recreation in these environments can contribute to improvements in well-being and reductions in stress.

The following document is structured in six chapters. The first chapter is a literature review of the research that has been conducted in the field of well-being, nature's effect on well-being, nature relatedness, the biophilia hypothesis, and how types of nature have been shown to impact people. The following chapter is the methods section which discusses the various aspects of the study environments, participants, and recruitment strategy. This section is followed by a

section that discusses the different variables used to assess well-being, concluding with the procedure used to complete the experiment. The following chapter, chapter 4 reveals the results of the study and chapter 5 is a discussion of what the results mean in relation to this study and to the literature. Finally the last section of this document is the conclusions, which summarizes the importance of the results and the social implications of the study.

CHAPTER 2- LITERATURE REVIEW

This study seeks to provide evidence on different types of urban environment that lead to a sense of increased well-being. The focus is on forest environments as these environments have been shown to increase well-being better than built urban environment. Throughout this study a built environment will be defined as an area where the surrounding environment is predominantly concrete and glass. Trees have been shown to induce relaxation and increase people's well-being through the sight and smells they provide (Nowak et al., 2001; Lohr and Pearson-Mims, 2006; Park et al., 2008; Cheng et al., 2009). In this literature review section, background information on the link between people's well-being and nature will be reviewed. The chapter will begin with a review of the concept of well-being. It will draw particular attention to how the concept has been defined and the various measurements or indicators used to study and understand it (e.g., vitality, happiness, affect, mood, and stress). The following section will discuss nature and well-being, touching on peoples preferences for natural environments. Following this the theories guiding this research, including nature relatedness and the biophilia hypothesis, will be introduced explored and defined. Current research regarding nature's effects on individuals will then be introduced in the final section of this chapter. It will cover the following affective relations: time spent in nature; the sounds of nature; the effects of trees and forest environments; green-spaces; and finally the effects that water has on well-being.

2.1 Well-being

There are a wide variety of factors that impact human health, and well-being is one of them (World Health Organization, 2003). For many people, well-being transcends economic prosperity and is considered to be more important than money (Diener et al., 1999). A study conducted on college students also found that almost all of their respondents believed happiness was more important than money (Diener & Oishi, in press). A good example of this is Taylor (1988) who concluded that the way people view themselves determines their well-being. People who view themselves in a positive way have the ability to adapt to negative information better because they have the illusion that their abilities match the situation. This in turn makes them perceive the negative information as unthreatening. Thus the individual feels more relaxed when handling the negative feedback, reducing negative feelings and increasing well-being (Taylor, 1988). It is therefore important to study what helps create well-being in individuals because the results will help researchers and city planners better understand their subjects.

Well-being has been organized into two broad traditions: (1) hedonic well-being, which is conceptualized as happiness (high positive affect and low negative affect), and (2) eudaimonic well-being, which deals with human potential and the lifetime of challenges and growth in that the individual experiences (Ryan & Deci, 2001). Waterman (1993) argues that eudaimonic well-being is associated with being challenged and exercising effort to deal with the challenges over a long period. On the other hand he argues that hedonic well-being means gaining relaxation, happiness, and separation from problems. The following will address the details of this distinction through the contemporary literature.

Hedonic well-being is also referred to as Subjective Well-Being (SWB). This includes happiness as indicated by affective measures that assess varying degrees of happiness with

variable environmental factors (Ryff, Keyes, & Shmotkin, 2002; Ryan & Deci, 2001). SWB is therefore attempts to gauge a comprehensive view of affect and quality of life (Ryff et al., 2002). The components of SWB include people's emotional responses, domain satisfactions, and global judgment of life satisfaction (Diener, Suh, Lucas, & Smith. 1999). Finally it can act as a buffer against psychological disorders and it promotes and maintains optimal mental health (Park, 2004).

Eudaimonic well-being or psychological well-being encompasses aspects of personal growth, purpose in life and challenges such as pursuing meaningful goals and developing as a person to achieve self-fulfillment (Ryff et al., 2002). Studies of psychological well-being focus on existential challenges in life. Ryff and Keyes (1995) believe psychological well-being is multidimensional and therefore to the extent to which each dimension is present. They postulate that six dimensions of positive psychological well-being can be attained through: 1) self-acceptance or the ability to look at one's life and positively reflect on past and present events that have happened with in it; 2) environmental mastery or the ability to manage life events and the world around the individual; 3) a sense of purpose or meaning in life; 4) positive relations with others, or the feeling that an individual has meaningful relationships with others; 5) personal growth which comes from the individual's sense that they are growing and changing in their life; and finally, 6) autonomy is felt when the individual feels they can accomplish their goals. These dimensions of psychological well-being are individually linked to different problems involving psychological well-being (Simon & Durand-Bush, 2015). An example of this is a study that studied the impact of interpersonal problems and work stress which were shown to be linked causing issues for individuals at work with interpersonal issues (Falkum & Vaglum, 2005).

2.1.2 Subjective Well-being.

SWB was used as the measure of well-being for this study because it changes based on environment, happiness, stress. Moreover, because SWB changes quickly over short periods of time depending on affective stimuli, it can be measured in individuals with relative simplicity (Ryff, Keyes, & Shmotkin, 2002; Ryan & Deci, 2001; Waterman, 1993; Watson, Clark, & Tellegen 1988). The difficulty in studying variations in an individual's well-being over the course of life, as would be necessary in a study of eudaimonic well-being, (Ryan & Deci, 2001) makes SWB a more suitable field of research.

SWB first became prominent in the 1950s when researchers were trying to measure individual's quality of life (Land, 1975). Ryff et al. (2002) summarized Andrews and Withey (1976) and Campbell, Converse, and Rodgers (1976) results by saying "although people live in objectively defined environments, it is their subjectively defined worlds that they respond to, thus giving prominence to SWB as a relevant index of people's life quality" (p. 1007).

The component of SWB focused on in the study is the participant's emotional responses, as these change relatively quickly and this study is interested in improving well-being in a short period of time. However there are many SWB researchers interested in long term moods (Diener et al., 1999). The importance of shorter term mood changes was suggested by Nisbet and Zelenski's (2011) study in which they indicate frequent short term exposure periods to natural environments may increase and prolong well-being.

Since SWB is not a single entity, it needs to be measured using a multitude of measures (Diener, Suh, Lucas, & Smith, 1999). The study employs happiness indicators of affect and overall happiness scores to measure hedonic well-being: vitality indicators, which have been shown to be related with eudaimonic well-being (Nix et al., 1999); mood which can be used as a

barometer of psychological well-being (Berger & Motl, 2000); and stress indicators which, if detected, may provide evidence for a lack of developed well-being (Hartig et al., 1996). Stress was also assessed across each environment in order to determine the environmental capacity to reduce stress (Parks et al. 2007). Specific measures of well-being are presented below.

2.1.3 Vitality.

Vitality has been defined as the energy that an individual experiences (Ryan & Frederick, 1997). Thayer (1996) refers to it as a calm energy without tension. It can be measured using positive affect similar to happiness; however happiness is different than vitality (Nix, Ryan, Manly, & Deci, 1999). When measuring vitality, the affective feelings include activated, peppy, energetic, vigorous, and liveliness. This is to be opposed to the happiness indicators of affect: pleasantness and contentment (Nix et al., 1999).

Vitality is important in measuring well-being because researchers have shown that it represents energy and wellness (Nix et al., 1999). McNair, Lorr and Doppleman (1971) indicate in their manual for the Profile of Mood States, that vitality has a positive relationship with mental health and is negatively related to feelings of fatigue. Mental health was also shown to have a positive relationship with subjective feelings of subjective vitality (Stewart, Hays, & Ware, 1992). Therefore to maintain or increase well-being and mental health, vitality is an important element for understanding the relationship between different environments and their impact on well-being.

Thayer (1987) indicated that moderate to high levels of stress or tension affect the calm energy people feel as vitality. If an individual can reduce stress levels and tense energy they can positively impact their vitality. Forest environments have been shown to help reduce stress (Park

et al., 2007; Kaplan and Kaplan, 1989), so they are valuable environments to anticipate increases in feeling of vitality.

Vitality was measured using the Vitality Scale created by Ryan and Frederick (1997). Vitality measures are important in helping to understand the psychological well-being of an individual. However other measures are needed to assess a more complete sense of well-being since it may also be felt in the form of peace and contentment (Ryan & Frederick, 1997). The Vitality Scale measures psychological and somatic factors of an individual's "health of spirit" (p.557) or subjective vitality (Ryan & Frederick, 1997). "Subjective vitality was therefore expected to be related not only to the individual's experience of physical health and bodily functioning, but also to variables associated with sense of agency, self-actualization, and personal well-being" (Ryan & Frederick, 1997. p. 557). Subjective vitality was confirmed to be associated with psychological and physical well-being and is able to assess individual's vitality at the specific moment it is given attaining the "readily available feeling state" (Ryan & Frederick, 1997. P. 559). Stewart, Hays, and Ware (1992) indicated that this energy feeling state is related to mental health and poor mental health could lead to poor well-being, so measuring vitality is important when assessing well-being.

2.1.4 Happiness.

Happiness is an indication of subjective (hedonic) well-being (Ryff, Keyes, & Shmotkin, 2002), so measuring happiness provides insight into a person's subjective well-being. Lyubomirsky and Lepper (1999) stated "anecdotal evidence and everyday experience alike suggests that one of the most salient and important human disposition is that of happiness of well-being" (pp. 137-138). Many scales are used to measure subjective well-being such as the

Affect Balance Scale developed by Bradburn (1969), which is the most widely used happiness scale (Lyubomirsky & Lepper, 1999). Other scales measure cognitive subjective well-being, which assesses people's happiness with their life or their life satisfaction such as the Satisfaction With Life Scale (SWLS) developed by Diener, Emmons, Larsen & Griffin (1985). The SWLS scale looks at happiness within an individual's life and not at a given moment in time, as is required in this study. Lyubomirsky & Lepper (1999) devised a scale to measure subjective happiness through a measure "that is a global, subjective assessment of whether one is a happy or an unhappy person" (p. 139). This scale is also not ideal because it does not measure changes in immediate happiness, but rather longer term happiness, using questions such as: "some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you?"(Lyubomirsky & Lepper, 1999. p. 151). Psychophysiological measures and brain assessment techniques have also been developed to analyze happiness levels, but these are inefficient (Lyubomirsky & Lepper, 1999). Affect is a good measure for immediate fluxes in happiness levels because it indicates immediate changes in experience (Watson, Clark, & Tellegen 1988). Measuring affect is ideal when trying to determine which environments increase happiness in a short period of time.

2.1.4.1 Affect.

Affect refers to the emotions or moods that people feel in their immediate experience (Watson, Clark, & Tellegen 1988). It is important in this research because SWB is measured by affect (Diener, 2000) and because the indicators of well-being used in this study must assess changes in the participant's well-being in a short period of time. Furthermore, Nisbet et al. (2011) have hypothesized that given frequent exposure to positive natural environments, the

happiness feeling that is measured through positive affect may be sustained over extended periods of time (Nisbet & Zelenski, 2011). The urban forest in this study may, therefore, have the ability to provide prolonged feelings of well-being through positive affect and happiness. Nisbet and Zelenski (2011) used the Positive Affect and Negative Affect Schedule (PANAS) to assess affect. Affect is associated with well-being and happiness as proposed by Bradburn (1969) who suggested a balance between positive and negative affect results in happiness.

Affect has also been used in multiple studies examining the impact of different urban and natural environments on individuals (Kaplan, 1995; Nisbet & Zelenski, 2011; Hartig, Mang, & Evans, 1991) and as Ulrich (1979) indicated, positive affect was generally found in participants who were exposed to nature images while urban images produced feelings of sadness. This data follows similar findings of forest environments and thus it was expected that affect would change across different environments. Affect has also been shown to be a prominent component in people's environmental encounters as there are few times when it does not change indicating different affective sates (Mace, Bell, & Loomis, 2010). It is therefore expected that the affect measure will make possible the assessment of the four environments in terms of positive and negative affect. This means that if individuals have a negative experience in the natural environment the negative feelings will be able to be assessed. This is important to the study because, as Russell and Snodgrass (1987) have indicated, there is a strong connection between negative affect and a reduction in health levels. The forest environment used in this study is in an urban area, which will produce many experiences (sounds, smells) that do not exist in the rural forest environments used in previous studies. By measuring affect it will be possible to spot the changes the environments have on the participants both negative and positive.

2.1.5 Mood states.

Mood states have also been used to study well-being and in particular studies in which participants sit or walk through forest environments (Park et al., 2007; Tsunetsugu, Park, & Miyazaki, 2010; Horiuchi et al., 2013). Mood can "serve as a barometer of our general state of psychological well-being" (Berger & Motl, 2000. p. 70). This is shown through the general level of enjoyment, self-concept, and subjective well-being people feel (Thayer, 1996). Mood can also affect people's health as it has been connected to immune function (Melamed, 1995). People regulate their mood seeking and maintain a good mood, and reducing negative moods to maintain their well-being (Berger & Motl, 2000). Berger and Motl (2000) also argued that personal happiness can be regulated through self-regulation of moods. Thus, mood states are important to study when measuring subjective well-being.

Mood states will be assessed using the Profile of Moods scale. This scale was employed in many studies on the psychological effects of forests (Park et al., 2010; Mao et al., 2012; Tsunetsugu et al., 2013; Lee et al., 2014; Ochiai et al., 2015), so in keeping with previous studies on large rural forests the same mood scale was used in this study to allow for comparisons with a small accessible urban forest.

2.1.6 Stress.

Stress levels are high in developed countries, as Tsunetsugu, Park, & Miyazaki (2010) have indicated. For example the Ministry of Health Labor and Welfare of Japan concluded that 54.2% of the Japanese population had stress levels that were either "very high" or "relatively

high" (Tsunetsugu et al., 2010). Stress can be defined as the "relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and engendering his or her well-being" (Lazarus & Folkman, 1984. p.19). Parks et al. (2007) measured high levels of stress in the Japanese public and attributed the high stress levels to an increase in workload. This which was also indicated in Degenhardt et al. (2011) study which focused on Canada and the United States. Degenhardt et al. (2011) also noted that studies focusing on individuals with stress inducing workloads have shown there to be a link between such strains and increases in depression, fatigue, back problems, and other illnesses. In addition, Ulrich et al. (1991) argue that increased population, community noise, and air pollution have contributed to the increase in stress. Brod (1984) argues that modern stress is due primarily to the increase in technology and the way in which society is becoming increasingly complex and highly industrialized. Further, Laumann et al. (2003) showed that stressful mental activities can increase stress levels. As well, Vrijkotte, van Doornen, de Geus (2000) found that people with high stress jobs had corresponding stress levels. Finally, Kaplan (1995) showed that stressful mental activities are felt by students in particular as they are frequently required to work under tight deadlines causing high stress levels. Stress has also been shown to cause anxiety, depressed and angry moods, exhaustion, frustration, boredom and irritability (Michie, 2002). All of these studies are important to this project because stress has been shown to reduce or inhibit well-being (Laumann et al. 2003; Hartig et al., 1996). Therefore, in order to attain increased levels of well-being, stress levels need to be reduced, and environments, such as urban forests, are expected to increased well-being as forests have been shown to reduce stress.

Ulrich (1993) suggests the biophilia hypothesis might be an explanation for why people are feeling more stressed. In this explanation, people are becoming more stressed because the

world is becoming more urbanized and people are losing their connection with nature (Nisbet & Zelenski, 2011). Humans have evolved in nature and thus have developed innate responses to the natural environments. However, humans have recently removed themselves from this environment. The unfamiliar urban environments induce stress because human animals have not developed innate responses to these environments. Stress therefore occurs because of a lack of familiarity and understanding of how to react to the new urban environment. Evidence for this theory comes from studies that show stress levels decreasing with exposure to natural environments (Kaplan & Kaplan, 1989; Hartig, Mang, & Evans, 1991; Ulrich et al., 1991; Kaplan, 1995). Kaplan and Kaplan (1989) are proponents of the theory that natural stimuli help to lessen the effects of mental load and Ulrich (1993) believes that emotional and physiological stressors can be reduced from exposure to natural landscapes. Exposure to relaxing environments for periods as short as 20 minutes have be shown to produce reductions in stress (Pawlow, O'Neil, & Malcom, 2003). Trenberth, Drewe, and Walkey (1999) note the importance of using passive forms of leisure to manage and reduce work-related stress. As well Hutchinson, Bland, and Kleiber (2008) speak to the value of using leisure as a buffer and distraction for individuals, thus providing relief from every day and persistent stress.

2.1.6.2 Measures of stress.

Research has been conducted on the relationship between stress levels and natural environments. Many studies measuring the impact that environments have on participants have used blood pressure and heart rate to assess stress levels (Ulrich et al., 1991; Vrijkotte, van Doornen & de Geus, 2000; Park et al., 2007; Tsunetsugu et al., 2013).

Ulrich et al. (1991) investigated stress recovery across natural and urban landscapes using blood pressure and heart rate. Using a stress inducing video of industrial accidents he increased participants stress levels, and then had some participants watch a video on nature scenery, while others watched a video of urban scenes. The participants watching the natural scenes reduced their stress levels significantly faster than those watching the urban video. Additionally, increased positive moods and decreased feelings of fear and aggression were felt by the participants watching the nature scenes. Ulrich (1991) concluded that nature can lessen tress recovery time.

Pretty et al. (2005) studied people exercising on treadmills and viewing pleasing natural pastoral scenes, unpleasing natural scenes, urban pleasant scenes, and urban unpleasant scenes. The results showed a reduction in blood pressure from the exercise, but there were additional reductions in blood pressure levels when the pleasant natural rural scenes were being viewed. This indicated the high level of influence that certain experiences can have on physiological and psychological functions (Pretty et al., 2005). Theoretically then, if we place people in a more natural environment, as in outdoor recreation, we should see a decrease in stress levels through decreased levels of heart rate and blood pressure.

Laumann et al. (2003) also used heart rate comparison measures collected after a stress inducing task that increased mental load. The participants had their heart rate taken during their exposure to either a nature video or a video depicting urban scenes. Laumann et al. (2003) found that heart rate was lower during the viewing of the nature video as compared to the urban video. Vrijkotte, van Doornen and de Geus (2000) studied ambulatory blood pressure and heart rate to measure stress from high workloads. They found that heart rate and blood pressure rose when the

subjects experienced high workloads indicating an increase in stress (Vrijkotte, van Doornen & de Geus, 2000). This suggests that stress levels can be inferred using heart rates.

Ambulatory blood pressure is the monitoring of blood pressure over an extended period of time to avoid recording measures of high blood pressure that may have been caused by stress occurring during the reading period (Pickering, 2000). This study however took single measures of blood pressure because the goal was to measure the brief changes in stress that the environments put on the participants. Another reason for not using ambulatory blood pressure measures was that it was very uncomfortable for participants to have their blood pressure taken more than three times in two hours. This was noted by many of the participants in the preliminary summer experiment period.

Other urban forest studies have used heart rate, blood pressure and salivary cortisol level measurements. This latter measures stress hormones to identify increases or decreases in stress from exposure to urban and forest environments (Park et al., 2007; Tsunetsugu et al., 2013). It was shown that the three aforementioned measures of stress decreased with exposure to forest environments (Park et al., 2007; Tsunetsugu et al., 2013). Further studies have been conducted using blood pressure and heart rate as predictors of stress leading Laumann et al., 2003 to conclude that heart rate and blood pressure are appropriate measures of stress. These measures of stress were assessed using a digital heart rate monitor and a digital blood pressure cuff.

Overall, these studies indicate that heart rate and blood pressure measures are good indicators of stress and demonstrate the ability of the different environments to lower or heighten stress levels. Using heart rate and blood pressure is also important in this study because they are a measure of well-being that cannot be manipulated by the expectations of participants. They

will be used in conjunction with the other measures of well-being and it is expected that as heart rate and blood pressure decrease the indicators of well-being will increase as has been shown in other forest studies (Park et al., 2007; Tsunetsugu et al., 2013) and as indicated would happen by Laumann et al., (2003) and Hartig et al., (1996).

2.2 Nature and Well-being

2.2.1 Nature's effects on well-being

People have always had a fascination with nature from the hanging gardens of Babylon to Ancient Persian's word for an ideal heavenly garden "Pairi-daeza" or "paradise" as we refer to it now (Thompson, 2011). Wilson (2007) describes peoples need to affiliate with nature and the attraction to it as biophilia. He argues that people have been disconnected from the natural environment because of our shift into urban environments (Wilson, 2007) with almost half of the world's population now living in urban areas (United Nations, 2004). Nature gives us pleasure to look at as an esthetic resource described in poetry, and replicated through paintings and photographs (Aurther, Daniel, & Boster, 1977). Nature has been shown to foster positive feelings, emotions and reduce stress, while providing restorative benefits thus improving our overall health and well-being (Degenhart et al., 2011; Horiuchi et al., 2013; Park et al., 2010). It is important to study the areas that connect people to nature to further define and disseminate the benefits it holds. People are unaware of the potential benefits even small natural environments provide (Nisbet & Zelesnki, 2011) and as people become increasingly disconnected and isolated from nature (Miller, 2005) they lose the positive benefits that may be accumulated from exposure.

2.2.2 Preferences for natural environments

Kaplan and Kaplan (1989) reviewed the literature on the effect natural landscapes have on people. They noted that a dominant theme produced by their review of the research was that natural elements, no matter how small, affected people's positive perception of the natural scenes they were viewing. They argue that although preference is considered a luxury, organisms thrive in environments they prefer and preferences are tied to basic concerns. These preferences can also be tied to underlying human needs, so preference is an important factor to take into account when finding environments that have all the elements needed to increase well-being.

In Kaplan and Kaplan's (1989) review of the literature on perceptions of greenspaces they noted that built environments affected individual's perception of natural environments negatively. Parklands and natural environments provided pleasure from the natural settings; however the presence of built objects in these natural settings reduced people's preference for these scenes of nature. Therefore optimal pleasure from natural areas can only be gained when elements of the built environment are reduced such as in forests where vegetation may block out the built environment.

Kaplan and Kaplan (1989) also investigated people's perceptions of nature in their review of the literature on natural settings. They found that even small natural elements such as vegetation improved people's perception on the areas they were in. This provides further evidence for the hypothesis that outdoor environments, including the built ones, will increase well-being as long as there are some elements of nature included in them. They also noted that in Herbert's (1981) experiment on the perception of landscapes people showed a preference for views with rivers running through them. The presence of water is therefore an important element that may help to increase positive moods.

2.2.2.2 Cultural perceptions of nature.

Yang (1988) noted a cultural component to views of nature specifically that Westerners preferred to have water in their scenery. Yang (1988) also noted that Westerners and Koreans disliked nature scenes with rocks in them. This could indicate that cultural backgrounds have an impact on how the natural areas are perceived.

Van Den Born et al. (2001) compiled a number of research articles on cultural views and nature. They found that in many Western cultural centers, represented by nations such as the U.S.A, Ireland, Norway, Sweden, and the Netherlands, there was a preference for nature and a wish to preserve it for its intrinsic value. Kahn (1999) also showed that children valued nature with a question regarding harming birds. The results were that 90% of the U.S.A, Brazilian, and Portuguese children wished birds would not be harmed, indicating they value nature, according to the study (as cited in Van Den Born et al., 2001).

As for non-Western cultures the research indicates a lack of appreciation for nature. For example, a study conducted on Ugandans appreciation for nature reported that only 34% of the people living near a forests that once had elephants responding positively to seeing them return. This indicates according to the study that many Ugandans in the report did appreciate nature (Hill, 1998). Cattle owners in the Amazon also showed a lack of appreciation for nature as they explained the forest as a problem for ranch houses because it impedes progress (Van Den Born et al., 2001).

Another cultural difference that could affect this study is the different rating styles of well-being. Diener et al. (1995) found a cultural difference in ratings of subjective well-being in terms of life satisfaction. Diener et al. (1995) indicated Chinese individuals consistently rated their well-being lower than other cultures. Finally it was noted by Kaplan and Kaplan (1989) that

the Canadian culture has a love for nature, so the Canadians in the study may rate the forest environment higher than other cultural groups assessed in the study.

Kaplan and Kaplan (1989) also investigated people's perceptions of parkland and noted that in general Westerners enjoyed more wilderness than groomed parkland. Kaplan and Talbot (1988) indicate that a population of low to moderate income African-American people from Detroit did not provide positive review of overgrown parkland that seemed the most natural, because they were concerned for safety and lack of visibility.

This literature may suggest that simply being exposed to nature may not maximize the amount of well-being, but the cultures of the individuals in the area and the elements of the natural world may need to be considered when using nature to help increase positive well-being. The demographic used in this study was more likely to enjoy natural environments because the majority were Canadians. Given the literature reviewed, it was expected that the forest environments will improve the well-being of the participants because it would connect them to a setting that is familiar and preferred: a natural area that is partially groomed, reducing fear, while still allowing for the perception of a wild environment.

2.2.3 Nature Relatedness.

As Wilson (1984) has indicated, being in nature can provide positive feelings and therefore nearby nature may provide natural stress reducing opportunities. Because humans have only recently moved into cities and we have not become physically and psychologically accustomed, the fast paced, constructed, technologically determined urban centers produce an excess of stress in modern individuals. We therefore need to regain our connection with nature in order to reap the benefits it provides (Nisbet et al., 2009) as has been shown by Ulrich (1993)

and Frumkin (2001). Nisbet et al. (2009) have devised a measure that indicates levels of nature relatedness (NR) which they summarize as follows: "the concept of NR encompasses one's appreciation for and understanding of our interconnectedness with all other living things on the earth" (Nisbet et al., 2009. p.718).

"Nature and natural settings have well-documented relaxation, healing, and restorative benefit" (Nisbet, Zelenski, & Murphy, 2007. p. 304). Nisbet and Zelenski (2011) have shown that when people are more connected with nature they spend more time in it and experience more happiness because of this connection. In their work, Nisbet and Zelenski tested university students on an urban university campus to measure whether walking outside versus walking inside had any effects on participants. They found that walking outdoors near nature had a positive relationship to mood. Using the nature relatedness scale, their conclusion was that spending fifteen minutes in nature would improve mood and have a positive effect on the way in which participants related to nature. Zelenski and Nisbet (2014) also replicated previous research using a survey to help understand whether subjective connectedness with nature predicts happiness. Their results found that there is a unique happiness benefit from feeling related to nature (Zelenski & Nisbet, 2014). This indicates that a potential increase in connection to nature such as exposing participants to outdoor urban environments and urban forests could potentially increase individual's happiness. However, the study by Zelenski and Nisbet (2014) only looked at subjective connectedness. This means that it was up to the participants to rate how connected to nature they were. They determined that there was a link between how connected to nature participants felt and their happiness levels, which was a significant contribution.

Similar findings were also discovered by Nisbet et al. (2009) and Schultz (2002) using measures other than the nature relatedness scale. Multiple studies conducted by Nisbet and

colleagues indicated increases in well-being when participants were exposed to nearby nature in urban areas. NR was correlated with changes in well-being through the use of participant's emotional experience, sense of satisfaction, vitality measures using the Vitality scale, and eudaimonic dimensions of psychological well-being (PWB) (Nisbet et al., 2011). The results produced from Nisbet's et al. (2011) report indicate that the greater the connection to nature people have the greater their sense of well-being (Nisbet et al., 2011). They noted that a connection with nature may be enough to overcome negative emotions for recovering from adverse experiences. This again may indicate that a connection with nature can help increase positive well-being. Nisbet et al. (2011) have suggested that future research is needed on the types of nature experiences, such as nature contact, that can have a positive impact on well-being. Additionally they write that, "future research on nature's health benefits might also investigate how subjective (dis)connection from natural environment may influence physical and psychological health" (Nisbet et al., 2011. p. 316).

Nisbet, Zelenski and Murphy (2011) suggest that "nature's influence extends beyond physical health to psychological health, not just the absence of, or recovery from, ill health, but differences in well-being" (p.305). Nature is important to have near populations because people often forget the positive impact it can have on hedonic well-being (Niesbet & Zelenski, 2011).

2.2.4 The Biophilia Hypothesis.

Wilson (1984) proposed that the reason humans feel comfortable in nature is because we evolved in nature and only recently removed ourselves from these settings. Wilson (2007) poses the logical argument of evolution to provide evidence for his hypothesis. Humans have lived in hunter gatherer societies living off and with nature for 99% of their existence (Wilson, 2007). It

would only be natural that they evolved survival instincts that elicit responses to their surroundings. In the same paper he goes on to suggest that humans are not just attracted to or have an affiliation with nature, but that they have innate emotional responses which are triggered when in areas that have survival advantages. Forest areas are one such example. People who may have had greater success surviving when they attached an emotional response such as fear to living elements around them may have had higher rates of survival. These emotional responses would then be passed on through the surviving species, hardwiring biophilic (postivite feelings form nature) and biophobic (attaining negative feelings from nature, such as stress) tendencies into genetic coding (Wilson, 2007). Ulrich (1993) provided evidence of this indicating many people have an emotional fear response to snakes, spiders, and heights or biophobia. Ulrich (1993) carries this argument further with evidence from people living in urban environments who have these fears even though they may have little to no contact with these dangerous elements of nature. Furthermore the most common fears in Western society (a very urbanized society) are from snakes and spiders (Ulrich, 1993). Further evidence to confirm the theory that biophobic tendencies are genetic have come from twin studies which have shown that some fears and phobias are familial and genetic in origin. For example Kendler and associates (1992) researched female twins and noted that there was strong support for genetic biophobia tendencies as they found that phobias of animals such as snakes and spiders as well as agoraphobia stemmed from genetic origins and not from environmental factors (as cited in Ulrich, 1993). Further evidence of the influence from genetics on biophobic factors are from studies using conditioned responses, which focused on modern negative stimuli and natural negative stimuli that showed the feelings of the modern negative stimuli were forgotten more

quickly than the negative feelings attained from the natural negative stimuli such as spiders and snakes (Cook, Hodes, & Lang, 1986; Hugdahl & Karker, 1981).

It has also been argued that people have also developed a genetic predisposition to become emotionally attached to elements that provide the best chance for survival or biophilia (Joye & De Block, 2011). There are few research studies that have specifically tested the hypothesis of a genetic predisposition to biophilia and nature (Ulrich, 1993). One of these is Ulrich (1993) who has provided examples of the biophilic reaction to natural stimuli as these environments produce less and reduce stress creating a recovery space as Hartig et al. (1991) and Ulrich et al. (1991) found. This biophilic response could be causally related to a human survival impulse generated by certain environments that provide access to resources necessary for life, such as water and trees (food and safety), that have been coded in our genes resulting in a decrease in stress as survival in these environments is more likely. For Wilson (2007) urban environments may be stressful because we have moved into modern environments without the elements of the natural world producing either positive or negative emotional responses, and where people have not had time to replace the responses to natural environments with the equivalent response to elements of this new urban world.

These biophilic/biophobic evolutionary responses of nature were then passed down from generation to generation in our genetics. One source of evidence for this theory is from the statistics which indicate that more people visit zoos each year than all sporting events combined (Wilson, 2007). Higher property values on real-estate located near or on parkland with water nearby is also a good example of how common it is for people to value regaining a connection with nature (Wilson, 2007).

The evidence for the biophilia hypothesis is not limited to the research described above. There has been extensive research conducted on how nature and natural environments make people feel better, which is further explored in the following section, Benefits of Nature. The research presented in that section will refer to key studies supporting the biophilia hypothesis and provide support for the choice of environments in this study. However, before reviewing the literature on how nature provides benefits to people, a critique of the biophilia hypothesis will be presented to provide a more complete understanding of the biophilia hypothesis.

2.2.4.2 Critique of the Biophilia Hypothesis.

In Joye and De Block's (2011) critique of biophilia they begin with an analysis of the definition Wilson (1984) first proposed of the biophilia hypothesis, "the innate tendency to focus on life and life-like processes" (p.1). The first section critiques the idea of 'life and life-like processes'. They indicate that this insinuates a biological element or something that is alive and natural, however not everything that is life-like is natural and not everything natural is life-like (Joye & De Block, 2011).

Joye and De Block (2011) contest the life-like component of Wilson's (1984) definition. Ulrich (1993) indicates support for the biophilia hypotheses through the relaxed attraction people feel around natural elements such as water. However, water is not alive, so Joye and De Block (2011) ask the question, why do people feel this attraction to water if it is not life-like as the definition describes that induces our biophilia. Joye and De Block (2011) also argue that a general human attraction to water is not sufficient evidence to connect it to the survival instinct which serves as the basis for biophilia. Joye and De Block (2011) also critique the idea that

people are attracted to everything in nature and that not everything in nature is life-like, so why does Wilson (1984) suggest this.

The next part of the definition that Joye and De Block (2011) contest is the use of the word 'focus'. Joye and De Block (2011) do not have a problem with this section of the definition, but they do note that in recent years the term 'focus' has turned into an affective affiliation with life rather than the original focus on life. In their view, these two terms should not be confused.

Finally the use of the word 'innate' is a problem in the definition because, according to Joye and De Block (2011), current evolutionary psychology suggests that adaptation is domain specific (Tooby and Cosmides, 1992; Herzog, 2002). The issue here is that biophilia suggests the adaptations are rooted in a single domain instead of numerous learned concepts. If the adaptations are genetically retained then there must be a domain it can be situated in (Joye & De Block, 2011). Kellert (2005) suggests that the adaptation is knowledge that has been learnt and retained through evolution, which he indicates is a weak factor in genetics.

The rest of the critique of the biophilia hypothesis describes the evidence for it to be vague and not concrete. For example the critics address the assumption that since humans have an innate fear of certain dangerous elements of their environment then the reverse must be true as well. Joye and De Block (2011) contested this argument for the biophilia hypothesis because there is not enough concrete evidence showing this instinctual fear and pleasure in different objects.

Joye and De Block (2011) also argue that there is little evidence to suggest that the learned experiences embedded in evolutionary history provides us with the fear instinct. Question whether these fears are merely learned through our cultural conditioning. However

Cook, Hodes, and Lang (1986) and Hugdahl and Karker (1981) showed that participants remembered negative feelings associated with negative natural stimuli for a longer period of time than the non-natural stimuli. This indicates that people do learn from experience, but that there is some kind of instinctual response to natural stimuli.

Additionally while it is true that not everything natural is life-like as Joye and De Block (2011) first point out, it could be argued that the water in lakes and rivers could be considered life-like because it contains and supports a massive amount of life, such as algae and other organisms. It could be argued that the water people feel better around is the water we see life in as opposed to the sterile water from taps in our houses. Thus it is not the water per se that we see that promotes the emotional biophilic response of enjoyment or preferences as Kaplan and Kaplan (1989) argue, but the knowledge that millions of organisms are contained in and supported by the water in lakes, rivers, and streams that elicit the biophilia response. The water in natural environments may be life-like because it contains so much life that it elicits our emotional responses to life.

Joye and De Block's (2011) statements that people are not being attracted to everything in nature because not everything is life-like is not a fair critique, because Wilson (1984) does not suggest people are attracted to everything in nature. Wilson's (1984) first definition did not include the term nature, so this critique about the biophilia hypothesis definition needs a greater discussion. The interpretation of the biophilia hypothesis used in this study is that Wilson (1984) believed people do not have an affinity for everything in nature, but that people have an affinity for all life-like aspects of nature. Even Yang, (1988) showed people do not have an innate need for all aspects of nature through his study on preferential landscapes. Participants in the study did not enjoy the scenes with rocks in them, even though rocks are natural.

Joye and De Block's (2011) critique about the term 'focus' is important as this study uses Wilson's newer 2007 definition of the biophilia hypothesis "the innately emotional affiliation of human beings to other living organisms" (p249) which uses 'affective affiliation' instead of 'focus'.

Finally the critique of the weak relationship between people's genetic predisposition to affiliate with nature is important. However, there is evidence regarding the existence of this genetic factor in twin studies (Kendler et al., 1992. As cited in Kellert & Wilson, 1993) as well as in the overwhelming number of people who are afraid of snakes, spiders, and heights with little to no experience with these elements of nature (Wilson, 2007). There is some type of genetic predisposition regarding elements of nature, however further research is needed to fully understand these factors of biophilias and biophobias.

Although there are some criticisms of the biophilia hypothesis it is still a useful way to look at how people react to nature and the research evidence for the study indicates this as cited here in the thesis.

2.3 Benefits of nature

Nature has been used in a variety of ways to reduce stress and improve well-being. For example, in addition to natural environments, researchers have used pictures, video, and views of nature to achieve benefits. Nature's effect on people explained by the biophilia hypothesis will be explored in this section. Time spent in nature and the sounds from nature will be assessed in regards to their effect on well-being. Exposure to trees and forest environments will discussed using past research on the subject and shinrin-yoku examples of physiological and psychological

restoration in forest environments are then explored. Finally, the reason why forests are important for improving well-being will be discussed.

Roger Ulrich was a pioneer in the field of the rehabilitating effects of natural landscapes. Ulrich (1979) conducted research in which he presented participants with natural and urban scenes. His study indicated that nature scenes improve well-being and positive affect, while reducing anxiety and fear. Urban scenes on the other hand increased levels of sadness and reduced attention capacity (Ulrich, 1979). He then looked at people's recovery time in hospitals after a routine surgery. In that research, he found that patients who had a window with a view of nature as opposed to a brick hospital wall recovered faster, with less pain, less complications and fewer negative evaluations on their charts. In another experiment, participants watched a video of industrial accidents invoking stress, fear, and anxiety. Following the film some participants watched nature scenes while others watched urban scenes (Ulrich, 1991). Participants were measured for signs of stress and fear, anger and aggression, positive affect, sadness, and attentiveness and interestedness. Participants who viewed the nature scenes had a quicker recovery time from stress, with decreased anger, aggression, fear, and a large effect on positive affect. Ulrich concluded that the nature scenes had a positive effect on peoples stress levels and well-being as stress reduction is typically associated with a reduction in negative feelings (Hull & Michael, 1995).

2.4 Time spent in environments

It would appear from previous research, that the amount of time people need to be in nature to have a positive effect is relatively short. For example some studies of nature's effects on individuals had the participants sit in the environments for 15 minutes and then walk for

another 15 minutes (Tsunetsugu et al., 2010) to determine if the natural environment had an effect. Nisbet and Zelenski's (2011) model on nearby nature's effects on happiness and happiness sustainability had the participant's spend an average of 17 minutes in the nearby nature. The conclusion of the report was that 15 minutes was long enough for the nearby nature to have an effect on the participant. It was also noted that blood pressure and heart rate was reduced when individuals were exposed to the smells of the forest and the sound of murmuring streams within 60-90 seconds of exposure (Miyazaki et al., 1999; Mishima et al., 2004). This indicated that short periods of exposure to an environment can have an effect on individuals. The significance of this should be emphasized since the participants of this study were students who often have little time to spend in natural spaces during periods of high stress (Abouserie. 1994). Eyler et al (2002) also found that women and men with full-time jobs and families had leisure constraints which limited their participation in outdoor recreational activity (Goossen & Langers, 2000). If an environment could be found that increases well-being in a short period of time it is more likely that people would be able to allocate the time needed to access them and thereby improve their well-being. Furthermore, if the environment is shown to increase well-being it is more likely to be used. In line with this Degenhardt (2009) indicated a major factor influencing the use of recreation areas is the resident's knowledge of the area. If the residents are aware the area is a beautiful place with restorative benefits the use of the environment increases. Within the context of the literature, this study aims to increase the knowledge that the urban forests in Waterloo Park increase well-being, even with short exposure time, helping to increase the use of this space and potentially helping to increase the well-being of the population in the area.

The study's hope was to increase well-being over a standard lunch break. Degenhardt, Frick, and Buchecker (2011) have indicated that busy work weeks limit the accessibility of

natural outdoor spaces for working people. Therefore providing accessible environments that improve well-being in short periods of time may increase the use of these areas, helping to maximize well-being in the population.

2.5 Sounds of nature

Ulrich (1991) has noted that stress is increased by noise. It has also been argued that noise can lead to poor mental health and suboptimal well-being (Chu, Thorne, & Guite, 2004). Although the theory that mental health problems result from unpleasant noises has yet to be conclusively proven, it has been shown to increase aggressive behavior, contribute to tension related illness, depression, and anxiety (Monahan & Vaux, 1980). Therefore areas away from noise are ideal locations to help improve people's well-being.

Mishima et al. (2004) studied the effect of a stream mummer sound on participant's blood pressure, heart rate, and regional cerebral blood flow. They noted that heart rate did decrease to levels lower than the baseline. This experiment used a recording of a stream mummer, so research regarding stress reduction qualities of natural audible streams is expected to yield higher levels of stress reduction; helping to increase perceptions of well-being.

2.6 Effect of trees and forest

Trees have been well documented to improve health and well-being especially for people living in urban environments (Nowak et al., 2001). In addition Lohr and Pearson-Mims (2006) found that people preferred scenes with trees and felt happier when viewing trees. Ulrich (1991; 1984) produced many research studies on the positive emotional effects and health

improvements that natural landscape scenery contributed to. One of Ulrich's (1984) first studies looked at patients in a hospital after receiving a standard surgery. One group of patients had a window with a view of a tree and recovered faster, with less pain than those with the view of the hospital wall (Ulrich 1984). Dwyer et al. (1992) discuss the psychological benefits of trees and beyond the increased esthetic appeal to surroundings they note that trees can increase people's enjoyment of their everyday lives.

2.6.1 Forest Environments.

Forest environments have been consistently proven to provide positive physiological and psychological effects on people (Parks et al., 2010; Horiuchi et al., 2013; Tsuetsugu et al., 2013). Through medical evidence from research conducted in the field of forest medicine based on shinrin-yoku, the Association of Therapeutic Effects of Forests was established in 2004, along with the Japanese Society of Forest Medicine in 2007 (Park et al., 2010). Since then there have been multiple research projects on shinrin-yoku which have focused on the benefits of large rural forests and the contrasting detrimental effects of urban environments.

The term "shirin-yoku" was coined by the Ministry of Agriculture, Forestry and Fisheries in 1982 (Park et al., 2010). Since then, the ministry has established over 40 forest trails for shirin-yoku. The basic idea is that the participant walks 3-6 km, or simply sits and soaks in the environment in order to increase relaxation and mood which in turn helps increase overall well-being (Park et al., 2010). The forests used are generally large rural forests. All the experiments conducted in this field of research have shown improvements in mood and stress reduction. Tsunetsugu et al. (2013), Horiuchi et al. (2013), and Morita et al. (2007) have shown improvements in mood using the Profile of Mood scale (POM) when participants were exposed

to the forest environments. A reduction in heart rate and blood pressure from being in the forest environments as opposed to urban environments was also demonstrated by Horiuchi et al. (2013) and Park et al. (2010). The study will explore the effects of forests on participants practicing in shinrin-yoku as has been done in Japan, except the study will be conducted in a small accessible Canadian urban forest with Canadian participants.

2.6.2 Greenspace.

The study conducted by Nisbet and Zelenski (2011) provides empirical evidence that being outdoors near nature can have a positive effect on well-being, but it does not address the potentially greater effects of immersing participants in significant amounts of nature within the urban environment. Forests are important to study because they provide a diverse array of vegetation. The diversity of vegetation in a single area has been shown to increase feelings of well-being (Fuller et al. 2007). A study done by Fuller et al. (2007) showed a positive relationship between greater amounts of plant diversity and positive well-being. There were also positive benefits for larger greenspace areas, but the relationship was stronger in areas of plant species diversity. This indicates that greenspace alone is not enough to enhance feelings of well-being, but the biodiversity found in the area is an important factor in nature relatedness (Fuller et al. 2007).

2.7 The effects of water on well-being

As indicated by Kaplan and Kaplan (1989), people have a preference for water in their landscapes. Research conducted using picture cards with multiple landscapes showed waterscapes were almost always the most preferred scene. Kaplan and Kaplan (1989) also make

the point that people are even willing to pay higher prices for a view of water, showing a strong preference for this landscape element. Herbert (1981) also noted that people favor having water in their environments. This preference for water is important because while preference for something is not considered a necessity people feel better when they are surrounded by things they prefer (Kaplan and Kaplan, 1989). It is therefore important to add generally preferred elements of nature to environments that are being used to test improvements in well-being. It was also noted by Mishima et al. (2004) that the sound of a stream's murmur had the ability to reduce stress. However, while all this data suggests that water helps people feel a greater sense of well-being, the evidence remains indirect (Velarde, Fry, and Tveit 2007). Given the possibility that water elements could impact well-being it was considered in this study. However, if preliminary evidence does not support an increase in well-being over the forest environment, the water condition will be not be studied. The study was expected to show that small accessible urban forests can provide similar therapeutic benefits as large rural forests; through increases in moods and stress recovery. These smaller accessible natural environments can therefore be utilized as areas to maximize people's feelings of well-being to support a healthy population.

CHAPTER 3- METHODOLOGY

Participants were exposed to three outdoor environments (built, forest, and forest-stream) and an indoor (classroom) environment for baseline measures. They were exposed to each environment for 20 minutes with the expectation that the environment would impact their sense of well-being as measured by vitality, happiness, mood, blood pressure and heart rate.

3.1 Design

The study used a mixed experimental design with one within-subjects factor (environments) and one between-subjects factor (forest). The within-subjects component was used to compare the baseline environment and the built environment to the forest environments. A within-subjects design was used as it reduces the error associated with having different participants for each condition. These errors may become confounding variables and are prominent in between-subject design experiments (Gravetter & Forzano, 2012). In addition, daily differences in each environment (created by weather and other factors) occurred and the between-subjects design added these differences to the error variance, reducing the likelihood of finding an effect. Finally, a within-subjects design was used because fewer overall participants would be needed with each participant being exposed to each environment (Gravetter & Forzano, 2012). For example if 30 participants are needed for each environment to demonstrate an effect, only 30 participants would be needed in a within-subjects design, while in a between-subjects design with two environmental conditions, 60 participants would be needed because each participant participates in each environment only once (Gravetter & Forzano, 2012).

However, a full within-subjects design can create participant fatigue as they must experience all conditions. Therefore, a between-subjects component was used to compare the

two forest environments. This design was used because while within-subjects designs are very effective at decreasing variance across conditions, they take longer for the participants to complete. This is because the participants must be exposed to each environment in the study (Gravetter & Forzano, 2012). The result is that fatigue for the participants may create error variance because the amount of time required for each participant to complete the four environments in the study may cause reduced response accuracy (Gravetter & Forzano, 2012). This is especially a problem when multiple surveys must be completed throughout the experiment as was done in this study. In addition participants may gain experience in the treatment conditions and begin to understand the expected results of the experiment, thereby influencing their responses (Gravetter & Forzano, 2012).

This design allowed an analysis of the different forest environments as well as the built environment without fatiguing the participants with multiple surveys and lengthy participation time from being in too many environments. The required number of participants was more easily achieved using the mixed design. Finally, the reduced variance from the within-subjects component increased the likelihood of finding an effect making this the most appropriate experimental design for the study.

3.1.2 Environments.

There were four experimental locations used for the study including an indoor environment, an urban built environment, an urban forest, and an urban forest with an audible stream environment. Figure 1 contains pictures of the three outdoor environments. The urban environment was located at the south-east end of the University of Waterloo campus. The two other forest environments were located in a small urban forest about 50 meters long and 10

meters wide in Waterloo Park directly adjacent to the University of Waterloo. Both urban and forest environments are located within a 10 to 15 minute walk from the MC building which is where the baseline measures were taken. The 10-minute walking distance was important because Degenhardt, Kienast, and Buchecker (2010) indicate 10 minutes to be the threshold for frequent use of an outdoor recreation areas (as cited in Degenhardt, Frick, and Buchecker, 2011). Table 1 presents an explanation of each site as well as the outcomes that were expected at each location.

Built environment

Forest environment

Forest-stream environment

Figure 1. Pictures of environments used in study

Table 1

Study environments, descriptions and expected outcomes

Environments	Description of Landscape	Expected effects of location
Baseline	Indoor classroom	NA (baseline measures)
Built	Buildings 3 stories high surround the area. The surface is paved and there are a few young trees on the patches of grass to the right of the location.	It was expected that a slight improvement in mood, heart rate and blood pressure would occur.
Forest	The trees are in a 10 by 50m area. The surface is covered in soil, leaves, and moss. Small trees and bushes are dispersed throughout the area. The trees also form a light canopy.	Increases in vitality, happiness, and mood were expected. Reductions in heart rate and blood pressure are also expected.
Forest-stream	The trees are in a 10 by 50m area. The surface is covered in soil, leaves, and moss. There are small trees and bushes dispersed throughout the area and an audible stream runs adjacent to the location. The trees also form a light canopy	Expected to have the greatest increases in vitality, happiness, and mood. Higher reductions in heart rate and blood pressure are also expected.

3.1.2.2 Time in Environment.

The participants were asked to sit and provide their undivided attention in the environments for 20 minutes. Cell phones, reading material and other distractions were not available during the 20 minute session. The participants were asked simple questions about the environment they were in to encourage focus on the environment itself. For example: "can you name any of the trees around us?", and "do you know what the chalk sign is about on that wall over there?" Some studies have had participants walk for part of the time (Tsunetsugu et al., 2010; Park et al., 2007), but this was considered inappropriate given the use of heart rate and blood pressure, and the impact of physical activities on these measures. Previous studies have shown blood pressure decreases when moderate exercise is performed, so the participants were not asked to walk around. Participants remained seated for the duration of their exposure to the different environments as walking could cause false indications of stress reduction from the different environments (Halliwill 2001). The study used 20 minutes for the participants to "soak" in the environment because it is within the range of time used by previous studies (Tsunetsugu et al., 2010; Parks et al., 2007; Nisbet and Zelenski's, 2011).

3.1.2.3 Urban forest environment.

The urban forest environment at Waterloo Park was chosen because the characteristics are consistent with various definitions of urban forest environments. For example, Agee (1995) has defined an urban forest as a small fragmented area of forest in an urban area. He also described urban forest environments as containing mainly native species of vegetation. The trees in the urban forest environments used in this study were consistent with his definition. Tsunetsugu et al. (2013) also studied urban forest environments and described the forests he studied as semi or fully groomed nature that was not wild and provided a secure and safe

environment to visitors. As described by Tyrväinen (1997) the size of urban forests can vary from less than half a hectare to hundreds of hectares. Tyrväinen also mentions that urban forests are usually small and often dispersed throughout housing developments. The urban forest being used in this study fits these descriptions of the size, safety, and maintenance of the environment. It is also important because it is within the limits of a city park known as Waterloo Park. Parks are used for a multitude of purposes including conservation, recreation, and education (Maller, Townsend, Pryor, Brown, St Leger, 2005). The urban forest with in this park makes it a location for intermediate outdoor recreation.

3.1.3 Participants.

A sample of 155 volunteers from the University of Waterloo student population were used in the study. The population of students is appropriate given that the study is investigating improvements in well-being, which should be applicable to everyone. Furthermore, much of the student population lives in modern urban areas as indicated in the section above on Urban Forest Environments. These areas contain all the stresses of modern urban environments such as loud noises, high populations, deadlines, high workloads, and the lack of a connection to nature in their everyday lives. In other studies, students have been used to compare the impact of natural and urban settings on people's physiological and psychological well-being (Morita et al., 2007; Laumann et al., 2003; Nisbet et al., 2010; Kaplan, 1995). University students are important to study because they experience high workloads, which lead to increases in stress (Vrijkotte, van Doornen & de Geus, 2000). Finally Kaplan (1995) notes that students especially experience mental exhaustion from the intense work required from them. By studying students it is possible

to contribute to the literature concerned with reducing stress and increasing vitality, happiness, and mood levels in individuals who have high workloads (Kaplan, 1995).

Studying environments that increase well-being over a short period of time was also done because the participants used in the study (university students) feel the greatest amount of stress during their exam periods and the study time before that (Abouserie, 1994) These exam periods of increased stress also limit the amount of down time available for those individuals (Hartig et al., 1996). The study was partly completed during one of these exam periods. It was ran from the beginning of September to the beginning of November with midterm examinations happening throughout the month of October.

The student population was a mix of females (93) and males (61) who agreed to volunteer. They were between the ages of 17 to 26. Other researchers have used similar populations with successful results, so it was expected that this sample would be appropriate (Parks et al., 2011; Tsunetsugu et al., 2007; Zelenski & Nisbet, 2010).

3.1.4 Recruitment.

To acquire a sample, a presentation (Appendix D) of what the experiment was about and the implications of it was given to summer and fall semester classes. The recruitment that took place in the summer was a pilot study conducted in the same format as the study in the fall. To encourage participation, participants were entered into a draw to win $100. The summer semester study had 4 participants.

The in-class recruitment presentation involved providing students with a description of the study. This included explanations of what would be expected of them during the study. Examples included: completing questionnaires; visiting local urban forest environments and

urban settings; having their blood pressure and heart rate measurements and recorded; and the length of time required for each participant to complete the study. In the first email confirming their availability, and a brief set of screening questions was included to ensure participants were healthy, mobile and all senses were functioning well. Participants in the fall were encouraged by receiving a 2% point increase on their overall grade. Because of the valuable experience of experimental methodology that participating students would acquire, a 2% bonus mark was offered to volunteers in the field of Recreation and Leisure Studies. Mark Havitz, the department Chair of Recreation and Leisure Studies, signed off on the courses chosen for recruitment indicating that he believed in the educational value of participation (email Appendix A). There was an alternative option if students wanted the 2% bonus marks, but did not want to participate in the study. Appendix B shows the section of a syllabus where the study was explained and the alternative assignment is explained. Finally, the ORE ethics number given to this study and validation of ethics approval is in Appendix C. There were 151 students recruited for the fall sample.

3.2 Measures

3.2.1 Vitality Scale.

The Vitality Scale, developed by Ryan and Frederick (1997), was assessed for validity by Bostic, Rubio, and Hood (2000). They found that the 7 item scale produced valid results that specifically measures vitality. However, they removed the question “I don’t feel very energetic” because it produced better goodness of fit indices (Bostic et al., 2000). The revised 6 item Vitality Scale measures how alive and energetic the participants feel using a Likert scale ranging from 1 (not true at all) to 7 (very true). Some example questions are “I feel alive and vital” or “I

have energy and spirit" (Nisbet, et al., 2011). The Vitality Scale has a coefficient alpha with a range of .87 to .89 (Ryan and Frederick, 1997).

Nisbet et al. (2011) used the Vitality Scale with the modification that Bostic et al. (2000) developed. They used this scale to assess psychological health and reported that, of the well-being measures used in their study, the Vitality Scale had the highest positive correlation with people feeling a connecting to nature. In addition, Nix et al. (1999) indicated that vitality is related to other well-being indicators that measure eudemonic well-being. Furthermore Ryan and Frederick (1997) indicate that the subjective Vitality Scale is an appropriate measure of an individual's well-being because "subjective vitality ratings as one index of well-being pertain to a readily accessible feeling state" (p.559). This is important in this study because the participants were measured for increases in vitality over a relatively short period of time. Given this literature the Vitality Scale is a sensitive measure of well-being and thus good to use for this type of research.

Nix et al. (1999) indicated that vitality falls under a state of positive affect, related to feeling peppy and energized (Watson & Tellegen 1985). Given that the POM scale has the participants rate their feelings based on how energized and peppy they feel, it was important to analyze these to see if the feelings followed a similar pattern to the vitality scale. An observation of the moods tense, fatigued, exhausted, and weary, were also studied to determine whether there is a negative relation between these moods and vitality as indicated by (Thayer 1987, 1996; McNair, Lorr, & Doppleman. 1971)

3.2.2 Happiness.

Affect was measured using the Positive Affect and Negative Affect schedule also referred to as the PANAS scale. This test looks at positive and negative affect using two independent scales to measure affect (Watson et al.,1988). The PANAS scale was specifically developed to measure the balance between positive and negative affect as suggested by Bradburn (1969). He argued that a balance between positive and negative affect results in happiness. This balance of affect has also been suggested by Park (2004) who indicated that subjective well-being consists of high positive affect and low negative affect. The PANAS consists of two short 10 item scales and was designed to be easy to administer (Watson et al., 1988). "The scales are shown to be highly internally consistent, largely uncorrelated, and stable at appropriate levels over a 2-month time period" (Watson et at., 1988. p. 1063). The correlations between the PANAS positive and negative scales were low, with ranges of -.12 to -.23, indicating quasi-independence which was shown to be lower than other short versions of positive and negative affect scales (Watson et al., 1988). The Chronbach's alphas were .86 (positive affect), and .87 (negative affect) with a correlation between the scales of -.09. Item responses are based on a Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely). The participants rate their emotions and feelings using the descriptive words provided such as "excited and interested" (positive affect) and "distressed and upset" (negative affect).

A study conducted on the brief measures of positive and negative affect scale by Watson and Clark (1988) indicated what the results mean as described below:

> "Positive Affect (PA) reflects the extent to which a person feels enthusiastic, active, and alert. High PA is a state of high energy, full concentration, and pleasurable engagement, whereas low PA is characterized by sadness and

> lethargy. In contrast, Negative Affect (NA) is a general dimension of subjective distress and unpleasurable engagement that subsumes a variety of aversive mood states, including anger, contempt, disgust, guilt, fear, and nervousness, with low NA being a state of calmness and serenity"(p.1063).

This quote details how the PANAS scale was analyzed in the results and discussion section of the study.

3.2.3 Overall Happiness Scale.

Hartig, Mang, and Evans (1991) used the Overall Happiness Scale (OHS) when studying the effects of fitness in a natural setting using a backpacking trip in the wilderness. It substantiated their claim that longer wilderness experiences have restorative effects. The OHS was taken from the American Quality of Life survey. It is a single item used to measure happiness on a scale of 1 (not happy at all) to 100 (very happy) (Campbell, Converse, and Rogers, 1976). This scale was compared with the results of the unhappiness feeling state from the POM scale. This was meant to further corroborate the findings of this scale since there was no analysis of this scale that indicated its validity or reliability in the literature. This scale was used because it is a simple way to gauge the participant's level of happiness. Moreover, it had the advantage of being used in conjunction with other analyses of subjective well-being.

3.2.4 Profile of Mood.

The Profile of Mood scale (POM) was used in numerous studies focusing on the psychological effects of forest environments (Tsunetsugu et al. 2010; Horiuchi et al. 2013; Park

et al., 2011). It is effective because it indicates changes in emotional well-being (Horiuchi et al., 2013; Park et al., 2011) through increases or decreases in mood state (Berger &Motl, 2000).

The Profile of Mood scale was used to measure how people feel in the environments. It has been used in the past by other researchers for this purpose and was therefore considered a viable measure (Tsunetsugu, Park, &Miyazaki, 2010; Tsunetsugu et al., 2007; Park et al., 2010; Park et al., 2010; Horiuchi et al., 2013; Tsunestsugu et al., 2013; McNair & Lorr, 1964). The POM scale has a high level of reliability and validity (Tsunestsugu et al, 2013; McNair and Lorr 1964) and provides an evaluation on 6 measures of mood including tension and anxiety (tense, panicky), depression (unworthy, guilty, hopeless), anger and hostility (annoyed, ready to fight, anger), vigor (active, energetic), confusion (forgetful, unable to concentrate), fatigue (exhausted, sluggish, worn-out), and total mood disturbance (Shacham, 1983; Norcross, Guadagnoli, & Prochaska 1984).

The short version of the POMs scale has been shown to be either similar or have higher coefficient alphas than the original (Curran, Andrykowski, & Studts, 1995). The POMs shortened version is a 37 item scale using a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely) (Shacham, 1983) and has coefficient alphas ranging from .87 to .90 (Curran, Andrykowski, & Studts, 1995). The short version was used in the study.

3.2.5 Physiological Measures.

Blood pressure and heart rate were used as a proxy for measuring a reduction or increase in stress and overall well-being. They have been used to measure physiological signs of well-being in several studies comparing participants' exposure to urban and forest environments (Parks et al., 2008; Park et al., 2010; Horiuchi et al., 2013; Tsunetsugu et al., 2013). Heart rate

and blood pressure are part of the autonomic nervous system which can show unconscious changes in stress levels based on how high or low both physiological measures are.

3.2.5.2 Blood pressure.

Blood pressure was measured using a digital blood pressure cuff on the participant's upper arm as was done by Horiuchi et al. (2013). There must be a difference of 10 mm Hg for the blood pressures to indicate significance as this difference in blood pressure is associated with a mortality hazard (Agarwal, Bunaye, & Bekele, 2008)

3.2.5.3 Heart rate.

A digital heart rate monitor was used to measure heart rate as it is simple to use and there is little training required to take the measurements.

3.2.6 Nature Relatedness.

The Nature Relatedness (NR) scale indicates an individual's connection to nature. It is a self-reported questionnaire based measure that assesses the affective, cognitive, and physical relationship people have to the natural world. It is a list of statements such as: "humans have the right to use natural resources any way we want". It was developed to assess an individual's NR and help examine relationships between NR and environmental behaviors, attitudes, and personality (Nisbet et al., 2009). It is related to environmental activism, but it measures more than activism. It was devised because no scale existed within the environmentalism and

ecological worldview research literature that held all the elements Nisbet et al. (2009) considered important for measuring the human-nature relationship.

NR is considered to be a trait that is generally stable over time, although it can fluctuate (Nisbet et al., 2009). It is an interpretation of the self that includes the natural world and indicates an individual's appreciation and understanding of nature (Nisbet et al., 2009). It illuminates an individual's understanding of aspects of nature, and includes the unpleasing and non-aesthetically appealing ones (Nisbet et al., 2009). The NR questionnaire was developed to assess these aspects of individuals and is similar to the *Connection to Nature Scale* (CNS) developed by Mayer and Frantz (2004), however the NR questionnaire draws out the physical aspects of human-nature relations (Nisbet et al., 2009). Clayton (2003) also developed a scale to assess self-identification with the environments using the *Environmental Identity Scale* (EIS), but it does not provide measures on experiences and emotions individuals feel related to nature (Nisbet et al., 2009).

The NR scale uses aspects from other environmental scales because Nisbet et al (2009) felt it would reduce the quality of the scale had they not added some elements that measure concern for and behavior toward the environment. Because of this, the NR scale is closely correlated to other environmental measures; however there is enough difference between the NR scale and other environmental measures to make the NR scale able to be differentiated (Nisbet et al., 2009).

The NR scale is a 21 item scale with three different sub-scales: NR- Self with questions like "my relation to nature is an important part of who I am," and "I am very aware of environmental issues"; NR-Perspective with questions like "animals, birds, and plants have fewer rights than humans," and "some species are just meant to die out or become extinct"; and

NR-Experience with questions like "I enjoy being outdoors, even in unpleasant weather", and "I don't often go out in nature" (Nisbet et al., 2009). The 21 items full scale had a Chronbach's alpha of .87. The NR test-retest correlation over a 6-8 week period was .85. The total NR is internally consistent and temporally stable (Nisbet et al., 2009).

The NR scale also has a short version with only 6 items and is ideally suited for field studies. It has a Chronbach alpha range of .85 to.89 and was strongly correlated with the 21 item NR scale (Nisbet & Zelenski, 2013). Given that participants had a number of other scales to complete, and this was a field study, the 6 item NR scale was the best option for this study. Its use reduced the time required for the survey to be filled out and thereby reduced participant's fatigue that can contribute to error variance (Gravetter & Forzano, 2012).

3.3 Procedure

3.3.1 Phase 1.

A presentation (Appendix D) was made in September 2014 to recruit undergraduate participants from three University of Waterloo courses: REC 100 Introduction to the study of recreation and leisure studies, REC 334 Introduction to park management, and REC 401 Advanced Seminar on the Socio-Cultural and Behavioral Dimensions of Leisure. The presentation outlined what the experiment was about and its importance, and explained what would be required of the participants. Students interested in participating provided their name, email address, and the date they would be available in the study period on cards (Appendix E) that were collected by the researcher at the end of the class. Students were also provided with the name and email address of the researcher, so they could register for the study at a later date. A

follow up email (Appendix F) was sent providing a confirmation of the date, time, and location of their appointment. The email also asked for their cell phone number and permission to send text messages as reminders. Participants were sent an email or a text message as a reminder the day before (Appendix G), and one hour before the appointment if a phone number was provided (Appendix H).

3.3.2 Phase 2.

Participants were tested in groups of two and baseline (indoor) measurements were taken before participants were exposed to the exterior environments, built, forest, and forest with stream, which were randomly assigned to them. The random assignment controlled for variables such as weather and time of day, which may affected feelings of well-being (Nisbet et al., 2010). Participants were tested in groups of two in the different environments with four test periods per day, for eight weeks. The total time of participation was around 2 hours with each participant experiencing each environments for 20 minutes.

The participants were met at a classroom where they were given an informational pamphlet on the study (Appendix I). During this session, the study was also explained verbally. They were then asked to sign a consent form (Appendix J) confirming that they understood the requirements of the study and were still willing to participate. The participants were then given a self-administered pencil and paper questionnaire package related to well-being with the measures of happiness, vitality, mood state and NR. This package also had demographic characteristic questions for the first and only time in the questionnaire package (Appendix K). After completion of the questionnaire, the heart rate monitors were explained to the participants and they were instructed on how to attach it to their torso. They were then informed of the location of

the washroom where they had the privacy to put on the heart rate sensor. The heart rate monitoring system was then tested. The participants were given a short break of about 5 minutes to ensure the participant's heart rate and blood pressure returned to its resting level, so heart rate and blood pressure readings could be recorded as a baseline measure. The blood pressure and heart rate monitors were sanitized before each use, using sanitizing wipes to ensure cleanliness. The results collected in this stage were used as a baseline measure to compare to results from the different environments.

3.3.3 Phase 3.

The researcher then walked the participants to the site for which they were randomly assigned. A coin flip was completed before the participants entered the room in order to determine whether they would be sent to the urban or forest environment first. Another coin flip was completed to randomly assign which forest environment the participants were taken to forest only or forest with stream. The act of flipping a coin to decide on the location the participants were assigned is done to prevent biases in location selection through randomization of assigning the location. The students were then escorted to their assigned environment and asked to sit for 20 minutes in a chair and absorb the atmosphere (sights, sounds, smells) of their environment. This followed the methodologies of other similar studies (Park et al, 2011; Tsunetsugu et al, 2007; Parks et al, 2008). Questions of what they noticed in the forest and built environment were used to ensure the students were engaged with their surroundings. Some examples of the questions were "can you identify any of the trees around here?", "have you seen this leaf? Have you ever seen this type of fungus reaction to other plants?", and "look at all the bikes on the bike rack, do you think there is a patterns of how the bikes are locked up (i.e. more expensive ones in

the front?).”Participants were asked to provide their blood pressure and heart rate after the 20 minutes passed and then the questionnaire package (Appendix L) was completed again, but this time without the demographic characteristics.

Once the questionnaires were completed and the heart rate and blood pressure measures were taken, the participants were escorted to the second environment. The participants again sat for 20 minutes and then filled out the questionnaire package (Appendix L) and had their blood pressure and heart rate recorded. The study ended with a debriefing on the experiment and participants were given the opportunity to ask question. They were either given or sent an email with a feedback letter containing more information on the study (Appendix M) and again asked if they had any further questions regarding the study. Participants were then asked if they would like to receive a summary of the study results by email and were thanked for their participation.

3.4 Analysis

The different environments were compared using analysis of variance (with repeated measures) and the following dependent measures were analyzed: the PANAS scale, POM scale, NR scale, Vitality Scale, Overall Happiness scale, heart rate, and blood pressure. The changes in the participant’s feelings of well-being were assessed across the four environments; baseline, built, forest, and forest-stream. After the overall ANOVA is shown to be significant, planned comparisons were made to determine which environments provided the greatest positive change in well-being. Partial eta-squared was used to assess the variance in the effect of the dependent measures. The larger the value eta-squared is “the more variance the effect explains in the dependent variable” (Yockey, 2011, p.135).

Confidence intervals were also calculated for each dependent measure in order to help illustrate the changes seen across each environment. Finally, correlation coefficients were used to see if the dependent measures were correlated with each other and to make sure none of the well-being measures measured the same well-being indicator.

CHAPTER 4- RESULTS

The results from the analyses showed a statistically significant difference in the psychological measures of well-being following exposure to the indoor, built, and forest environments. The physiological measures of heart rate and systolic blood pressure showed changes between the environments, while the diastolic blood pressure did not. The dependent variables being used as indicators of well-being included: the Vitality Scales, Positive Negative Affect Scale, Overall Happiness Scale, Profile of Mood Scale, Nature Relatedness Scale, heart rates, systolic and diastolic blood pressure. *F*-tests and confidence intervals were used to compare the means across the environments. The analyses show that not all measures change over the four environments, but there were consistently lower scores on positive indicators of well-being in the built environment. There was also no statistically significant difference between the forest and the forest-stream environment across all measures. Given the lack of difference between the forest and forest-stream environments the data were collapsed into the forest environment category for all further analyses.

It was expected that the indoor environment would generate the lowest scores from the well-being indicators as the participants in this environment were completely isolated from the natural world, and as Nisbet et al. (2011) and Ulrich (1993) indicate, nature is necessary to help increase well-being. Nisbet and Zelesnki (2011) provide evidence that outdoor urban environments increase well-being to a greater extent than indoor environments. The built and forest environments were therefore expected to have a positive effect on the well-being indicators. However, the forest environment was expected to have an even greater impact on the well-being indicators over the built environment as forests have been shown to provide more positive well-being results than outdoor urban environments (Park et al., 2010). The forest-

stream environment was expected to have the greatest impact on well-being over all three of the environments because it contained a water feature that was expected to relax participants and provide a more preferable space. Finally, it was expected that Nature Relatedness (NR) would rise as the participants experience a progressively increasing exposure to nature in this order: indoor, built, forest, and forest-stream in unison with the well-being indicators.

The first section of the results presents the demographic characteristics of the sample in a series of tables followed by the analysis of the forest and forest-stream environments, which showed no statistically significant difference between these environments. The following sections will discuss each well-being indicator in the order of POM, heart rate, OHS, affect, vitality, NR, and blood pressure. Each section compared the respective dependent measures across the three environments: indoor, built, and forest. There is a pattern with/in each of these variables showing that they increase in the direction of well-being as participants are exposed to the forest environment with measures generally at their highest within this environment. The final section presents a series of follow up analyses designed to address specific questions.

4.1 Demographic characteristics

The next section is a series of tables that displays the demographic characteristics of the 150 participant sample. The demographic questions were included in the first questionnaire package participants completed. The tables present the frequency of response for each category within each question.

Table 2

Demographic of males and females

Sex	Frequency
Male	61
Female	93
Total	154

Table 3

Demographic of age

Age	Frequency
17	5
18	30
19	45
20	25
21	18
22	16
23	9
24	5
25	1
43	1
Total	155

Table 4

Demographic of the cities participants grew up in

City Name	Frequency
Toronto	6
Richmond Hill	4
Vaughan	2
Markham	4
Mississauga	5
Kitchener/ Waterloo	7
Other	34
Total	62

Table 5

Participants' level of education

Level of education	Frequency
Undergraduate	149
Graduate	4
Other	1
Total	154

Table 6

Demographic of sick participants

Feeling healthy?	Frequency
No	9
Yes	145
Total	154

Table 7

Demographic of the cultural backgrounds of participants

Cultural background	Frequency
Western	92
Asian	41
African	5
Other	9
Total	147

Table 8

Demographic of where the participants grew up

Spent childhood in	Frequency
Urban center	54
Suburbs	71
Country/Rural	28
Total	153

Table 9

Demographic of the type of building participants lived in growing up

Building lived in during childhood	Frequency
House	137
Apartment	16
Other	1
Total	154

Table 10

Demographic of participants who live within walking distance of a park or forested area

Live within walking distance of a park or forested area	Frequency
Yes	142
No	11
Total	153

Table 11

Demographic of participants who pass parks or forest environments areas everyday

Do you get exposure to a natural environment everyday (park or forest)	Frequency
Yes	108
No	45
Total	153

Table 12

Demographic of programs being attended by participants

Program Attending	Frequency
Environment/Parks	22
Geography	3
RLS	52
Science	39
Math	4
Arts	14
Other	20
Total	154

Table 13

Demographic of participants who enjoy being in nature

Enjoy nature?	Frequency
Yes	148
No	6
Total	154

Table 14

Demographic of how much of participant's free time is spent outside

Amount of free time spend outside	Frequency
Less than 25%	74
26-50%	63
51-75%	16
Greater than 75%	1
Total	154

Table 15

Demographic of activities participants were most interested in

Activity most interested in doing	Frequency
Walking in downtown center	33
Walking through neighborhood	10
Walking through park	31
Walking in forest	79
Total	153

Table 16

Demographic of activity participant was most interested in

Which place do you feel most comfortable	Frequency
Downtown center	18
A neighborhood	38
An open park	56
A small forest	41
Total	153

4.2 Comparison of Forest and Forest-Stream Environment

Before proceeding to the analyses of the four environments, statistical tests were conducted to determine whether there was an actual difference in effects across the forest and the forest-stream environment. Several authors indicated that water in the environment would positively impact the subjective well-being. The biophilia hypothesis suggests environments with

more competitive advantages such as water might have a positive effect (Ulrich, 1993; Herbert, 1981; Velarde, Fry, & Tveit. 2007; Kaplan and Kaplan. 1989). However, in the present study, the forest-stream environment did not show any statistically significant differences with the forest environment across the psychological and physiological measures as shown in the confidence intervals presented in Figure 1.

The heart rate and blood pressure of each participant were also expected to change between the forest and forest-stream environments because the stream's murmur was expected to reduce distress in the participants (Mishima et al. 2004). Heart rates, measured in beats per minute (BPM), were slightly lower in the forest environment over the 20 minutes of exposure (5min=74.63, 10min=71.24, 15min=69.39, 20min=68.94) than the forest-stream environment (HR BPM 5min=75.8, 10min=72.79, 15min=71.65, 20min=70.35), however not significantly lower to indicate any possible relaxation differences. Similarly, the blood pressure measures did not show any significant differences between the forest and forest-stream environments. Given these results, the forest and forest stream environments were collapsed to create the environment "forest" which will be used for all further analyses.

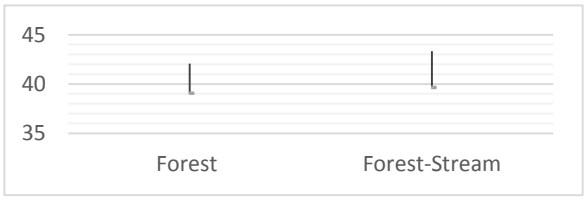
Graph A Vitality

Graph B Positive Affect

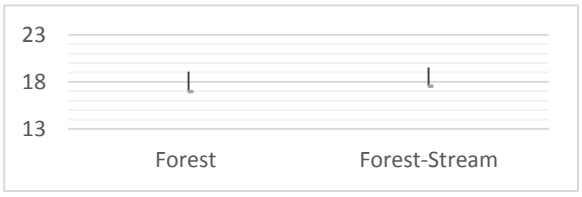
Graph C Negative Affect

Graph D Overall Happiness

Graph E Profile of Mood



Graph F Nature Relatedness



Graph G Heart Rate

Graph H Systolic Blood Pressure

Graph I Diastolic Blood Pressure

Figure 2. Graphs of confidence intervals for dependent variables from the forest and forest-stream environments.

4.3.1 Overview of ANOVA results.

Table 17 presents the indicators of well-being as they changed across the different environments. It also presents the significance of the mean changes in the environments. Each measure of well-being is discussed further in their own sections bellow Table 17.

Table 17

Analysis of variance results across the three environments

Measures	Indoor	Built	Forest	*F*	*Eta*
Profile of Mood	48.5_1	44.4_1	40.9_3	98.28**	0.414
Heart Rate	75.24_1	68.8_2	66.97_3	129.99**	0.473
Overall Happiness	74.2_1	75.6_1	79.5_2	29.13**	0.193
Positive Affect	30.8_1	26.8_2	30.2_1	42.66**	0.230
Negative Affect	13.22_1	11.37_2	11.18_2	52.81**	0.267
Vitality	20.6_1	18.5_2	20.6_1	30.21**	0.175
Nature Relatedness	17.1_1	16.7_1	18.2_2	24.39**	0.146
Systolic Blood Pressure	120.19_1	116.97_2	117.68_2	7.7**	0.05
Diastolic Blood Pressure	72.43_1	73.45_1	73.53_1	1.472	0.01

For the *F*-test the *df* were 2 and ranged between 139-155. The "*" indicates the number of zeros recorded from the significance tests *P>0.05* * and *P>0.00*** Subscripts that are similar show no significant difference between the means while means with different subscripts are statistically different from each other.

4.3.2 Profile of Mood.

The Profile of Moods (POM) scale showed statistically significant differences between the three environments, as shown in Table 17 (POM $F(2, 139)= 98.28$, $p<0.000$. The result is further demonstrated in Figure 3, which shows no overlap between confidence intervals. Overall, mood improved from the indoor environment to the built environment to the forest environment.

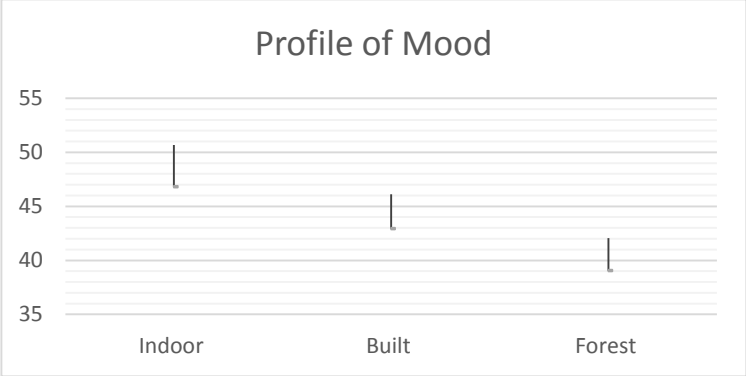


Figure 3. Profile of Mood Scale confidence intervals.

4.3.3 Heart Rate.

Heart Rate (HR) showed statistically significant differences between the three environments (as shown in Table 17 $F(2)= 129.99$, $p<0.000$) with no overlap between the confidence intervals as shown in Figure 4. HR showed small changes in the participant's stress across the environments following a similar pattern to the POM, decreasing during the exposure to the built environment and further still, with exposure to the forest environment as expected.

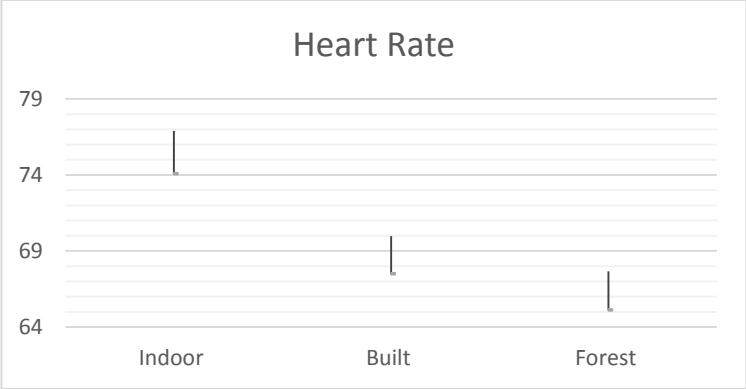


Figure 4. Heart rate confidence intervals.

Heart rate was also measured at four intervals during the outdoor environment tests. With a measurement (Table 18) showing the changes every 5 minutes during the 20 minutes spent in each environment. The changes over time in heart rate between the built environment and the forest environments are displayed in Figure 5. Forest heart rate and the built heart rate measures both start at 75 BPM. However, for the participants in the forest environment, their heart rate decreased to 69 BPM, while in the built environment heart rate decreased to 72 BMP. This indicates that the forest environments were more effective at lowering individual's heart rates, than simply being outdoors. Differences in heart rates at each time period were also compared in Table 18, with significant differences between the environments starting at the 10 minute point.

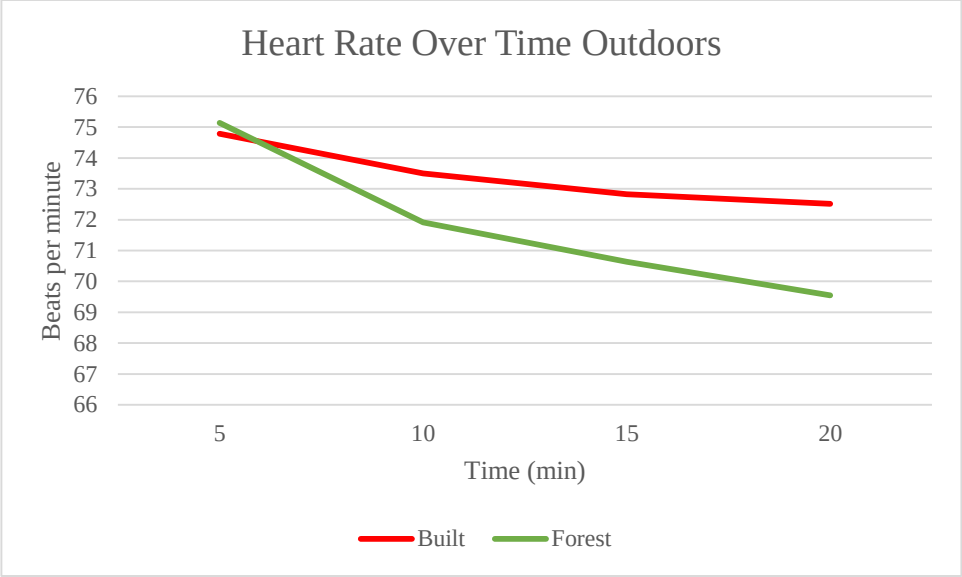


Figure 5. Heart rate over time in the outdoor environments.

Table 18

Paired sample t-tests comparing mean heart rates in the built and forest environments

	Built	Forest	T-test	Degrees of freedom
5 minutes	74.91	74.89	0.28	148
10 minutes	73.54	71.67	2.84*	148
15 minutes	72.88	70.36	4.18**	148
20 minutes	72.46	69.24	5.09**	148

The "*" indicates the number of zeros recorded from the significance tests $P>0.05$ * and $P>0.00$**.

4.3.4 Overall Happiness Scale.

The Overall Happiness Scale produced a significant difference between the environments, ($F(2)=29.13$, $p<0.000$) as indicated in Figure 6 and Table 19. As predicted, the highest level of overall happiness across the three environments was shown to be in the forest

environment. It is interesting to note that while there is overlap in the confidence intervals for the indoor and built environments, suggesting no significant difference, the built environment produced is slightly higher levels of happiness than the indoor environment. This indicates that the built environment is slightly better at increasing happiness. Figure 6 depicts a trend of increasing happiness as measured by the OHS when participants moved from the indoor environment to the outdoor built environment and then to the forest environment. This is consistent with the literature on outdoor environments and also with what was found for the POM scale and the HR measures.

The OHS results were replicated through an analysis of a POMs subscale item "unhappy" which ranged from 1(lowest) to 5 (highest) as shown in the POM scale in Appendix K and L. The mood "unhappy" across the environments shows the opposite pattern to the OHS as expected. Participants indicated they were least unhappy in the forest, then the built environment and finally most unhappy in the indoor environment. This provides evidence that the OHS was measuring each individual's level of happiness accurately and further indicates that the forest environment is the best place to raise happiness levels.

Table 19

Frequency of the Feeling state 'Unhappy'

Environment	Indoor	Built	Forest
Number of participants feeling unhappy 'not at all' or 'very little'	146	151	149
Percent	94.2	97.4	96.1

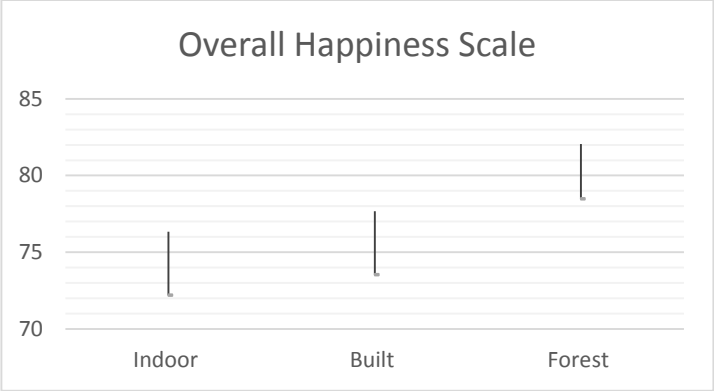


Figure 6. Overall Happiness Scale confidence intervals**.**

4.3.5 Affect.

Positive affect was shown to be significantly different across the environments as shown in Table 17. The confidence intervals (Figure 7) show that in the built environment positive affect was felt significantly lower than either the indoor or forest environment. Overall, the forest and the indoor environments show increased positive affect.

Negative Affect (NA) also changed over the three environments (see Table 17) $F=$ (2) 52.81, $p<0.000$. The built and the forest environment show the expected pattern with the two outdoor environments producing the lowest NA across the three environments as shown by the confidence interval graph in Figure 8. It was also expected that the forest environment would reduce NA to a greater extent than the built environment, however this was not the case, even with the slightly decreased NA in the forest over the built the amount is insignificant.

The best result for an affective state in terms of well-being is a higher PA (excitement, interested and inspired feelings) with lower NA (distressed, upset, and irritable feelings). With this in mind the results show (Figure 7 & 8) high PA and high NA for the indoor environment

and low PA and low NA for the built environment. Neither of these results are desirable. However, the forest produced a balance in affect with one of the highest levels of PA and one of the lowest levels of NA indicating high excitement, interest and inspired feelings with low distress, upset, and irritable feelings.

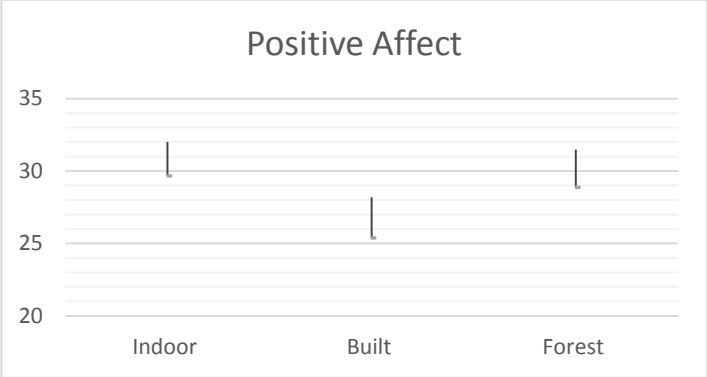


Figure 7. Positive affect confidence intervals

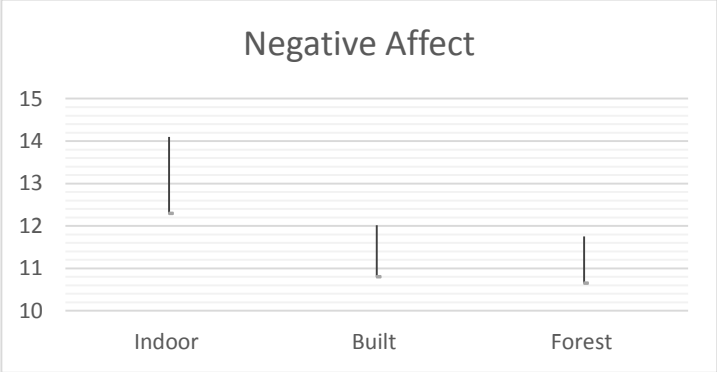


Figure 8. Negative affect confidence interval

4.3.6 Vitality.

The Vitality Scale produced statistically significant differences between the three environments as shown in Table 17 and Figure 9. Figure 9 shows the built environment

decreased the level of vitality felt by the participants relative to the indoor and forest environments which had significantly higher levels of vitality. The confidence intervals in Figure 9 also shows the forest environment to have produced slightly higher vitality levels than the indoor environment, while not significantly different, as indicated by the overlap in confidence intervals, a small increase is there. Across the three environments, the built environment had the lowest vitality levels while the forest and the indoor had the highest. This is interesting because the indoor environment was the baseline measure, meaning the built environment lowered the level of vitality and the forest environment either maintained or increased the feelings of vitality.

Figure 9. Vitality scale confidence intervals.

The results of the Vitality Scale did not produce the results expected, so feeling states from the POM scale were used as a reference to indicate whether vitality actually changed within the individuals in the different environments. The negative feeling states of tension, fatigue, exhaustion, and weariness were expected to lessen as the vitality levels increased. This means that in the indoor and forest environment there should have been a small amount of negative feeling. This was then expected to increase in the built environment as the level of vitality fell. Table 20 shows the number of participants that felt the negative feelings states either “not at all” or “a little”. This was because these were the only two categories that had a significant number

of participants who filled out these answers. All other categories indicating amounts of the feelings such as “moderate” or “extremely” were not used.

Table 20

Percentages of participants who indicated ‘not at all’ or ‘a little’ selected mood states

	Indoor	Built	Forest
Tense	88.3% (n=136)	94.1% (n=143)	98.6% (n=149)
Fatigued	58.4% (n=90)	75.6% (n=115)	82.1% (n=124)
Exhausted	70.8% (n=109)	75.7% (n=115)	84.1% (n=127)
Weary	83.7% (n=129)	89.5% (n=136)	92% (n=139)

“n” is the number of participants responding to this category.

Table 20 shows that more participants did not feel tense, fatigued, exhausted, and weary as they were exposed to greater amounts of nature in the order of the built and forest environment. This indicates that the expected trend that more participants would indicate feeling less tired and tense as they moved from indoor to the built environment and then from the built to the forest. However this does not correlate with the Vitality Scale results as the participants indicated feeling greater levels of vitality indoor and lower levels of vitality in the built environment contrary to what is indicated with these feeling states.

Another indicator feeling state that is related to vitality is the feeling of peppiness (Watson & Tellegen, 1985). It was assessed with the POM scale. Table 21 shows the number of participants who indicated feeling this feeling state as ‘quite a bit’ and extremely as the other

categories such as ‘moderate’ did not represent a significant number of the sample. The level of pep went up as expected by the study in the order of the indoor, built, and forest environments however these results again do not match the Vitality Scale results. This indicates that there may have been something wrong with the use of the Vitality Scale or the methodology used to gather this data.

Table 21

Frequency of feeling state ‘Full of Pep’

Environment	Indoor	Built	Forest
Number of participants feeling full of pep not at all or very little	18	21	31
Percent	11.8	12.8	20.5

Many of the participants indicated their excitement to start the study. This may be able to explain the high levels of vitality recorded in the indoor environments. This can be verified through an analysis of how much energy the participants felt throughout their participation in the study. The POM scale assessed the feeling state “energized” which was used to analyze how much energy the participants felt throughout their participation in the study. Table 22 shows the number of participants indicating they felt this feeling ‘energized’ “quite a bit” or “extremely”. The results from this table show the expected higher levels of energy in the indoor environment, which then were decreased in the built environment and then raised in the forest environment. This helps substantiate the hypothesis that the participants indicated a higher level of vitality indoors than what would actually be felt in the indoor environment.

Table 22

Frequency of feeling state 'Energized'

Environment	Indoor	Built	Forest
Feeling "Quite a bit" and "Extremely"	54	39	62
Percent	35	25.6	41

4.3.7 Nature Relatedness.

Nature Relatedness was highest (18.2) in the forest environment, and significantly different from the indoor and built environment ($F(2)=24.39$, $p<0.000$) as shown in Table 17. It is important to note that even though no statistically significant difference was found between the indoor and the built environment, NR was slightly higher in the indoor environment compared to the built environment (Table 17 and Figure 10). This was not expected as NR relates to how close to nature one feels. It would thus be reasonable to assume that NR scores in the indoor environment—a classroom that had no direct connections to the outdoors and contained no windows or pictures of the outdoors—would be lower than NR scores for the built environment, which placed the students outdoors connecting them to the natural weather, views of grassland, and small trees in the distance.

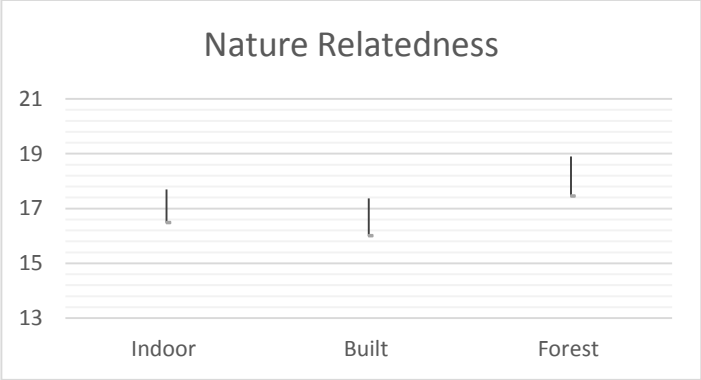


Figure 10. Nature Relatedness confidence intervals.

4.3.8 Blood Pressure.

As shown in Table 17, Systolic blood pressure (SBP) produced a statistically significant difference across the three environments. Figure 11 shows a significant decline in SBP in the two outdoor environments built and forest as compared to the indoor environment.

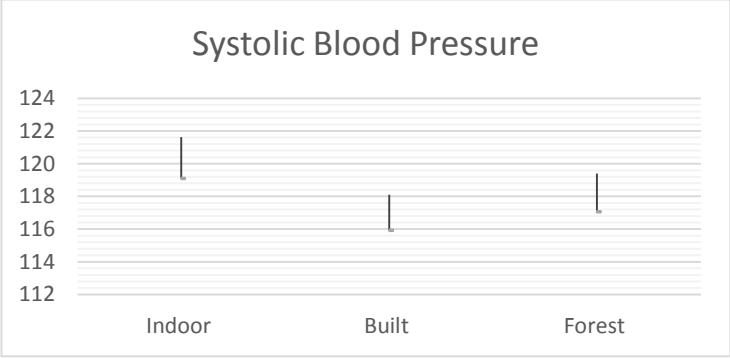


Figure 11. Systolic blood pressure confidence interval.

While many of the well-being indicators showed a difference across the environments, diastolic blood pressure (DBP), as shown in Table 17 and the confidence intervals in Figure 12, did not change. No difference was found between DBP in the three environments, though there was a trend in the DBP increasing as the participants were exposed to the indoor, built, and forest environments. These results indicate that the environments had little effect on blood pressure.

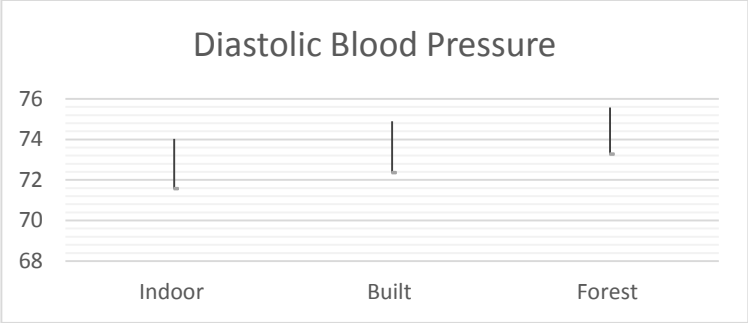


Figure 12. Diastolic blood pressure confidence interval

4.4 Other analysis

A possible issue with respect to the built environment was that participants might have experienced negative feelings associated with other people moving through the area. Ulrich et al. (1991) has noted that increased numbers of people may cause stress in individuals. A significant amount of people unrelated to the study were in the built environment, so there was the potential that the extra people could have distracted the participants or affected stress levels. It must be noted that this was the only environment with unexpected reductions in well-being. To test for this possible confound, results were analyzed from morning periods, when many students were present in the built environment and afternoon periods when few students were in the built environment. Results from this test indicate that no statistically significant difference was found between morning experiment experiences and afternoon experiment experiences across all the variables. It is therefore assumed that the increase in student traffic in the built environment had little effect on participants' indicators of well-being.

4.4.2 Correlations.

Correlations were calculated for the built and the forest environment variables to see if there were differences between the measures of well-being and the environments they were assessed in. Table 23 shows the results with the built environment correlations above the diagonal and the forest environment correlations below the diagonal.

The results show how the dependent measures related to each other. Table 23 shows that most of the variables were moderately inter-correlated which was expected as they measure similar concepts. However, heart rate was highly uncorrelated with all the measures, which means it measured something completely different than the psychological measures as expected.

Table 23

Correlation coefficients of indoor and forest environment well-being variables

	Profile of Mood	Heart Rate	Overall Happiness Scale	Affect	Vitality	Nature Relatedness
Profile of Mood	1	-0.15	-0.458**	-0.671**	-.626**	-0.154
Heart Rate	0.06	1	0.025	-0.124	-093	-0.131
Overall Happiness Scale	-.438**	0.094	1	.420**	.443**	0.272**
Affect	-.665**	-.202*	.326**	1	.766**	.329**
Vitality	-.562**	-0.105	.399**	.751**	1	.363**
Nature Relatedness	-.214**	-0.126	.199*	.467**	.461**	1

The built environment correlation coefficients are above the diagonal and the forest environments coefficients are bellow.* indicates a significant correlation at the 0.05 level (2-tailed) and ** indicates a significant correlation at the 0.01 level (2-tailed)

4.4.3 Ethnicity.

Ethnicity of individuals has been shown to be a factor in perceptions of surroundings and may have an impact on how well-being increases or decreases based on the environment. An analysis using a two way ANOVA showed that there were no significant differences between individuals who described their cultural background as Asian and those who described their cultural background as Westerners or Caucasian. These were the only ethnicities analyzed because they were the only categories with significant numbers Westerners (84) and participants of Asian descent (38). None of the indicators of well-being showed a statistically significant difference between Western and Asian individuals. The only noteworthy result regarding ethnicity was that in all cases the Asian participants rated their well-being indicators lower than the Western participants. For example, the POM means were: Western (mean=43.21), Asian (mean= 45.96); and positive affect means were: Western (mean=30.65), Asian (mean=26.94). However, they both follow the same pattern with increases and decreases with in the environments.

CHAPTER 5- DISCUSSION

The purpose of the study was to explore the impact of experiences in four urban environments on well-being with the expectation that a forest environment would produce the greatest sense of well-being. All of the psychological well-being indicators showed a significant difference between the three environments. This means that the environments had an effect on the participant's levels of vitality, positive affect, negative affect, overall happiness, mood, and nature relatedness. Heart rate was the only physiological measure that showed a significant change between the environments as both blood pressures measures showed no meaningfully significant changes.

The indoor environment was expected to provide the lowest levels of well-being between the three environments (Ulrich, 1993; Nisbet & Zelesnki, 2011). The outdoor built environment was expected to have a slightly more positive impact on the well-being indicators over the indoor environment (Nisbet & Zelenski, 2011; Nisbet et al., 2011), and the forest environment was expected to increase the well-being indicators to an even greater extent than the outdoor built environment and the indoor environment (Nowak et al., 2001; Lohr & Pearson-Mims. 2006; Park et al., 2008). Finally the forest-stream environment was expected to produce the greatest sense of well-being because of the sight and sounds of the water in the area (Ulrich, 1993; Mishima et al,. 2004; Herbert, 1981; Velarde, Fry, & Tveit. 2007; Kaplan and Kaplan. 1989).

While some of the indicators of well-being showed the expected result of a positive increase across the indoor, built, and forest environment not one indicator showed a significant difference between the exposure to the forest and forest-stream environment. However, almost all of the well-being indicators showed the expected change between the built and the forest

environment where the forest environment produced more positive results from the measures. Furthermore some indicators showed little change between two of the three environments, indicating some of the environments are similar in the way they affect well-being. For example the indoor and the forest environments produced similar well-being results for the Vitality Scale and Nature Relatedness (NR) scale. These measures were analyzed and potential explanations for why this might have happened will be discussed in the following.

The following section discusses the results of the study beginning with an explanation as to why the forest-stream environments may have not had a significant impact on the well-being indicators over the forest environment. Results for each dependent measure will then be discussed in the order of the Profile of Mood scale, heart rate, Overall Happiness Scale, Nature Relatedness, Vitality Scale, Positive Affect Negative Affect Scale, and blood pressure. The Other Analysis, in the results section will then be discussed followed by a discussion of the results related to research hypothesis. The scholarly contributions of the results is then discussed with a final section regarding the implications of this research related to the biophilia hypothesis and leisure studies.

5.1 Water improving well-being

Given the literature on how water may impact well-being, the study explored whether increases in well-being are attainable with exposure to a small audible stream. It was expected that the forest-stream environment would result in the greatest increases in the well-being indicators, but the results showed little to no change between the forest and forest-stream environment, which were the same environment except for the stream adding visual and auditory stimulation in the forest-stream environment. Studies conducted on the effects of water and well-being show only small changes in positive health effects (Velarde, Fry, & Tveit, 2007), so there

was a chance that there would be little effect on well-being with this manipulation. Kaplan and Kaplan (1989) also did not show any changes in well-being from their studies on preferences for nature, but they did provide literature on a number of studies that indicated people have a strong preference for environments with water elements in them. Perhaps contrary to what Kaplan and Kaplan (1989) indicate, preference is not enough to increase the thriving potency of organisms, or perhaps the measures used in this study were not able to capture the value added by the actual presence of the water.

There was also evidence from other studies that the sound of a stream murmur would have relaxing effects on the participants, so heart rate and blood pressure were expected to decrease (Mishima et al., 2004). However, there was no statistically significant difference between the blood pressures and heart rate from exposure to the forest and forest-stream environments. This indicates that either there were other factors impacting the effect of the stream murmur. It is also possible that the effect could not be demonstrated within the framework of this study. One factor that could have impacted the stream's effect was the high traffic road near the study site resulting in loud sounds from cars, trucks, and motorcycles that may have interfered with the water sound, an effect common in urban environments. For example Ulrich (1991) noted that sounds have the ability to cause stress and poor mental health. In addition, Monahan and Vaux (1980) studied the sounds from automobiles and their effects on mental health. They showed that these sounds have the ability to increase aggressive behavior, tension, depression, and anxiety. Chu, Thorne, and Guite. (2004) also noted that noise can lead to suboptimal well-being. Taken together, this literature may help explain why the participants, who were exposed to the sound of a stream murmur, did not show increases in the well-being measures as had been found by Mishima et al. (2004) in their lab experiment.

5.2 Well-being indicators that changed over each environment

The indicators of well-being that changed over the three environments were the Profile of Mood (POM), and heart rate. The POM scale had been used in many other studies on forest therapy and the effect forests have on individuals (Parks et al., 2007; Tsunetsugu, Park, & Miyazaki, 2010; Horiuchi et al., 2013). These studies were all conducted in large rural forests and it was predicted that the therapeutic effect of the large forests would extend to urban forest environments. The POM scale was able measure the impacts of the different environments on the participants mood changes, showing that as the participants moved from the indoors to the outdoor environments there was a decrease in negative moods. From there, the participant's negative moods decreased further still through their exposure to the forest environment, as previous forest therapy research has shown (Park et al., 2007; Tsunetsugu et al., 2010). Nisbet et al (2011) indicated, there is the potential for nearby nature, such as the forest environment, to be used to overcome negative emotions. The decrease in negative emotions confirms that an urban forest helps with negative moods and thus helps increase subjective well-being.

Heart rate, used as an indicator of stress, also changed in each environment. As expected, based on the biophilia hypothesis (Ulrich, 1993) and the forest therapy studies (Park et al., 2007; Tsunetsugu et al., 2013), there was a downward trend in the heart rate levels from the indoor to the built and from the built to the forest with the lowest heart rate recorded in the forest environment. This indicates that in terms of heart rate the forest produced the most relaxing environment. This result is confirmed though the analysis of heart rate over time in the built and forest environment. As Figure 5 showed, over the 20 minutes spent in the two environments heart rate declined in both, but declined faster, and ended lower, in the forest environment. This was expected as Ulrich et al. (1991) concluded views of nature allows people faster stress

recovery time than urban landscapes. These results suggest that well-being (reduced heart rate) can be improved by taking short breaks in a forest, or even, in an outdoor urban environment.

The study demonstrates that, as with the larger rural forests used in forest therapy studies, small urban forest environment can improve well-being as measured by heart rate and mood. The results also corroborate the biophilia hypothesis which states people feel more relaxed in environments that are closer to a natural environment.

5.3 Measures that changed in one environment

The results from the Overall Happiness Scale (OHS) indicate that hedonic well-being, as it pertains to happiness, can be improved through greater exposure to nature. The OHS showed a positive, statistically significant difference for the forest environment over the built environment. There was also a slight increase from the indoor environment to the built environment in happiness, however it was not large enough to be statistically significant. This trend was replicated with the POM scale analysis of the "unhappy" feeling state. The feeling of unhappiness decreased though exposure to the built environment and decreased further still in the forest environment. The OHS and the analysis of the POM 'unhappy' feeling shows that the forest environment produced the greatest amount of happiness in participants. The greater level of happiness felt in the forest environment is explained by Nisbet et al. (2011) and Nisbet and Zelenski (2011) who noted in their studies on nearby nature that a greater connection to nature, such as being outdoors, has a positive relationship with happiness.

The PANAS scale showed high levels of positive affect in the indoor environment and in the forest environment, while showing low levels in the built environment. This unexpected high positive affect from the indoor environment is not believed to be caused by the environment, but

by the excitement and enthusiasm the students felt when beginning the experiment. The experimental design needed to account for the feelings felt by participants as they began the study and allowed for a longer period of relaxation before the baseline and indoor environment data (survey packages) were collected. It is likely that this flaw in the study design was causing the higher levels of affect and not the environment. However, while the positive affect was high indoors, so were the negative affect scores, which indicate distress, and subsumes many moods that are lacking positivity (Watson & Clark. 1988). This is reinforced through the POM scale which indicated the highest levels of unpleasant moods in the indoor environment.

Negative affect lessened during exposure to the built and forest environment, suggesting feelings of calmness and serenity (Watson & Clark. 1988). However in the built environment, the positive affect levels were also significantly reduced indicating a reduction in high enthusiasm and alertness. Given these results the built environment produced a more positive environment in terms of calmness, but it also produced an environment with low energy.

Finally when the forest environment is considered for its ability to increase the overall well-being felt, the positive and negative affect results showed significant differences in the direction of the two measures: positive affect went up and negative affect went down. These changes indicate that the forest environment provided feelings of calmness, serenity, energy, full concentration and pleasurable engagement (Watson & Clark. 1988). Therefore the forest environment produced the most positive environment in terms of affect (Park, 2004). These results show the potential for forest environments to increase individual's well-being.

The better affective state was expected in the forest environment as the biophilia hypothesis indicates that there should be a reduction in stress in the forest, and thus an increase in attainable well-being (Laumann et al., 2003; Hartig et al., 1996). While Nisbet et al. (2011)

predicted the change in positive affect as it was expected to be connected with participant's connection to nature essentially measuring biophilia, so it should have also predicted well-being.

The vitality scale also indicated that the built environment produced significantly lower levels of well-being over the indoor and forest environments. This is contrary to the theory that a greater connection to nature (i.e. being outdoors) increases vitality (Nisbet et al., 2011). However the relationship between NR and vitality was reproduced in the study as the levels of NR and vitality were higher in the indoor environment than the built environment and the highest levels for both of these measures were recorded in the forest environment. Vitality is also related to positive affect as it is characterized as a state of enthusiasm, active, and alertness (Watson & Clark. 1988), so it is not surprising that it follows the same pattern as positive affect (low in the built environment and high in the indoor and forest environments).

The higher levels of vitality in the indoor environment can be partly explained by the participant's expectations of the study. The participants may have marked vitality levels higher in the indoor environment because they were responding to experimenter expectations at the outset of the experiment. As the study proceeded, exposure to the built and the forest environments may have reduced the vitality effects of experimenter expectations. This hypothesis is supported by the fact that heart rate, which was less likely to be affected by expectations, declined as predicted in the order of the indoor, built, and forest environment. The vitality levels in the indoor environment can also be explained by looking at the questions on the vitality scale survey. Some questions from the Vitality Scale are how much do you feel (scale of 1 (lowest) to 5 (highest)) "I feel alive and vital", "I feel awake and alert", and "I feel energized". The indoor environment was the first environment that all the participants were exposed to, so it can be assumed that the participants had higher levels of energy at this stage of the study

resulting in the high levels of energy observed. This trend was reinforced by the results that indicated feelings of energetic and full of pep, which followed the Vitality Scale's results indicating that energy levels were very high indoors at the start of the study. It is also important to note that Ryan and Frederick (1997) have indicated that having energy and feeling alive is a good indicator of psychological well-being. This means that many of the participants started off with high psychological well-being which was then lowered in the built environment indicating that built environments are not ideal for improving well-being. Further research is needed to confirm this hypothesis.

Finally many of the participants indicated their excitement in participating in the study and seemed eager to get started. These observations indicate that the students were feeling energized and excited at the beginning of the study, again reinforcing the point that false results of the indoor environments' effects on the participants were gathered and that if the methodology was changed the same environment may not have produced such high levels of vitality.

Vitality was used in the study because it is known to be related to other well-being indicators such as self-actualization, autonomy, and self-esteem, while negatively related to depression and anxiety (Nisbet et al., 2011; Nix et al., 1999). Given the results, the forest environment could be a good place to lower anxiety and depression and thus increase well-being as this environment positively impacted the student's vitality levels by either maintaining or increasing it depending on which environment forest or built they experienced first.

Furthermore while vitality did not show the expected increase over the three environments, there were indicators of tension, fatigue, exhaustion, and weariness that lessened over the three environments indicating a potential increase in energy or vitality as Thayer (1996) describes. This means that while the Vitality Scale did not show the results expected, other

results related to vitality did. Given these findings a more sensitive vitality scale should be used in future research to determine if the expected outcome would be supported. Adjustments to the methodology could also provide time for the initial high energy levels to be decrease allowing for a more accurate baseline measure of the level of vitality.

NR showed an interesting pattern with the highest recorded feelings of NR in both the indoor and forest environments. The indoor environment had the least amount of nature with no connection to the outdoors, including no windows or posters of the outdoors. Given this setting, it was expected that the level of nature relatedness would be at its lowest. However, since the levels of NR were lowest in the built environment it can be suggested that the participants either felt more connected to nature indoors, or there was a problem with the study design. One possible explanation for the results could be the participant's expectations at the start of the study, as was discussed for the Vitality Scale. In general, the outdoor built environment (similar to that of Carleton University's campus used in Nisbet and Zelenski (2011) experiment) and the forest environment (similar to the nearby nature used in Nisbets et al. (2011) experiment) produced higher levels of happiness, affect, and mood, confirming the results of the well-being and NR indicators of Nisbet and Zelenski (2011) and Nisbet et al. (2011).

All of the well-being indicators demonstrated the forest environment was the best environment for increasing well-being. The built environment on the other hand, was shown by most of the indicators of well-being to be the least positive place. Interestingly, this is contrary to Nisbet and Zelski's (2011) study which demonstrated that simply being outdoors can improve happiness and well-being. As previously discussed, the results could have been caused by the substantial amount of people walking around the area. Klopfer and Rubenstein (1977) indicate that privacy is a basic and vital need for people and Ulrich et al. (1991) noted increase

populations may be the cause of increased stress in urban areas. The presence of additional people may have resulted in a reduction in well-being as the indoor and forest environment both provided solitary environments. However, this hypothesis was tested using the data in the study, and well-being was not affected by the presence of people in the outdoor environment. This leads to the conclusion that the built environment was the main factor impacting the indicators of well-being.

Cultural differences were also analyzed to see if they had an impact on how well-being was felt in the different environments. Other studies such as Diener et al. (1995), found that different cultures experience subjective well-being in different ways. However, based on the data collected in this study, there was no significant difference between the two cultural groups, Western and Asian, although there was a small difference in the levels of well-being indicated. Asian participants had slightly lower levels of well-being for every indicator of well-being across all environments compared to the Western participants. However, the Asian and Western participants well-being indicators all followed similar trends in that the levels went up and down in the same environments with the same indicators of well-being. This is similar to the Diener et al. (1995) finding that Chinese individuals reported lower levels of subjective well-being than those of other cultures. To conclude, the well-being indicators did show the forest environment to be the best at improving well-being for both cultures.

5.4 Indicators of well-being that showed no change

Changes in blood pressure, both systolic and diastolic, showed no meaningful difference across the environments. The raw systolic blood pressure data produced a statistically significant difference but, as Agarwal, Bunaye, & Bekele (2008) indicate, there is a need for a change in 10

mmHg to have an impact on well-being. There was therefore, no meaningful impact of the three environments in relation to blood pressure.

In line with the as the studies conducted on shinrin-yoku (Park et al., 2008) blood pressure was expected to change across environments. The lack of meaningful change in blood pressure could indicate that the urban forest is not able to produce the same relaxing effects as the large rural forests used in the Japanese studies, or it could indicate that the time spent in the environments was not adequate to reduce the blood pressure. Further studies are needed to assess the effects of urban forest environments on blood pressure, including extending the time in the forest. However, the small change in blood pressure that was observed does provide support for the environments effect on well-being.

5.5 Hypothesis

The first hypothesis, "exposure to outdoor areas will be associated with higher levels of well-being within the sample than indoor environments," requires more refined testing to fully understand if the outdoor environments caused more positive results from the well-being indicators. Some of the indicators showed the expected increase in positive results such as the POM scale and heart rate. However others showed slight increases which were not large enough to be statistically significant and therefore cannot be used as evidence to support this hypothesis. Additionally, some of the indicators of well-being show higher results in the indoor environment over the built outdoor environment. This evidence suggests that more research is needed to further test the biophilia hypothesis and the nature relatedness theory, as some of the measures, showed results for simply being outdoors do not support biophilia or NR. This challenges Nisbet and Zelenski's (2011) study which indicated higher levels of well-being are attainable by simply

being outdoors. However, there were methodological issues that could explain the finding. For example participant expectations and insufficient time to adjust excitement levels of being in a research study for the first time may have been factors.

The more positive indoor results could have been due to an issue with the methodology, discussed above, and further research is required. Therefore this hypothesis is only partially supported until further studies can be completed.

For the second hypothesis, as indicated by higher positive results for the well-being indicators, the evidence suggests well-being is increased with time spent in an urban forest environment. All the measures, except blood pressure, produced the highest measures of well-being, indicating that urban forest environment are places to increase vitality, happiness, mood, NR, and decrease heart rate or stress.

The third hypothesis was that, "urban forest environments with audible stream will be associated with the highest sense of well-being across the environments." This was not proven: there were no significant differences between any measure across the forest and forest-stream environment. This may mean that more sensitive scales are needed to assess the subtle changes in well-being from the participants for these closely related environments. For example sampling salivary cortisol levels (a chemical released related to stress) could more effectively measure stress levels. Measuring salivary cortisol levels was used along with heat rate and blood pressure in other studies to measure stress (Park et al., 2007). The other explanation for no changes between the two forest environments is that the forest-stream environment was significantly impacted by the surrounding urban environment, as the sounds penetrated the forest environment. Russell and Snodgrass (1984), Ulrich et al. (1991), and Chu, Thorne, and Guite

(2004) note the ability for increased unpleasant urban noise to reduce well-being, potentially drowning out the impact the audible stream had on the participants.

The importance of a water feature in a landscape used to improving well-being was noted by Kaplan and Kaplan in their 1989 review of people's experience with nature and by Velarde, Fry, and Tveit (2007) in their literature review of research related to the impact natural landscapes have on human health. However neither of these literature reviews had conclusive evidence suggesting water features improve well-being, so further research is still required to confirm or deny waters' impact on health and well-being.

Finally, the fourth hypothesis, "nature relatedness will increase as the participants are exposed to environments with increasing natural elements" was not supported as the indoor environment produced a higher level of NR than the outdoor built environment. These results demonstrate that there is a more complex relationship between people's connection to nature and their nature relatedness. Perhaps there is an amount of nature or type of environment that is required to increase individuals NR past their trait level, as the forest environment changed the participants NR levels past their original level collected as their baseline. A different methodology should also be used to limit participant expectations in future studies and produce a more accurate baseline measure. However, NR was higher in the forest environment than the built one, providing some validity to this hypothesis.

5.6 Scholarly contributions to outdoor recreation and well-being

This research contributes to the field of outdoor recreation by demonstrating the value of short term sedentary nature based recreation in small urban forest environments. The results also demonstrate that well-being can be increased with short term exposure to small natural

environments in urban areas, and extends this research by providing greater detail on the characteristic of these small accessible urban forests. The built environment showed it was not an ideal environment to increase well-being because not all the well-being indicators positively increased and some even showed decreases. However, some of the well-being indicators did show an increase in the built environment, so more research is needed to further investigate what elements of nature can be added to an urban environment for consistent increases in well-being. These results complement previous studies on the use of outdoor recreation in forest environments to increase well-being and reduce stress, but it also shows the utility of using even small urban forests for short periods of time to increase well-being. This provides evidence that urban forest environments can be used as a sources of well-being.

This also shows that intermediate recreation or outdoor recreation in accessible urban forest environments (parks) is valuable because well-being can be increased and stress can be reduced in these environments. This is important because the study used students to show these findings, indicating the need for accessible urban forest environments on universities campuses. The built environment of campuses, with trees widely dispersed throughout the area, is not enough to have a substantial impact on increasing positive well-being. The benefits of urban forests go beyond increasing the student's well-being and reducing their stress in exam periods. Park (2004) noted the ability of subjective or hedonic well-being to act as a buffer against psychological disorders, so if a students attending university begins to experience a mental health disorder natural areas may provide therapeutic benefits. Additionally, this is the period when most mental health disorders occur (Kessler et al., 2005). The students will have a place to increase and maintain optimal subjective well-being helping them deal with the mental health disorder better than if nothing was available. Furthermore the forest environment indicated that

students may be able to reduce their stress levels with exposure. This could have major implications for their future as stress has been linked to increased illnesses and sick day use (DAK, 2005; Parent-Thirion, Fernandez Macias, Hurley, & Vermeylen, 2008, as cited in Degenhardt, Frick, & Buchecker, 2011). If students are becoming sick or not feeling well enough to go to classes they will miss learning opportunities and hours of studying. This may lead to reduced success on examinations or projects (lower grades), which could potentially reduce their success at finding a job in the future (Zivin, Eisenberg, Gollust, & Golberstein, 2009). The reduced learning opportunities could also reduce the amount of education they receive reducing their knowledge for their future careers. The potential benefits of environments that reduce stress and increase well-being for student populations is substantial for their futures success in their careers and in society.

The study also provides support for adding outdoor recreation areas such as parks in Canada's urban environments. Currently there is tension between biologists who want to use parks to preserve the land for ecological integrity and those who wish to use parks for outdoor recreation (Eagles & McCool, 2002). This study shows how to use parks in a way that does not require the destruction of the forest through countless trails, while providing a benefit to people through increases in well-being. Visitors may enjoy the park through a sedentary activity which allows more of the park to be preserved because less room is needed for this activity, reducing the likelihood of over-exploitation of the land and retaining the ecological integrity of it.

The study also provides evidence for the utility of parks in urban environments through their ability to increase well-being and reduce stress. This is important because development is increasingly fragmenting and destroying biodiversity (Shafer, 1990). By showing the utility of an urban forest there may be more pressure to leave more forest environments intact for outdoor

recreation and ecological purposes. It has been shown that through work related stress there is an increase in sick days taken by working people. The illnesses caused by stress also increase healthcare costs (DAK, 2005; Parent-Thirion, Fernandez Macias, Hurley, & Vermeylen, 2008, as cited in Degenhardt, Frick, & Buchecker, 2011). Furthermore Boyd (1997) found that people who were experiencing poor mental health and reduced well-being were more prone to being absent from work, being less productive, and making poor quality decisions. All of these issues reduce cost effective operations for business owners and the increased health care costs for Canada could have real consequences for the government, businesses, and taxpayers. Providing an environment that can increase well-being and reduce stress reduces these problems. Thus the preservation and creation of urban forest environments for outdoor recreation could have considerable advantages to many stakeholders concerned about efficient economical decisions and ecological prosperity.

5.7. Scholarly contributions to ecological psychology

Through the use of sedentary outdoor recreation in the urban environments the study better confirmed that the environment was the variable that affected the participant's well-being. Ecopsychology suggests that a greater connection to nature may lead to a happier, healthier human being, with a disconnect from nature contributing to unhealthy humans (Conn, 1998). The biophilic tendency brings people to nature evoking optimal emotional and psychological development (Keller, 1997). To test this theory of EP the study followed the environmental psychology approach of research, through providing a sedentary activity in the environment (proving it is the environment alone and no the activity done in the environment that caused the changes). It was found that a greater connection to nature as noted by the NR scale was related to increased well-being as the biophilia hypothesis suggests. The strongest connection to nature was

reported in the forest environment and this is also where the most positive measures of well-being (high levels of happiness, mood, etc) were found. In support of EP, as the connection with nature increased well-being increased, helping to advance the understanding of the person/nature environment relationship. Further to this point many of the measures of well-being showed positive increases in the built environment indicating support for environments with higher patterns of nature (natural light, fresh air, and varying amount of vegetation) increase well-being. These results provide further evidence that patters of increased natural elements in environments will increase well-being. It also bolsters Conn's (1998) theory that greater connections to nature lead to happier and healthier humans.

5.8 Biophilia and Leisure

An important conclusion that can be drawn from the study is that biophilic landscapes, such as the urban forest, produce increased leaves of well-being for patients undergoing forms therapeutic recreation (TR). The benefits of sitting in a forest as compared to the built environment were evident. The study also shows that biophilic feelings can be produced in a minimal amount of geographic space. As many people using this form of therapy need areas that are more accessible, this contributes huge advantages to the field of TR. This form of therapy is inclusive of individuals with socio economic disadvantages and physical disability's which may be preventing them from accessing rural wilderness environments. The TR field of leisure studies should seek to establish these areas as resources of well-being and prescribe them to their clients.

The results of this study point to the benefits of biophilia leisure that is leisure done in areas close to other life forms including plants and animals. The forest showed more positive results for well-being and stress reduction indicating the importance of leisure time in areas that contain more life. Using leisure as a buffer has shown benefits of reducing everyday and persistent stress (Hutchinson, Bland, & Kleiber, 2008), however, this study shows that even more benefits can be drawn from leisure time in living nature filled areas. It shows that even sedentary leisure for those who may be experiencing severe disability could benefit from this form of outdoor recreation.

In conclusion this demonstrates the close tie between the validity of the biophilia hypothesis and TR. These conclusions also extend to problems of accessibility in minority populations and people in diverse socioeconomic situations. This study provides evidence for spaces that are easy to access in terms of distance (time and transportation constraints) and the time it takes to increase well-being (time constraints on working mothers and men).

5.9 Limitations

One limitation for the research was the budget available for the study. This did not allow for more robust testing of stress levels as, for example, would have been possible through the use of salivary cortisol levels. Samples of saliva must be obtained and then sent away for testing, which was not feasible for this study.

Ambulatory blood pressure measures were also not recorded due to budget as the equipment was not available. This may have shown greater changes in the blood pressure measures as the recordings would have been made overtime providing blood pressures results throughout the environments, similar to the heart rate recording in the study.

The heart rate measurement could have been improved as many studies used portable electrocardiographs (Park et al., 2008), which measure heart rate and heart rate variability. Heart rate variability can be calculated in two spectral components which are the high frequency component and the low frequency component. The high frequency is considered to reflect the parasympathetic nervous activity and the low frequency component reflects sympathetic nervous activity (Weise & Heydenreich, 1989). Parasympathetic nervous activity shows relaxation, while the sympathetic nervous activity indicates mental stress (Chatterton, Vogelson, Lu, Ellman, & Hudgens, 1996). These measures, in conjunction with the heart rate and blood pressure recorded, would have strengthened the results related to stress levels, as other studies have done (Tsunetsugu et al., 2010).

The participants used in the study were students because they were the most accessible population and suited the objectives well. However, a more diverse population might be more appropriate for more generalizable results.

Finally, the participants had limited time to spend in each environment, while many studies indicated 15 minutes is adequate for increasing well-being (Nisbet and Zelenski, 2011), other studies used 30 minutes (Park et al., 2011; Horiuchi et al., 2013), which may have allowed for more significant changes in the blood pressure and other measures.

5.10 Future Research

The study was able to show that the urban forest environments produced significantly more positive effects in well-being. This means that future research can be conducted on this environment to see if increasing the amount of trips to this location while keeping the exposure time at a minimum can help sustain higher levels of well-being for prolonged periods. This has also been suggested in the research conducted by Nisbet et al. (2011).

Furthermore, additional research should be conducted on positive affect, vitality, and NR in the three environments utilized for the study. Using a different methodology, could produce more accurate measures of the indoor environment's effect on well-being. One example would be to allow participants time to settle into the study environment before being exposed to the indoor environment. Future study should reduce participant expectations, potentially using instructions that do not define, as clearly, the purposes of the study.

Further research is also needed on the different types and characteristics of environments that improve well-being. The forest-stream environment produced no changes in the participant's well-being. Research that uses a more prominent water feature than the small stream used here might be able to provide support for this environmental element. Additionally the built environment in this study did not produce the same level of positive well-being as the urban environment in Nisbet and Zelenski's (2011) study. Therefore there needs to be further investigation into what are the characteristics of different types of environments that contribute to the greatest increase in well-being.

Ambulatory blood pressure measures should also be used to further investigate whether blood pressure can be significantly impacted by small accessible forest environments, as has been shown in the large rural forests (Park et al., 2008). Slightly longer exposure times to these

environments would also be an interesting way to see if blood pressure could be changed by different environments. Many studies of blood pressure variation in forests, exposed participants to longer periods of time in the different environments. These new blood pressure results could help confirm the conclusions regarding stress reduction and urban accessible forest environments.

A different sample of participants could also help reaffirm the study's results as it relates to people in different age groups, employment status, socio economic groups and cultures. Such research would demonstrate that urban forest environments increase well-being in more populations.

Finally further research needs to be conducted to validate the biophilia hypothesis as it has not been proven to be a valid theory. There is currently evidence supporting it as this study has done. However, more research is needed to conclusively validate the theory. Potentially trying to answer the question what is increasing the feelings of positive well-being and reductions in stress within the human body could help establish further support or help validate the hypothesis.

CHAPTER 6- CONCLUSION

The main conclusion is that urban forest environments can increase well-being by increasing positive levels of vitality, affect, happiness, mood, and heart rate. The outdoor built environment did increase happiness, contributing to an increase in hedonic well-being and mood levels, a barometer for psychological well-being. This reaffirms Nisbet and Zelenski's (2011) results that simply being outdoors has a more positive impact on well-being than indoor environments.

Stress levels, indicated by heart rate, were also shown to be reduced in the transition from the indoor environment to the built environment and again to the forest environment. An increase in stress may reduce or inhibit the well-being an individual feels (Laumann et al., 2003; Hartig et al., 1996), so the reduction in stress levels suggest these outdoor environments are efficient at increasing well-being.

The contribution of this study to the field of outdoor recreation is that simply sitting in a small accessible urban forest environment for a short period of time is enough to reduce stress and increase well-being as Trenberth, Drewe, and Walkey (1999), Hartig et al. (1991), and Park et al. (2011) indicated might happen. The study reinforces the value of outdoor recreation and its contribution to increasing the well-being of individuals.

Nature relatedness (NR) did improve significantly with the forest environment which is consistent with previous research (Nisbet et al., 2011). However NR did not increase as expected through the different environments or in the way that mood, happiness, and heart rate did. The NR indicator decreased with exposure to the outdoor built environment. This is contrary to what

has been found in the past where simple exposure to the outdoors increased NR (Nisbet & Zelesnki, 2011). However this may have been due to methodological issues. For example participant expectations could have contributed to the increased levels of NR in the indoor environment resulting in higher NR scores than would be normal.

What this means in terms of nature relatedness is that in general as people get closer to nature they feel greater levels of happiness, affect, and mood indicating a parallel between people's connection to nature and their well-being. These results also provide further support for the biophilia hypothesis as participants did become more relaxed and had more positive emotional responses to the outdoor environments. Finally more research is needed to test the biophilia hypothesis and to clarify the connection between nature relatedness and well-being.

Overall the study demonstrates that small accessible urban forest environments can help improve well-being in terms of vitality, happiness, mood, and stress reduction further contributing literature on the positive impact of outdoor recreation and the ability of even small forest experiences to have a positive effect. Accessible urban forests were also shown to be a buffer helping to improve people's well-being, including university students, during times of high stress showing the value of these environments for everyone. These results suggest there is a need for small urban forest on university campuses and in urban areas where all citizens can access the advantages of the healthy recreation benefits they offer.

6.2 Implications

One of the unique things about this study is that it has practical consequences in a variety of fields. It has shown how the biophilia hypothesis can guide planning outdoor urban environments for increased positive well-being. Biophilia has suggested the value of adding

plants to environments and allowing outdoor areas to revert back to their natural states. Although the study has not concluded that the biophilia hypothesis is definitively true, it has suggested the validity of the genetic argument through the relationship between natural urban spaces and stress reduction. The areas that are more natural allow people to reconnect with environments they were familiar with for thousands of years before the industrial revolution. These innately familiar environments thus reduce our stress levels as the stress of unfamiliarity decreases. Furthermore through the incorporation of plants and other natural features that provide survival advantage people will experience reductions in stress as they will innately know they are secure for their safety and potentially food. Finally increased well-being can be attained through emotional responses to plant life and animal life, with people's genetic affinity to affiliate with nature. The mechanisms at play here are people's innate biophilic needs through the satisfaction of which will result in increased well-being and reductions in stress as shown through this study.

Students attending university may be able to use this information to help themselves have a better university experience as they could seek out small accessible forests to attain well-being and reduce their stress when needed. This way the students would have a way to cope with stressful exam periods and high workloads without losing time to illness or debilitating stress as they would have a way to control it. This ability to reduce stress could help them reduce stress in the future as the knowledge of a recovery space will making the stressful periods of time seem less stressful because they would know a strategy to deal with the stress. This knowledge makes the stressful situations seem more manageable (Klitzing, 2010). Furthermore students could do better at their projects and study sessions in times of poor mental health as they could reduce it with the accessible forest reducing the likelihood of poor productivity and poor decision making (Boyd, 1997).

The health centers in universities could also benefit from these sources of well-being as they would have a place to direct students who were feeling poor well-being and had to wait for their counseling session. It could even free up the councilors dealing with students who did not have severe depression and reduced well-being as the environments could be prescribed for their ability to reduce tension (vitality increases in forest) and increase happiness.

The potential benefits Canadian Universities could accrue from providing these well-being spaces on their campuses is substantial. The first advantage universities could gain from these spaces is an increase in attendance. Providing a space for students to increase their well-being might increase interest of potential future students as they would know that they have a space to retreat to if they begin to feel unwell due to an increase in stress from their work or social lives. It would also sway the parents who may add pressure to their child to go to a university with a well-being forest as they may feel more comfortable with their child attending a university with a recognized area designed to increase well-being and reduce stress. The area may also help to increase the living standards of the university helping to increase the status of the university allowing them to charge more money for addition to the school.

Finally the study gives information to park planners who design areas that accommodate the new trends and societal values of parks today. Currently there is a shift in interest regarding how parks are used. Previously parks were used for recreational purposes, but now there has been a shift and people are more focused on the ecology of parks (Plummer, 2008). The study shows how people can be ecologically conscious and globally help preserve the 12% of natural areas suggested by the World Commission on Environment and Development (WCED) (WCED, 1987) though the evidence provided by this study. The evidence has shown that nature provides health benefits. This illuminates the value of nature to city planners and shows that natural areas

are worthy of our urban spaces. Through this knowledge they may be more inclined to allow park planners to establish more park areas around urban centers and preserve more nature areas. This increase of nature in urban spaces would benefit the ecological health of the area and the human health, while accommodating the new trend in societal values.

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Appendix A

Mark Havitz email to ethics board

Hi Julie,

I'm writing to confirm my support of Emily Grant's MA thesis project "Exploring the Impact of Diverse Urban Environments on Well-being" (Bryan Grimwood, supervisor).

I've reviewed course outline material provided for each of REC 100, REC 334 and REC 401 and believe there is a strong element of educational merit of the research from the perspective of students in those courses and from the instructors of record. This looks to have potential to serve as a model for how we better integrate future research into the classroom.

Let me know if any additional information is needed.

Mark E. Havitz
Professor and Chair
Department of Recreation and Leisure Studies
University of Waterloo
Waterloo, ON, Canada N2L 3G1
519-888-4567 x33013
mhavitz@uwaterloo.ca

Appendix B

Additional Credit

Park and protected area organizations within Canada and beyond are increasingly interested in delivering society-oriented programs and communicating their social relevance to decision-makers and the public. In an era of rapid socio-economic and environmental transformation, managers and other advocates are finding it important to improve their understanding of the human health and well-being values associated with park visitation, green spaces, and nature experience. For an additional but optional course credit of 2%, students are invited to explore the relationships between park/nature experience and human health and well-being. To obtain these bonus marks (the 2% will be added to a participating student's overall final grade), students may complete one of the options described below. Both options will require a time commitment of roughly two hours and must be completed by October 31, 2014.

Option 1 –Research project participation

Students are invited to participate in a research study entitled "Exploring the Impact of Diverse Urban Environments on Well-being". The study is being conducted by Emily Grant, a Master's student in the Department of Recreation and Leisure Studies at the University of Waterloo, and under the supervision of Dr. Bryan Grimwood. The main objective of the study is to understand the effect of different urban outdoor environments on well-being indicators such as mood, affect, vitality, and nature relatedness.

Prior to participation, students will be given a detailed information letter and asked to fill out an informed consent form. As participants in this study, students will arrange a time to meet with Emily and complete the experiment protocols. This process involves the following stages:

- First, students will be asked to complete a series of questionnaires as well as provide blood pressure and heart rate data using a digital blood pressure cuff and a digital hear rate monitor. The questionnaires will ask about well-being indicators such as mood, emotions, and feelings about nature connection and experience.
- Second, participants will be asked to walk to a first outdoor environment (e.g., a built environment surrounded by concrete or an urban forest environment) and to sit in a chair provided with no distractions and to observe the surroundings for 20 minutes. Heart rate data will be monitored throughout and, once the 20 minutes are up, participants will have their blood pressure taken and asked to complete a second set of questionnaires.
- Third, participants will be asked to walk to a second outdoor environment and to again sit in a chair provided and observe surroundings for 20 minutes. The same measurements described above (i.e., heart rate, blood pressure, and questionnaires) will be taken.
- Finally, participation will end by the researcher debriefing the experiment and addressing any questions from participants.

In addition to supporting the research process, REC/ENVS 334 students that choose to participate in this study will experience first hand how knowledge that is relevant to the management of parks and protected areas can be generated.

Option 2 – Journal article review

Begin by reading the following two journal articles, which can be accessed through the course LEARN site:

Lemieux, C. J. et al. (2012). Human health and well-being motivations and benefits associated with protected area experiences: An opportunity for transforming policy and management in Canada. *Parks, 18*(1), 71-86.

Maller, C. et al. (2006). Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International*, *21*(1), 45-54.

Prepare and submit a two-page (single space) review of the articles. In your review, first synthesize *and* critique the main objectives, methods, findings, and conclusions presented in each paper (~1 page). Second, by reflecting on your own experiences, identify and explain the extent to you own health and well-being is influenced by parks, protected areas, and other green spaces.

Appendix C

Ethics approval email

>Dear Researcher:
>A Request for ethics review of a modification or amendment (ORE 104) to
>your ORE application:
>Title: Exploring the Impact of Diverse Urban Environments on Well-being
>ORE #: 19981
>Faculty Supervisor: Bryan Grimwood (bgrimwood@uwaterloo.ca)
>Student Investigator: Emily Grant (e3grant@uwaterloo.ca)
>----------
>together with a copy of relevant materials, was received in the Office of
>Research Ethics on:
>
>September 4, 2014 - The revised materials provided in association with
>the ethics review feedback on your recent modification request are fine.
>
>Best wishes for success with the study,
>Julie
>
>The proposed modification request has been reviewed and has received full
>ethics clearance

Appendix D

Presentation to classes

Hello, my name is Emily Grant and I am a graduate student here at the University of Waterloo in Recreation and Leisure Studies. I received my undergraduate degree at Lakehead University in Thunder Bay. I was changed by the wild natural landscapes of the forests and Lake Superior that surround the region of Thunder Bay. The region instilled a deep admiration for natural environments and I found myself feeling excited to return to the wilderness every year of my undergraduate degree. I have lived in Ottawa, Ontario most of my life and so I also have a love for the city. I wondered if I could take my passion for geography and landscapes and combine them as I have a greater connection with nature, but I love living in cities. I spend most of my recreation and leisure time outdoors and as much as possible in natural areas. My passion for the outdoors and landscapes has lead me to design the study I need your help with.

I want you to imagine you are a student devising a research experiment for your thesis. You may be wondering how do I start? What are the procedures I need to follow? And what does an experiment entail. Now I want you to think about being outdoors relaxing in a chair. It seems like a nice image compared to the panic feeling you may have felt when thinking about designing a research experiment. Now I want you all to imagine yourself doing both relaxing outside and getting real life experience on how an experiment is done from beginning with the signing of the consent forms to the debriefing after the experiments has reached its end. You can have all these experiences in one place, which is my Master's thesis study.

I am looking into how different outdoor environments affect people's well-being. I believe that even in cities we can find environments that can help us relax, and restore energy and happiness from outdoor urban settings.

I am looking for volunteers who wish to participate in my study to sign up for a section of time in the next two weeks.

I will take you to two different environments, within a 5 minute walk from the visitor's center building, and you will be asked to sit in a chair for 20 minutes. You will fill out a questionnaire package at the beginning of the study as well as two more times after each environment. I will also be taking physiological measures of blood pressure and heart rate in each environment. The blood pressure will be taken using a digital blood pressure cuff that I will attach to your upper arm each time I need a reading and your heart rate will be recoded from a digital heart rate monitor that will be around your chest providing minute by minute readings of your heart rate transmitted to a watch that will store the data. The study will take approximately 2 hours and will be weather permitting, that is, I will not be taking people out in rain, thunderstorms, or periods of extreme heat such as 35 degrees Celsius and higher.

Each participants will be provided with beverages and a chance to enter a draw to win $100. There are 2 prizes of $100 and all you have to do is sit outside and provide your feedback on how you feel about each environment, and let me measure your heart rate and blood pressure.

When the study is over I will send you an abstract of the results. If you would like to participate in this exciting experiment on well-being and outdoor environments please sign up on the sheets provided. I am asking for your name and email, so we can arrange an exact time on the day you choose.

The goal of this experiment is to find the environments that make people feel the best, so we can design cities with pockets of oasis's that will allow people to rejuvenate their energy and revitalize them while calming them down from hectic workloads. Through this work we can design the most efficient cities, so if there is a small section of park that is available we don't

simply turn it into another field, but build cities that increase people's health and well-being within the confines of city structures.

So if you are interested in taking part in this experiment where you will provide valuable information on how to design functioning health improving cities and learn how to conduct an experiment while sitting outside I would be really excited to have your help. Together we can design the cities that will be efficient through function and support of recreation areas that enhance feelings of happiness, vitality, and increase relaxation. It could also be used to help design University campuses. This experiment may improve students around Canada's mental health and well-being.

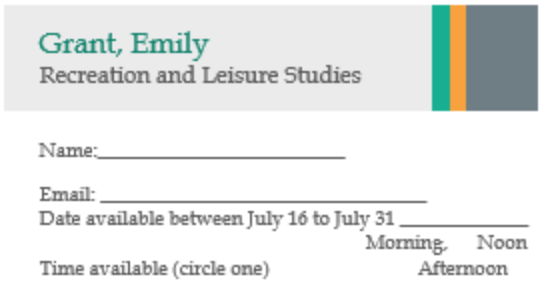
I appreciate all of your time thank you for listening and have an excellent day.

Appendix E

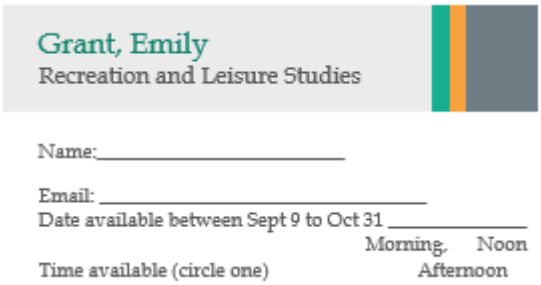
Sign-up card for recruitment

Front of card

Back of card for summer semester



Back of card for fall semester



Appendix F

Preliminary email to participants
Dear Participants

I would first like to extend my sincere thanks for your participation and interest in my study Exploring the Impact of Diverse Urban Environments on Well-being. The study being conducted involves taking in an environment through all of your sense (i.e sights, sounds, smells, ect.). I would ask that if you have any problems with your sense when you are outdoors that you make the researcher aware of the issue in the reply to this email. This could help avoid any problems when the experiment is underway.

The study sites are 5 to 10 minutes away from the meeting room. If you have any mobility issues please make me aware of these in the follow up email. There will be seats provided at the sites for participants to sit down and there will be shade, to avoid the discomforts of direct sunlight for the duration of the 2 hour study.

Health Screening Form:

This questionnaire asks some questions about your health status. This information is used to guide us with your entry into the study.

Health Screening Form

SELF REPORT CHECKLIST:

Past Health Problems:

[ ] Heart Murmur

[ ] High Blood Pressure

[ ] Epilepsy

Present Health:

List current problems:

1.

2.

List medications taken now or in last 3 months:

1.

2.

For Females: Pregnant _____ Nursing _____

List Symptoms:

[ ] Irregular Heart Beat

[ ] Chest Pain

[ ] Shortness of Breath

[ ] Persistent Cough

[ ] Wheezing (Asthma)

[ ] Fatigue

[ ] Dizziness

[ ] Back Pain/Injury

[ ] Leg Pain/Injury

I have tentatively booked your appointment for _____ (date) at _____ (time). If these times are acceptable please confirm by a return email.

We will meet in room ### at the arranged time. There will be a follow up email the day before the study appointment as well as one an hour before the study appointment time. If you prefer, to receive text messages please send me an email with your phone number.
I would like to thank you for agreeing to participate in this important study. If you have any questions or require additional information please contact me at e3grant@uwaterloo.ca. If you wish to contact me on the day of your appointment please call (613)999-9999.

Have a wonderful day and I look forward to seeing you.

Sincerely

Emily Grant
Recreation and Leisure Graduate Studies

Appendix G

Email/ text message to be sent out to participants the day before participation in the study
Dear (insert name)

This is a reminder message of your participation in the study on urban environments and their effects on well-being. The participation time arranged for you is (day) and (time) room ####. I look forward to our meeting.

If you have any questions, concerns, or require additional information on the study please contact me at e3grant@uwaterloo.ca. If you wish to contact me on the day of your appointment please call (613)999-9999.

Sincerely

Emily Grant
Recreation and Leisure Graduate Studies

Appendix H

Email/ text message to be sent out to participants the day before participation in the study
Dear (insert name)

This is a reminder message of your participation in the study on urban environments and their effects on well-being. The participation time arranged for you is Sept 14 and at 2:45pm in MC 4044. I look forward to seeing you soon.

If you have any questions, concerns, or require additional information on the study please contact me at e3grant@uwaterloo.ca. If you wish to contact me today please call (613) 601-8770.

Sincerely

Emily Grant
Recreation and Leisure Graduate Studies

Appendix I

Information Form

RECREATION AND LEISURE STUDIES

Information Form

Date: ***(insert date)***

Title of Project: ***Exploring the Impact of Diverse Urban Environments on Well-being***

Faculty Supervisors: ***Bryan Grimwood, Recreation and Leisure Studies, 519-888-4567 x32612, bgrimwood@uwaterloo.ca***

Student Investigators: ***Emily Grant, Recreation and Leisure Studies, e3grant@uwaterloo.ca***

Study Overview

I am a Master's student in the Department of Recreation and Leisure Studies at the University of Waterloo conducting research under the supervision of Dr. Bryan Grimwood.

You are invited to participate in a study exploring the impact of diverse urban environment on well-being. Past research has demonstrated that spending time outdoors can improve well-being. This study will extend previous research by looking at a diverse array of environments to understand which environments can maximise people's well-being.

What You Will Be Asked to Do

As a participant in this study, you will be asked to complete a number of questionnaires as well as provide your blood pressure and heart rate which will be taken using a digital blood pressure cuff and a digital heart rate monitor. These questionnaires will ask you about your mood, emotions, and how connected to nature you feel. For example, you will be asked to rate the extent to which you feel different mood states (e.g., I feel energized, or on a scale from 1 (lowest) to 5 (highest) how Nervous do you feel?).

Following the baseline (first) questionnaires, you will be asked to place the heart rate strap around your torso against your skin in the bathroom after being instructed on how to put it on. Then we will test the signial of the monitor making sure it is picking up your heart rate. We will then wait 5 minutes and take your blood pressure. You will then be asked to walk outdoors the the environment you were assigned first either a built environment surrounded by concrete or an urban forest environment in Waterloo Park. Once we arrive in the environment you will be asked to sit in the chair provided with no distractions and observe your surroundings for 20 minutes.

Once the 20 minutes are up the researcher will take your blood pressure and you will be asked to fill out the questionnaire again.

Once you have filled out the questionnaire package you will be asked to walk with the researcher to the next environment where again you will observe your surroundings. Once the 20 minutes have passed your blood pressure will be taken for the final time and you will be asked to fill out the questionnaire package again. The study will end with a debriefing on the experiment and you will have the opportunity to ask question. Participants will be asked if they would like to receive a summary of the study results by email and will be thanked for their participation.

Participation and Remuneration

Participation will be awarded up to a five percentage point increase on their overall grade for the class from which they were recruited as bonus marks.
For students who do not wish to participant in the study an alternative assignment to complete for the bonus marks will be provided by the professor.

Personal Benefits of the Study

The participants may feel an improved sense of well-being after being exposed to the outdoors and especially from exposure to the forest environment.

Risks to Participation in the Study

No known or anticipated risks.
The environments being used are in safe areas where the students would often go their self. Two physiological measures are being taken but these are not obtained to assess health status.

In the event that you develop any negative reactions, or are concerned that you may, please alert the researcher. You may also contact Bryan Grimwood at 519-888-4567 x32612 bgrimwood@uwaterloo.ca or the University of Waterloo Counselling Services at 519-888-4567 x32655.

Confidentiality

All information you provide is considered completely confidential, your name will not be included in any other way associated, with the data collected in the study. Furthermore, you will not be identified individually in any way in any written reports of this research. The data, with identifying information will be removed, and kept for 1 year following publication of the research, after which it will be shredded. The data will be securely stored in a locked drawer in a locked offices in the department of Recreation and Leisure Studies in the BMH building to which only researchers associated with this study have access.

Questions and Research Ethics Clearance

If after receiving this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to ask the student investigator or a faculty supervisor listed at the top of this sheet.

I would like to assure you that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

Thank you for your interest in our research and for your assistance with this project.

Appendix J

Consent form

Consent of Participant

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

_____

I have read the information presented in the information letter about a study being conducted by *Emily Grant* of the Department of *Recreation and Leisure Studies* at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted. I am aware that I may withdraw from the study without penalty at any time by advising the researchers of this decision.

This project has been reviewed by, and received ethics clearance through a University of Waterloo Research Ethics Committee. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at 519-888-4567 ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

_____
Print Name

_____
Signature of Participant

_____
Dated at Waterloo, Ontario

_____
Witnessed

Appendix K

Survey package with demographic characteristics

1. Participant participation number_____
2. What is the date today?_____
3. What time of day is it? (Please circle one)
   i. Morning
   ii. Midday
   iii. Afternoon
4. Gender : male___ Female___
5. What is your age today in years: ___
6. Level of Education you have today:
   i. Incomplete undergraduate___
   ii. Undergraduate completed___
   iii. Graduate completed___
   iv. Other___
7. Do you feel unwell today? Yes__ No___
   a. If yes, please speak with the researcher. It may be better to reschedule the test session to another day.
8. What is your cultural background?
9. Where did you spend most of your childhood?
   i. Urban center:___
   ii. Suburbs:____
   iii. Country/rural: ___

10. What type of building did you live in for the majority of your childhood?

i. House___

ii. Apartment___

iii. Other___

11. Do you currently live within walking distance of a park or forested area? Yes___ No___

12. Are you exposed to natural environments on an average day (do you live near or walk past areas with lots of trees or vegetation or do you drive through extensive natural areas) Yes___ No___

13. What type of program are you in? (please indicate)

    i. Environmental/ Parks____

    ii. Geography____

    iii. Science____

    iv. Math____

    v. Arts____

    vi. Other_____

14. Do you enjoy being in nature? Yes___ No ___

15. What percentage of your free time do you spend outside in nature?

    i. Less than 25%____

    ii. 26-50%____

    iii. 51-75%____

    iv. Greater than 75%____

16. Which one of the following activity interests you most:

    i. Walking in a forest____

ii. Walking around a park____

iii. Walking through a neighbourhood____

iv. Walking through a downtown center____

17. Which one of the following places do you feel most comfortable:

i. A small forest____

ii. An open park___

iii. A neighbourhood____

iv. A downtown core ____

Vitality Scale

Describe how you feel by circling the number of the descriptive word that best fits how you feel.

	Note at all	A little	Moderately	Quite a bit	Extremely
I feel alive and vital	1	2	3	4	5
I am so alive I just want to burst	1	2	3	4	5
I have energy and spirit	1	2	3	4	5
I look forward to each new day	1	2	3	4	5
I feel awake and alert	1	2	3	4	5
I feel energized	1	2	3	4	5

PANAS Scale

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers

Feelings

	Very Slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	1	2	3	4	5
Distressed	1	2	3	4	5
Excited	1	2	3	4	5
Upset	1	2	3	4	5
Strong	1	2	3	4	5
Guilty	1	2	3	4	5
Scared	1	2	3	4	5
Hostile	1	2	3	4	5
Enthusiastic	1	2	3	4	5
Proud	1	2	3	4	5
Irritable	1	2	3	4	5
Alert	1	2	3	4	5
Ashamed	1	2	3	4	5
Inspired	1	2	3	4	5
Nervous	1	2	3	4	5
Determined	1	2	3	4	5
Attentive	1	2	3	4	5
Jittery	1	2	3	4	5
Active	1	2	3	4	5
Afraid	1	2	3	4	5

Overall Happiness Scale

How happy are you on a scale from 0 (not happy at all) to 100 (extremely happy) at this moment in time?_____

Profile of Mood States

Describe how you feel right now by circle one space after each of the words listed below:

FEELING

	Not at all	A little	Moderately	Quite a bit	Extremely
Unhappy	1	2	3	4	5
Sad	1	2	3	4	5
Blue	1	2	3	4	5
Hopeless	1	2	3	4	5
Discouraged	1	2	3	4	5
Miserable	1	2	3	4	5
Helpless	1	2	3	4	5
Worthless	1	2	3	4	5
Lively	1	2	3	4	5
Active	1	2	3	4	5
Energetic	1	2	3	4	5
Cheerful	1	2	3	4	5
Full of pep	1	2	3	4	5
Vigorous	1	2	3	4	5
Confused	1	2	3	4	5
Unable to concentrate	1	2	3	4	5
Bewildered	1	2	3	4	5
Forgetful	1	2	3	4	5
Uncertain About things	1	2	3	4	5
Tense	1	2	3	4	5
On edge	1	2	3	4	5
Uneasy	1	2	3	4	5
Restless	1	2	3	4	5
Nervous	1	2	3	4	5
Anxious	1	2	3	4	5
Angry	1	2	3	4	5
Peeved	1	2	3	4	5
Annoyed	1	2	3	4	5
Resentful	1	2	3	4	5
Bitter	1	2	3	4	5
Furious	1	2	3	4	5
Worn out	1	2	3	4	5
Fatigued	1	2	3	4	5
Exhausted	1	2	3	4	5
Weary	1	2	3	4	5

Nature relatedness scale

How strongly do you agree with these statements?

	Note at all	A little	Moderately	Quite a bit	Extremely
I am not separate from nature, but a part of nature	1	2	3	4	5
I always think about how my actions affect the environment	1	2	3	4	5
I think a lot about the suffering of animals	1	2	3	4	5
My feelings about nature do not affect how I live my life	1	2	3	4	5
My ideal vacation spot would be a remote, wilderness area	1	2	3	4	5
I take notice of wildlife wherever I am	1	2	3	4	5

Appendix L

Survey package for field measures

Participant participation number_____

Vitality Scale

Describe how you feel by putting the number of the descriptive word that best fits how you feel

	Note at all	A little	Moderately	Quite a bit	Extremely
I feel alive and vital	1	2	3	4	5
I am so alive I just want to burst	1	2	3	4	5
I have energy and spirit	1	2	3	4	5
I look forward to each new day	1	2	3	4	5
I feel awake and alert	1	2	3	4	5
I feel energized	1	2	3	4	5

PANAS Scale

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Use the following scale to record your answers

	Very Slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	1	2	3	4	5
Distressed	1	2	3	4	5
Excited	1	2	3	4	5
Upset	1	2	3	4	5
Strong	1	2	3	4	5
Guilty	1	2	3	4	5

Scared	1	2	3	4	5
Hostile	1	2	3	4	5
Enthusiastic	1	2	3	4	5
Proud	1	2	3	4	5
Irritable	1	2	3	4	5
Alert	1	2	3	4	5
Ashamed	1	2	3	4	5
Inspired	1	2	3	4	5
Nervous	1	2	3	4	5
Determined	1	2	3	4	5
Attentive	1	2	3	4	5
Jittery	1	2	3	4	5
Active	1	2	3	4	5
Afraid	1	2	3	4	5

Overall Happiness Scale

How happy are you on a scale from 0 (not happy at all) to 100 (extremely happy) at this moment in time?_____

Profile of Mood States

Describe how you feel right now

by circle one space after each of the words listed below:

FEELING

	Not at all	A little	Moderately	Quite a bit	Extremely
Unhappy	1	2	3	4	5
Sad	1	2	3	4	5
Blue	1	2	3	4	5
Hopeless	1	2	3	4	5
Discouraged	1	2	3	4	5
Miserable	1	2	3	4	5
Helpless	1	2	3	4	5

Worthless	1	2	3	4	5
Lively	1	2	3	4	5
Active	1	2	3	4	5
Energetic	1	2	3	4	5
Cheerful	1	2	3	4	5
Full of pep	1	2	3	4	5
Vigorous	1	2	3	4	5
Confused	1	2	3	4	5
Unable to concentrate	1	2	3	4	5
Bewildered	1	2	3	4	5
Forgetful	1	2	3	4	5
Uncertain About things	1	2	3	4	5
Tense	1	2	3	4	5
On edge	1	2	3	4	5
Uneasy	1	2	3	4	5
Restless	1	2	3	4	5
Nervous	1	2	3	4	5
Anxious	1	2	3	4	5
Angry	1	2	3	4	5
Peeved	1	2	3	4	5
Annoyed	1	2	3	4	5
Resentful	1	2	3	4	5
Bitter	1	2	3	4	5
Furious	1	2	3	4	5
Worn out	1	2	3	4	5
Fatigued	1	2	3	4	5
Exhausted	1	2	3	4	5
Weary	1	2	3	4	5

Nature relatedness scale

How strongly do you agree with these statements?

	Note at all	A little	Moderately	Quite a bit	Extremely
I am not separate from nature, but a part of nature	1	2	3	4	5

I always think about how my actions affect the environment	1	2	3	4	5
I think a lot about the suffering of animals	1	2	3	4	5
My feelings about nature do not affect how I live my life	1	2	3	4	5
My ideal vacation spot would be a remote, wilderness area	1	2	3	4	5
I take notice of wildlife wherever I am	1	2	3	4	5

Appendix M

Feedback letter

Feedback Letter

Recreation and Leisure Studies

Emily Grant

200 University Avenue West

Waterloo, ON, Canada N2L 3G1

Project Title: ***Exploring the Impact of Diverse Urban Environments on Well-being***

Student Investigator: ***(Emily Grant, Recreation and Leisure Studies, e3grant)***

Faculty Advisor: ***(Bryan Grimwood, Recreation and Leisure Studies, bgrimwood@uwaterloo.ca, 519-888-4567 x32612)***

We appreciate your participation in our study, and thank you for spending the time helping us with our research!

In this study you were exposed to 3 different urban environments and asked to fill out a survey on what you noticed in the environments about yourself as well, you provided your blood pressure and heart rate during the duration of the study. The purpose of this study was to demonstrate that there is a need to design urban spaces with increased access to natural environments that will maximize people's feelings of well-being through stress reduction and positive emotional feelings. In this case, the study examined whether different types of urban environments impact individuals and help to increase different levels of well-being. In the study, the environments included a baseline (indoor) environment, a built (outdoor) environment, a forest (outdoor) environment, and a forest environment with an audible stream (outdoors). You were exposed to the baseline, built and one of the forest environments.

It is expected that overall, the forest environments will produce the highest levels of well-being as they have the most amount of nature and forest environments as well as near-by nature as indicated by the literature can produce higher levels of well-being. The forest with the audible stream environment should produce the greatest amount of well-being as the steam will increase

relaxation greater than the areas that do not have the sound of a stream murmur. However, there should a slight increase in well-being once participants are outdoors as previous research has shown simply being outdoors can increase levels of happiness (Nisbet & Zelenski, 2011).

All information you provided is considered completely confidential, your name will not be included in any other way associated, with the data collected in the study. Furthermore, you will not be identified individually in any way in any written reports of this research. Paper records of data collected during this study will be retained indefinitely in my locked office in a locked drawer of my desk available only to myself and Bryan Grimwood my supervisor. All identifying information will be removed from the records prior to storage.

This project has been reviewed by, and received ethics clearance through a University of Waterloo Research Ethics Committee. In the event you have any comments or concerns resulting from your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

If you think of some other questions regarding this study, please do not hesitate to contact Emily Grant.

We really appreciate your participation, and hope that this has been an interesting experience for you.

References

Nisbet, E. K and Zelenski, J. M. (2011). Underestimating nearby nature: affective forecasting errors obscure the happy path to sustainability. *Psychological Science* 22(9), 1101-1106.