

THERAPEUTIC BENEFITS OF NATURE IMAGES ON HEALTH

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ABSTRACT

This thesis is a journey that travels back in time, when nature and health were inseparable, and forward to a time when science was the impetus for separation between the natural landscape and healing (chapter two), then into the present when nature and health are being reunited, only *through* science (chapter three).

The research conducted in 2008-2009 is reported in the form of three journal articles. The first article (chapter four) developed a methodology using sequential methods to select the nature images that would be used in the experiment. Appleton's prospect refuge theory was the basis for four image categories. The second article (chapter five) reports on the experimental procedures using multiple methods of psychological and physiological data collection to assess the therapeutic influence of the image on a person in pain. The third article (chapter six) reports on findings related to 'presence', a virtual environments concept that reports on a sense of "being in" the mediated environment and 'influence', which measured how much the image influenced thoughts during three stages: rest, pain treatment, and recovery.

This exploratory study was designed in an interdisciplinary format, using various theory, methodology, and concepts from a broad array of disciplines to investigate which nature images are more therapeutic than others. Only statistically significant results are reported.

ACKNOWLEDGMENTS

Joseph Campbell described the hero's journey "not as a courageous act but a life lived in self discovery." The hero, he believed, was "someone with the wisdom and the power to serve others" (Campbell, 1988, p. xiv). Therefore, I wish to acknowledge the heroes I have met on this educational journey.

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CHAPTER ONE

INTRODUCTION

It is not evident in the beginning what the outcome should be and speaks to a journey. Interdisciplinary work in terms of understanding the relationship between landscapes and healing is a journey. This theme has been a part of human progress. The purpose of this thesis, to arrive at a methodology for determining which nature images are more therapeutic than others, has been a step on this road of progress. This work has added to the continual desire of humankind to be part of and connected with its natural environment.

Symbolic landscape features associated with health included the staff of Asclepius, statues of the healing gods at the Roman baths, and art work depicting nature in a hospital patient room. Yet nature, whether it be found in the natural landscape or built landscape, has often held a spiritual connection for people with God or the divine. Medieval beliefs and Transcendentalist writings are particularly filled with divine associations with nature. Joseph Campbell, mythology scholar and former professor at Sarah Lawrence, claims that it is in experiences with nature that people experience the “mystery” of the unknown. He quotes a popular saying from the Upanishads, “When before the beauty of a sunset or of a mountain you pause and exclaim, ‘Ah,’ you are participating in divinity” (Campbell, 1991, p. 258). Campbell claims that people who live in the world of nature experience these types of divine moments every day and that the

experience transcends all times and all cultures. William James, an influential late 18th to early 19th century Harvard professor who contributed to the fields of physiology, psychology, and philosophy described this mystery associated with well-being and health, “Apart from anything acutely religious, we all have moments when the universal life seems to wrap us round with friendliness. In youth and health, in summer, in the woods or on the mountains, there come the days when the weather seems all whispering with peace, hours when the goodness and beauty of existence enfold us like a dry warm climate, or chime through us as if our inner ears were subtly ringing with the world’s security.” -- William James (1902) (Tuan, 1974, p. 98)

The Therapeutic Benefits of Nature Images on Health pursues the notion that the natural environment has the potential to be a healing force for people under stress or in pain. This study is exploratory and preliminary. The research was conducted on a college campus using student participants in a simulated hospital patient room in order to test the process on a healthy population prior to conducting the research on real patients in a hospital environment. The ultimate reminder of the Hippocratic oath, to “Do no harm” dictated this process.

This thesis contains seven chapters, two of which are articles that have been submitted to peer reviewed journals (chapters five and six) while two are in preparation (chapters two and four). Chapters two and three are a review of the literature. These two chapters situate this study within a larger tradition and knowledge base from a historical and contemporary perspective.

Chapter two illustrates how nature and healing were inextricably intertwined in ancient history, then completely separated, due to scientific discoveries in the 19th century. Chapter three uses a 30⁺ year timeline to identify significant contributions to the understanding and study of the therapeutic benefits of nature and health. This review of the literature focuses on contributions to two broad areas: concepts and theories, and significant research.

Chapters four, five, and six report on the research. The research studies developed in reaction to the work that is highlighted in the previous chapters. Each of these research reports includes a brief background of pertinent literature, research questions and hypotheses, research design and methods, results, limitations of the study, and a discussion of the findings.

Chapter four presents a replicable process for the selection of nature images that is built around theory and methods. An established theory, Appleton's prospect refuge theory of landscape preference, contributed the four categories of landscapes images that were studied. These categories include prospect, refuge, hazard, and mixed prospect and refuge. Selecting the preferred photographic image to represent each category involved four stages. Using sequential methods that included investigator selection, focus groups, a controlled sort task, and a content validity analysis, 300 possible images were reduced to one "best" representative for each of the four landscape categories being examined in the next phase, a clinical experiment.

Chapter five is the core study of the Therapeutic Benefits of Nature Images on Health because it examined the effects of the different nature images on perceived pain levels of research participants. This study answered the pertinent question, which image category is more therapeutic than others for people experiencing pain in the hospital patient room? First, the experiment was conducted using 32 pilot participants in a simulated hospital patient room. Each participant viewed only one image (or a blank screen), Figure 1.1, 1.2, 1.3, 1.4. Participants health responses in the form of physiological data (heart rate and blood pressures) and psychological data (self-report surveys) were collected during a rest period, a pain stressor, and a recovery period, As a result of the pilot trial, the processes were altered and the experiment was conducted again, this time using 109 participants. Responses from each image category were analyzed and statistically significant data were reported. Though no one image was truly 'most therapeutic', the hazard image and mixed prospect refuge image offered statistically significant responses that point to additional research opportunities (hazard image) and an opportunity for evoking therapeutic responses (mixed prospect and refuge image).



Photo: Ellen Vincent

Figure 1.1. Prospect image projection



Photo: Ellen Vincent

Figure 1.2. Pilot participant viewing refuge image



Photo: Ellen Vincent

Figure 1.3. Pilot participant viewing 'hazard' image



Photo: Ellen Vincent

Figure 1.4. Mixed prospect and refuge image projection

Chapter six reports on the levels of presence, how much the person experienced “being in” the image they viewed, and how much “influence” the image had on their thoughts. Perceived levels of presence and influence were rated five times during the session in order to capture changes over time and experience (rest versus pain versus recovery). These exploratory questions and the methods used to answer the questions add another level of understanding to the relationship between the image and the viewer. Statistically significant ‘influence’ responses were reported for the hazard image over time.

Chapter seven contains three sections. The first section identifies the distinguishing features of the study pertaining to theory and methodology. Section II outlines suggestions for breaching the gap between evolutionary and cultural/environmental preferences in theory and methodology. Section III discusses using research based therapeutic images in more contemporary formats.

This work builds on that which has come before, but it was undertaken with a modern notion, that true understanding can only come from a blending of the disciplines. The findings of this research have shown that image selection that is guided by sequential methods, not just by the investigators perceptions, contributes to a strong research methodology. Secondly, the use of appropriate theory, methods, and design for experimental use were only possible due to the involvement of the best minds available from an array of disciplines. These

multiple disciplines and approaches, synthesized together, resulted in a study that can and should be replicated. Lastly, this study also demonstrated that the use of multiple methods of data collection, multiple psychological and multiple physiological measures, are necessary to better understand the relationship between nature images and human health.

This methodology has great promise and will no doubt be improved. This work is part of a continuum of inquiry regarding nature and health that has existed for generations. Now, this work, based on interdisciplinary analysis using reproducible methods suggests that this model of inquiry can yield fruitful results.

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CHAPTER TWO

HISTORICAL EXAMPLES OF THERAPEUTIC LANDSCAPES

Introduction

Landscapes throughout time have been bestowed with therapeutic powers. Nature and health were interwoven to form healing landscapes. This relationship changed drastically with the advent of germ theory in the 19th century. Then, nature and health became separate, at least in western cultures. Landscapes became downgraded to sources of aesthetic pleasure, rather than healing places. In a time of escalating healthcare costs and increasing usage of healthcare systems, there is a resurgence however in contemporary thinking that believes nature has therapeutic qualities that can benefit hospitals and other healthcare environments. Researches who are pursuing this knowledge are using scientific methods to uncover the links between nature and health to better understand how nature can be used as a therapeutic agent. This brings the story of nature as a healing agent full circle. First, nature and health are interwoven; then, due to advances in science, nature and health are separated. Now, they are being reunited, through science.

Beginning with Buddha, healing relationships between a people and a specific landscape or landscape features are identified. Relationships are never simple so whenever possible the identified landscape is broken into categories of natural, built, and symbolic. Cultural geographers Gesler and Kearnes (2002) claim there is a synergistic effect between landscapes and healing places. The

basic concept, according to Gesler, is that both humans and landscapes have a creative force upon one another. Landscapes may in fact become social documents, “manifestations of symbolic systems” (Gesler, 1992, p.170). It may be useful to remember that symbols and landscapes are read differently. Their meaning, even within a specific school of thought, is ripe with individual interpretation.

5th- Century BCE

Buddha (5th century BCE) is symbolically associated with the landscape of trees. “Buddha Gotama was born, attained enlightenment, and died under trees” (Palmer 2001, p. 1). Born into a royal family in northern India, the young prince Siddharta Gotama was overwhelmed by the suffering, the illness, the old age, and the death he saw outside the palace gates. He adopted a life of contemplation and meditation and simplicity to try to understand the meaning of life, death, and suffering. “Seeking the supreme state of sublime peace, I wandered....until...I saw a delightful forest, so I sat down thinking. Indeed, this is an appropriate place to strive for the ultimate realization of...Nirvana” (Palmer 2001, p. 1). Gotama, who assumed the name Buddha after realizing enlightenment, had great compassion for the environment of people, animals, and plants. The natural landscape of forests appeared in textual references as important places for spiritual reflection and for teaching spiritual practices (Palmer, 2001). Trees, reports Schroeder (1991) have traditionally been used as symbolic landscapes by people to express their relationship with the world

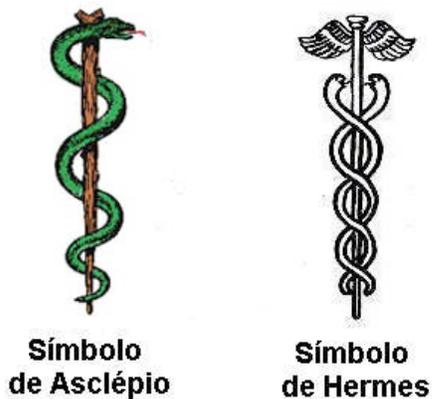
around them and to the spiritual or divine. Trees have been used to symbolize health, wisdom, and enlightenment in many different world religions and cultures. Groves of large trees often create a feeling of sanctuary and safety.

Greek Medicine: 500-300 BCE

Greek philosophers often engaged in discourse that included topics of illness and healing. One of the practices that arose at this time involved pilgrimages to the temples of Asclepius. People seeking healing and people wishing to retain good health would travel to Asclepieia, places where Asclepius could heal them (Gesler, 2003). Pilgrims were invited to enter the healing environment to sleep and dream. It was believed that during the dream stage, the cure for one's illness or problem would appear. The temples of Asclepius were often located in "soft" environments (Gesler, 2003, p. 30), natural settings of fresh air, pure water or mineral springs, and trees. The landscapes were often sheltered, located in hollows or open valleys ringed by hills with streams of water running through them and were considered havens or safe places (Gesler, 2003).

People on pilgrimage commonly endured great hardships before reaching their destination due to the long journeys, poor roads, robbers, inclement weather, way finding issues, or burdensome psychological or physical infirmities. The end destination often becomes "a symbolic landscape at a sacred site", as a result of the arduous journey (Gesler, 2003, p. 73). This also created an

environment ripe for healing and transformation. The story that symbolically endorsed Asclepius as a healer and allowed people to identify with him claimed that the god Apollo had taken a mortal woman Koronas, the daughter of a king, as his lover. She then had an affair with a mortal man and Artemis, Apollo's sister, killed Koronas, for being unfaithful. Koronas, who was pregnant with Apollo's child, was being burned on her funeral pyre, when Apollo, full of remorse, rescued the living child from his mother's womb. This was reputed to be the first Cesarean birth in European history. Apollo placed his son under the care of Cheiron, a wise centaur who taught him the practice of medicine (Gesler, 2003). Dogs and snakes became symbols of Asclepius's healing. Dogs at the temples apparently licked peoples' wounds while the harmless common snake was also bestowed with healing powers (Ibid). The staff with a single snake coiling about it is the symbol of Asclepius, and is considered by some to be the "only true symbol of medicine" today (Wilson, 1997, p. 173). More frequently however the modern medical symbol features two snakes on a staff, which instead relates to the Greek god Hermes or Mercury from Roman mythology (Wilson, 1997), Figure 2.1.



Source: *Europe's Journal of Psychology* www.ejop.org

Figure 2.1. Asclepius single snake and Hermes double snake symbols

Hippocrates (460-375 BCE) is the Greek name most often associated with western medicine (Cule, 1997). He contributed the practices of direct observation and record keeping to the field of medicine and established a set of ethical guidelines that inspired the Hippocratic oath, to “Do No Harm” which is still used to remind physicians of their ethical obligations and responsibilities. He may have also been the forefather of the holistic health movement, as he encouraged medical practitioners to focus on the whole person, rather than on a single part. Practitioners of Hippocrates teachings, known as the Hippocratic School, extolled the belief that nature was bestowed with healing properties and that there was a natural tendency for things to heal without intensive intervention (Cule, 1997). Hippocrates believed illness was a natural process and believed the causes of many diseases were directly linked to their natural environments (Wilson, 1997). Treatment involved providing a beneficial environment for the patient and

suitable diet and exercise. Beneficial natural landscapes that would ensure good health included clear water that ran down from high ground or from the atmosphere, “Rain waters, then, are the lightest, the sweetest, the thinnest, and the clearest...” (Hippocrates, 2004, p. 11). Additional healing environmental features included wooded fertile land, “a country covered with trees and well watered” (Ibid, p. 19) gentle light winds and sunshine.

Roman Baths

Nature was linked to health during Roman times through engineered water. Surviving literature of the time, and interpretations of archeological remains indicate that Roman baths and bathing were widely associated with good health, well-being, and healing. (Cunliffe, 1971). Baths were prescribed for medicinal purposes by medical authors such as Pliny the Elder (23-79 BCE) and Galen (130-200 BCE) as well as by lay writers in the upper classes (Fagan, 1999). Medicinal baths were often located at hot springs, one being the settlement at Bath, England known as *Aquae Sulis*, where the water “gushed out of the earth with such violence close to the Avon crossing” (Cunliffe, 1970, p. 2). The story that symbolically connected the springs at Bath to healing involved a King’s son, Bladud. He contracted leprosy and left court to fend for himself. He became a swineherd and infected all his pigs with the disease. One day, he noticed that his pigs were attracted to the black muddy water around the mineral springs, which they wallowed in. Afterwards, he noticed their sores had healed.

He immersed himself in the water and he also was miraculously healed. He was ultimately welcomed back to court and became king (Gesler, 2003, Cunliffe, 1971).

The Romans possessed the engineering and plumbing skills necessary to harness the water and filter out the sand at the spring. They redirected the water into a built bathing pool (Gesler, 2003) that was described as “simple and elegant” (Cunliffe, 1970, p. 12). A community grew up around the hot spring at Bath and people travelled from great distances to bathe in the healing waters. It is speculated that the Roman pools at Bath were as popular then as they were during the 18th century, when Bath was the most fashionable place to go in Europe (Cunliffe, 1970). Symbolic statues of healing figures, Asclepius and Hygeia, were commonly found at Roman baths (Fagan, 1999).

Nature was connected with Roman residences as well. Roman residential landscapes contained atriums, great open hallways that often featured a fountain of water in the center. Gardens were secure and sheltered. Constructed walls often surrounded gardens that contained stone tables and benches for outdoor seating and dining as well as plants (Turner, 2005). Useful herbs for culinary and medicinal use, such as parsley and fennel and mustard were cultivated as were fruits. Trees that provided shade included pines and cypress (Ibid).

Medieval Monastery Gardens

In the Middle Ages monasteries planted gardens that protected healing plants from the turbulence of the times. With the collapse of the Roman Empire Europe had become a “continent of warring tribes” (Turner, 2005, p. 109). Just as the Greeks would travel great distances to reach a temple of Asclepius, so would medieval people pilgrimage at great cost to reach a monastery for healing.

Behind protective walls, herbs and flowers used for medicine, dyes, scents, and seasonings were cultivated (Bayard, 1985). Many of these useful plants were also quite fragrant, such as roses, rosemary, fennel, and iris. Gardens were also planted near the infirmaries so patients could reflect on the view and make connections to God (van den Berg, 2005). These gardens were also places where people could meditate or recuperate from illness (RMNO, 2004; van den Berg, 2005). The cloistered garden often contained symmetrical beds, frequently arranged in simple but precise geometrical patterns (Turner, 2005). Fruit trees were often found in the center of the beds and functioned as focal points (Bayard, 1985). Small areas of lawn were also cultivated as part of the garden (Turner, 2005).

The relationship between nature and health peaked with the prevalence of herbal medicine and a body of literature, known as ‘the herbals’, was created (Cule, 1997). Stylized illustrations of the plants in the early herbals were made by wood block printing and copies of these early illustrations are still popular today as art.

The Renaissance

Renaissance hospital architecture blended beauty and function and included gardens in the built landscape. Hospital gardens and grounds were important and were tended by servants and nursing staff as well as paid part and full time gardeners (Henderson, 2006). A resurgence in popularity of Roman landscape architecture occurred during the Renaissance, which meant ample attention was given to the engineering of the built landscape. Gardens were often rectangular shaped and contained a dominant central axis. Classical statues were used as central focal points and fountains were often inserted in niches along walls. The plants included in the garden were often clipped hedges (Turner, 2005).

Herbals were still a popular source of medical reference, but during the Renaissance new books were published that featured accurate, rather than stylized drawings of plants and people. German botanist Leonhard Fuchs (1501-1566) published *De historia stirpium, The History of Plants*, in 1542. Traditionally, scribes only copied illustrations from existing books. Fuchs changed the trend by copying real plant material directly from nature, Figure 2.2 and Figure 2.3. The realistic images of plants aided correct identification of medicinal plants (Cule, 1997).



Figure 2.2. Scribes copying real specimens (Fuchs, 2001)



Figure 2.3. Wood cut illustration from *Gerard's Herbal* (Johnson, 1975, p. 1109)

In 1543 Andreas Vesalius (1514-1564) produced *De humani corporis fabrica, The Structure of the Human Body*. This publication included realistic images of human anatomy, Figure 2.4 and supported the developing Renaissance aesthetic, which insisted that art be an accurate and precise representation of the natural object, (Saunders & O'Malley, 1950).

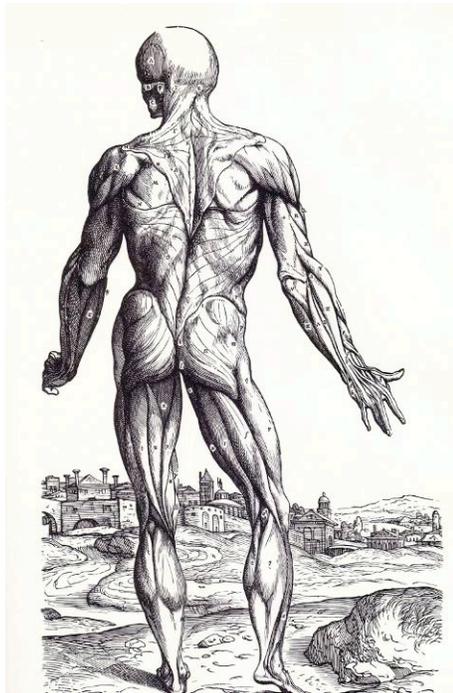


Figure 2.4. Realistic anatomical drawing by Vesalius (Saunders & O'Malley, 1950, p. 109)

Vesalius' drawings were obtained through the practice of human dissections. Dissection was increasingly used to train physicians and surgeons

during the Renaissance (Wilson, 1997) in defiance of religious beliefs. It was at this time that the body began to be viewed as “soul-less”, a machine by some, a series of parts (Wilson, 1997, p. 181).

A third publication in 1543 was by Nicolaus Copernicus (1473-1543), *De revolutionibus orbium coelestium, On the Revolution of the Celestial Spheres*, defied the astrological beliefs of the times and claimed the sun was the center of the planetary system. These realistic published works, according to Cule (1997) permitted scholars to work directly from nature.

These three books contributed to several transformative processes. First, they empowered people to question previous authoritative doctrines, and to examine the natural landscape that they lived in with accuracy. Images and concepts for literature were now created literally rather than figuratively. Secondly, they encouraged people to look clearly and carefully at their natural environment for answers to questions regarding health and well being, which laid the intellectual groundwork for the development of experimental science.

18th Century Picturesque Movement

In the 1700s the ‘picturesque’ landscape aesthetic was popularized by a group of intellectuals who celebrated seeing and appreciating nature as it was, rather than subjecting her to surgical reconstruction. The picturesque took its place on an aesthetic continuum between ‘beautiful’ and ‘sublime’ (Carlson,

2007) and established a beneficial connection between the natural landscape and art, Figure 2.5.



Beautiful

Picturesque

Sublime

Photos: Ellen Vincent

Figure 2.5. 18th century continuum of landscape preference

The concept of ‘beautiful’ refers to the cultivated and tamed European gardens and landscapes. There were smooth and soft features in this landscape. The ‘sublime’ on the other hand was rather terrifying, with rugged wilderness elements such as craggy peaks and steep slopes. The ‘picturesque’ landscape fell somewhere in between the beautiful and the sublime and celebrated rough tree bark (“rugged old oak”) rather than smooth, choppy water rather than glass-like, and gothic architecture rather than Grecian (Price, 1971, pp. 54, 56- 57.) The picturesque landscape began to be viewed as art-work at this time (Carlson, 2007). It was held in high esteem by those who saw the landscape as beauty, or “works of nature” to influence art.

Two picturesque theorists who advocated for the beauty of the vernacular were Uvedale Price (1747-1829) and Richard Payne Knight (1751-1824).

Roughness, intricacy, and variety were evident in these landscapes (Fryer, 1994). John Conron, a picturesque theory historian, claims items in the middle ground of the picturesque landscape are unusually “complex and eccentric, varied and irregular, rich and forceful, and vibrant with energy” (Carlson, 2007).

Of the three aesthetic concepts, the ‘picturesque’ supplied continuity between appreciating art and appreciating nature. The natural landscape could be experienced as if it were a landscape painting. Viewing the scene was desirable whereas immersion was not at all necessary for enjoyment (Turner, 2005).

The picturesque theorists connected intellectual, spiritual, and physical health with their preferred natural landscapes. Uvedale Price compared the art of gardening to the practice of medicine, “There is no small degree of resemblance between the art of gardening, and that of medicine, in which, after the general principles have been acquired, the judgment lies in the application; and every case (as an eminent physician observed to me) must be considered as a special case...in both arts the quacks are alike; they have no principles, but only a few nostrums, which they apply indiscriminately to all situations, and all constitutions. Clumps and Belts, pills and drops, are distributed with equal skill; the one plants the right, and clears the left, as the other bleeds the east, and purges the west ward. The best improver or physician, is he who leaves most to nature; who watches and takes advantage of those indications which she points out when left

to exert her own powers, but which, when once destroyed or suppressed by an empiric of either kind, present themselves no more” (Price, 1969, p. 253).

19th Century

Frederick Law Olmstead (1822-1903) noted 19th century designer of America’s parks and park systems claimed that parks made people feel better. In his 1865 writings, Olmsted claimed people living in urban environments suffered from “nervous exhaustion and nervous irritation” (Beveridge, 1997, p. 605). Urban dwellers were also more inclined than their rural counterparts to suffer ill health.

Parks, however, were tranquilizing and restorative. (Beveridge, 1997, p. 86). “A park may affect a man at the first visit exhilaratingly, which, when he is accustomed to the use of it, will have a reverse, that is to say, a soothing and tranquilizing effect” (Beveridge, 1997, p. 464).

People were leaving the countryside to obtain work in the cities and the urban infrastructure of the time was not developed to handle the flood of arrivals. Poor sanitary conditions were the norm and contagious diseases spread easily among people. Accurate diagnosis of illness and preventive and curative strategies were not developed at this time. Instead, people relied on the powers of observation and study of the landscape to help solve problems, including illness (Nadenicek & Hewitt, 2005).

The therapeutic role of the natural and built landscape is illustrated in the following 1881 quote by Olmsted: “These terms (sanative and restoring) are not metaphorical. They testify precisely that the charm of natural scenery is an influence of the highest curative value; highest, if for no other reason, because it acts directly upon the highest functions of the system, and through them upon all below, tending, more than any single form of medication we can use, to establish sound minds in sound bodies-the foundation of all wealth...”(Hewitt, 2005, p. 9-10).

The prevailing belief that cities caused ill health espoused by Olmsted and others created an exodus of insane asylums from urban to rural areas. The asylums were ideally set in tranquil natural settings “where the mad could be set apart from that which was driving them mad” (Gesler, 1992, p. 174). What was unique about Olmsted is that he did not migrate to the rural areas, which he celebrated. Rather, he created therapeutic places for people within city limits, for example Central Park in New York City and Boston’s Emerald Necklace being two of the most notable (Turner, 2005).

Olmsted’s belief that nature was healing or therapeutic was also being echoed by the Transcendentalists of the time, Ralph Waldo Emerson (1803-1882) and Henry David Thoreau (1817-1862) being the best known members of the group. Emerson and Thoreau were both graduates from Harvard, where they met and became lifelong friends (Krutch, 2004). The roots of transcendentalism are traced to Immanuel Kant’s claim that the human mind “forms” experience

(Goodman, 2009). Emerson stated that the transcendentalists believed in “the perpetual openness of the human mind to new influx of light and power” (Ibid). Nature, according to the Transcendentalists, was both a spiritual and physical necessity and immersion in nature was essential for emotional and physical health (Emerson, 1893). In 1845 Thoreau built a small one-room cabin on Walden Pond where he lived for two years and two months and kept a journal of his experiences and thoughts (Thoreau, 2004). His purpose was to reflect; on nature, himself, and social and economic situations in general. He felt that living in the wild was better than that “life of quiet desperation” which results from too much concentration on “getting ahead” in the material sense (Krutch, 2004, p. 8). *Walden* was written as a result of his experience in nature and published in 1854. Its popularity has increased over time and reprints are still reissued.

Emerson, like followers of the Picturesque movement, saw nature and art as connected. “Nature in the common sense, refers to essences unchanged by man; space, the air, the river, the leaf. Art is applied to the mixture of his will with the same things, as in a house, a canal, a statue, a picture.” (Emerson, 1893, p. 12).

While Emerson and Thoreau were writing about nature, and encouraging open-mindedness among people through immersion in wild nature, Olmsted was altering nature by designing parks for people that featured open air and also encouraged immersion. Their shared goal was for social and physical well-being and an understanding that ‘being in nature’ was essential to achieving this.

Mountain Cure Cottages

The natural landscape, in the form of wilderness and fresh air, became associated with the cure of tuberculosis in the late 1800s and early 1900s due to the contributions of Dr. Edward L. Trudeau (1848-1915). Trudeau came from a distinguished family of doctors on both his mother's side and his father's. His father and father-in-law were both founders of the New York Academy of Medicine (Rinehart, 2002). His father was an outdoor enthusiast and friend of naturalist John J. Audubon. Trudeau's father spent more time on hunting trips than he did practicing medicine and once spent two years living with the Osage Indians.

Edward Trudeau was first exposed to tuberculosis in 1865 when he was 17 years old. His brother Francis became ill with the disease and as there were no trained nurses for tuberculosis patients at the time, Edward became his brother's caretaker until Francis died three months later. As coughing was the main symptom of pulmonary tuberculosis, the medical advice of the day was to keep windows tightly closed. Edward remembered his brother asking for fresh air near the end of his life, which Edward provided by opening the windows. He reflected on the experience later, "How strange that, after helping stifle my brother and infect myself through such teaching as was then in vogue, I should have lived to save my own life and that of many others by the simple expedients of an abundance of fresh air....This was my first introduction to tuberculosis and to death...It was my first great sorrow... and I have never ceased to feel its

influence. In after years it developed in me an unquenchable sympathy for all tuberculosis patients—a sympathy, which I hope, has grown no less through a lifetime spent in trying to express it” (Rinehart, 2002, p. 5).

At age 25, after graduating from medical school, marrying and having a child, Edward Trudeau was diagnosed with tuberculosis, also referred to as consumption. Preparing to die, he left his family to return to the “peace of the wilderness” in the Adirondack mountains where he had spent time in childhood (Rinehart, 2002, p. 8). He arrived at Paul Smith’s Hotel, a rustic lodge, where he was too weak to walk and had to be carried to his room by a local wilderness guide. The landscape surrounding Paul Smith’s was a river valley surrounded by trees and mountains with fresh running streams and lakes. To his and everyone else’s astonishment he did not die, In fact, he slowly recuperated. He spent the next several years travelling back and forth between New York City and the Adirondacks and he would fall ill again when he left the mountains for any length of time (Gallos, 1985).

Trudeau made a series of discoveries from his personal experiences and rabbit research experiments and concluded that a combination of fresh air, rest, abundant good food, and when possible, mild exercise could strengthen the afflicted person and return quality of life. He also believed that treatment needed to include peace of mind and hope. While people never truly recovered from tuberculosis, one or two years of the wilderness experience could send the symptoms into remission, and a relatively normal life could be led (Gallos, 1985).

Trudeau built the Adirondack Cottage Sanitarium project for working class patients so they could come and experience the natural landscape that had aided his recovery. This became the first sanitarium of its kind in the U.S. The first cure cottage, called Little Red, cost \$350 to build and housed two patients. In 1884, Mary and Alice Hunt, two factory workers, arrived. They moved into Little Red, a small cottage with a roofed front porch, a cross between a portico and veranda (Gallos, 1985). The sheltered porch became the architectural symbol of the cure cottage and was the place where the tuberculosis patient interacted with nature and with people (Gallos, 1985). Cure chairs, the precursor to the outdoor lounge chair, were a necessity on the porches of the cure cottage. The chairs often reclined so that patients could stay outdoors while resting. Patients would bundle up in blankets, coats, and hats in order to stay outdoors even during cold weather. Porch views were of other cottages, pine trees, mountains, streams and lakes, and wildlife.

As word spread, more and more doctors referred their tuberculosis patients to Saranac Lake for a chance of recovery. The response to the fresh air cure was so positive that an entire town grew to accommodate tuberculosis patients. The patients were called “health-seekers” by the locals and Saranac Lake was called “pioneer health resort” by the rest of the United States (Gallos, 1985, p. 6). By 1909, 352 private and state institutions for the treatment of tuberculosis existed based on the Trudeau model (Rinehart, 2002). In 1912 Trudeau developed a training school for nurses and in 1917 he developed a six-

week training class in tuberculosis for post-graduate school physicians. Doctors from around the world came to Saranac Lake for training (Rinehart, 2002).

Garry Trudeau, American cartoonist, best known for the *Doonesbury* comic strip is Edward Trudeau's great-grandson. He remembers growing up in a "company town, built upon a single industry which one autumn day during my childhood simply ceased to be. Antibiotics had arrived, almost overnight, rendering the fresh-air cure completely irrelevant" (Rinehart, 2002, p. ix). The sanitarium closed its doors in 1954.

Germ Theory

Germ theory identified microscopic organisms as the cause of many diseases. Previously, it was thought that environmental conditions such as climate were involved in the disease process. Germ theory suggested that disease was simply an interaction between a microorganism and a host with no environmental causes (Harvard, 2009).

Germ theory developed between 1850 and 1920 and transformed medicine. It appeared at a time when Europe and North America were fully engaged in mechanization and mass production and germ theory was found to be quite compatible with the values of efficiency and standardization of the times. Germ theory was also compatible with the sanitation and hygiene measures that were developed earlier during 19th century though some of the stronger proponents of hygiene and sanitation such as Florence Nightingale were

skeptical about its value (Harvard, 2009). Improved sanitation and hygiene regimens accompanied by germ theory, vaccines, and eventually antibiotics in the 1940s all spoke to health as being separate from nature.

Contemporary Research Concerning Nature and Health

There is renewed interest in the health benefits of nature, largely emerging from the newer interdisciplinary fields of study such as environmental psychology, architecture and health, environmental design and planning, and virtual environments. This has largely been triggered by advancements in stress research (Selye, 1976), and to an understanding that stress negatively impacts health outcomes (Johnston & Wallace, 1990). A new field in biomedical research called psychoneuroimmunology (Straub, 2002) investigates the interactions of psychological processes, the neuroendocrine system (nervous and hormonal systems) and the immune system. Various forms of nature interventions in healthcare settings have been linked to stress reduction and in a few cases to pain distraction.

While some hospitals today are installing green roofs, meditation gardens, and including nature art on the walls, the question remains, which landscapes are more therapeutic than others? Do various illnesses or treatments require different types of landscapes or landscape images to stimulate emotional and physical well being? Research is ongoing and fortunately being used to investigate the therapeutic benefits of nature on health (chapter three). This

brings the ancient relationship between nature and health full circle, only now science is a partner in that relationship.

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CHAPTER 3

30+ YEAR TIMELINE OF KEY EVENTS FOR THERAPEUTIC BENEFITS OF NATURE ON HEALTH

Introduction

A review of the literature pertaining to nature and health resulted in the 30+ year timeline of key events, Appendix G. The timeline was then divided into two broad categories of concepts and theories, and significant research, which are reported in two parts within this chapter. These areas each contain contributions that have advanced the understanding of nature and health research. The timeline includes influential books in addition to published scholarly articles and does not include all of the accomplishments that have occurred within the nature and health field.

PART I: THEORIES AND CONCEPTS

Introduction

Significant concepts and theories pertaining to nature and health over the past 30 years, 1975-2005, are identified in Table 3.1. First, the concept of stress is better understood as having serious health outcomes, particularly in the healthcare setting and during surgery. Then, environmental landscape preference theories with an evolutionary perspective are highlighted. Appleton's prospect refuge theory and biophilia are described in this section. Restorative

environments, environmental preferences, and attention restoration theory developed by Kaplan and Kaplan are next outlined and illustrated. Ulrich's theory of positive distraction and the concept of emotional congruence are then highlighted. Finally, the concepts and activities that established nature within healthcare settings are highlighted. The Planetree model, healing gardens, and evidence-based design are included.

Table 3.1. 30+ year timeline of concepts and theories for nature and health

Year	Contribution	Author
1975	Prospect refuge theory of landscape preference	Appleton
1976	General adaptation syndrome to stress	Selye
1979	Hospitals are stressful places	Cousins
1982	Environmental preference matrix	Kaplan & Kaplan
1988	Surgery is stressful	Johnston
1989	Restorative environments	Kaplan & Kaplan
1989	Preference matrix advanced	Kaplan & Kaplan
1990	Stress effects medical outcomes	Johnston & Wallace
1990	Theory of positive distraction	Ulrich
1993	Biophilia	Kellert & Wilson
1995	Attention restoration theory (ART)	Kaplan
1996	Prospect refuge theory revisited	Appleton
1997	Psychoneuroimmunology	Ader, Felten, & Cohen
1998	5 preference patterns to restorative environments	Kaplan, Kaplan & Ryan
1999	Healing gardens for healthcare settings	Cooper Marcus & Barnes
2003	Reasonable person model (RPM)	Kaplan
2003	Planetree model developed in <i>Putting patients first</i>	Frampton, Gilpin, & Charmel
2003	Hospitals are stressful places	Frampton, Gilpin, & Charmel
2003	Emotional congruence theory	Ulrich & Gilpin
2005	Evidence based design scorecard includes points for positive distractions in hospitals	Center for Health Design

Stress and Medical Outcomes

Clearer understanding of the concept of stress and its effects on health helped advance environment and health research. Stress used to be thought of as a person's physical response to external forces. The body was thought to function like a machine, independent of the mind (Straub, 2002). The concept and understanding of stress as an interactive process between both the mind and the body was enhanced by the work of Hans Selye (1907-1982) who discovered the effects of stress on rats and adapted the knowledge to human behavior studies. Selye identified three stages of stress response that he called the general adaptation syndrome (Selye, 1976). The three reactions to stress include alarm, resistance, and exhaustion. The alarm reaction is similar to the fight or flight response when adrenal activity and cardiovascular and respiratory functions increase due to perceived threat. The rate of increase is relative to the degree of perceived threat. Resistance is the body's reaction to the threat when it attempts to adapt by producing adrenal hormones to replace what has been used. If the perceived threat continues, the body experiences the third stage, which is exhaustion. With this stage comes increased risk for injury, illness, or even death (Selye, 1976; Straub, 2002). Selye, in *Stress in Health and Disease*, described the general adaptation syndrome as empirical support of a popular phrase, "The candle of life does not last long if you burn it at both ends" (Selye, 1976, p. 1147).

The science behind stress continued to evolve and by the late 1980s the term psychoneuroimmunology was used to describe a new field in biomedical research (Ader, Felten, & Cohen, 1991; Straub, 2002). Psychoneuroimmunology investigates the interactions of psychological processes, the neuroendocrine system (nervous and hormonal systems), and the immune system. Stress, immune system activity, and disease are now seen as having strong interactive forces upon each other and there is evidence that stress is linked with lowered immune system functioning (Straub, 2002; Morley, Benton, & Solomon, 1991). Studies conducted on animals and humans showed that wounds healed slower when subjects were under stress (Kiecolt-Glaser & Marucha, 1995; Kiecolt-Glaser, Page, Marucha, MacCallum, & Glaser, 1998; Straub, 2002).

In 1990 Johnston and Wallace's *Stress and Medical Procedures* was published. Johnston was associated with health psychology at Royal Free Hospital School of Medicine, London; while Wallace was principal clinical psychologist at Monyhull Hospital, Birmingham, UK. The clinical evidence linking stress to health outcomes was emerging and they concluded that using psychological interventions for stressful medical procedures was warranted (Wallace & Johnston, 1990). What was missing was clinical research to know which interventions were more effective than others and they acknowledged the difficulty involved with asking patients who felt sick or tired to participate in survey questionnaires and other data collection activities. Lastly, Wallace and Johnston set the stage for healthcare reforms, by acknowledging that research needed to

include the concerns of patients, staff, and the healthcare system in order to effect real life impact. They also advocated for patients to be given more control in the healthcare setting and treated as partners in the process (Ibid).

The contributions of the stress researchers set the stage for reforms within the healthcare environment by identifying that people's psychological reactions to stressful experiences have an affect on their physiological responses which may in turn effect their medical outcomes. This knowledge gave power and value to the concept of using "psychological interventions," mentioned by Wallace and Johnston (1990, p. 178) to attempt to reduce stress within the healthcare setting. Research using nature as a psychological intervention gained momentum and theories to philosophically ground the research received notice.

Evolutionary Theories

Evolutionary explanations for human development exploded onto the world stage with Darwin's *Origin of Species* in 1859. He announced that all life species were descended from common ancestors through the process of natural selection, commonly referred to as survival of the fittest (Wells, 2007). Modern evolutionary theory's roots are traced to the works of Charles Darwin.

Evolutionary explanations for human environmental preferences claim that humans developed an innate predisposition for certain types of environments during the long developmental stage spent as hunters and gatherers. For foragers and hunters, habitat selection was linked to survival. Over time, this

preferential choice for habitat became neurologically “hardwired”, a term used by Edelman (1987) and contributed to our modern day landscape preferences. In essence, these evolutionary theories and explanations agree that our modern day environmental preferences have biological roots in the past (Ruso, Renninger, & Atzwanger, 2003).

Evolutionary landscape preferences received attention in 1975 with the publication *The Experience of Landscape* written by Jay Appleton, emeritus professor of geography at University of Hull, England. This book described, in detail, a theory called prospect refuge. Appleton’s prospect refuge theory is an evolutionary theory that claims humans (as hunter gatherers) developed an ability to assess the environment for selection of habitats that would ensure survival (Appleton, 1975, 1996). “To see without being seen” was the viewer’s ideal objective in prospect refuge landscapes. Appleton’s extensive examination of landscape paintings led to major category titles and operational definitions for landscape features and content. Appleton developed clear definitions for each category described below. Category titles included prospect, refuge, and hazard.

Prospect characteristics presented real or symbolic access to a view in landscape images. Clear skies, low ground cover vegetation, and ideal viewing advantages (from a high space for instance) that allowed the viewer to survey their surroundings all characterized prospect landscapes, Figure 3.1. Refuge in the landscape meanwhile presented real or symbolic situations for hiding or sheltering. Refuge characteristics included dim light and places to hide from

inclement weather or people, Figure 3.2. Hazard in the landscape presented incidents or conditions that posed real or symbolic threats to life and well-being. A fierce storm, a bramble field that impeded locomotion or movement, an iceberg, or forest fire all characterized hazard landscapes, Figure 3.3. Landscapes that contained multiple types of imagery were named by the dominant feature (e.g. prospect-dominant, refuge dominant.) Landscapes with equal amounts of prospect, refuge, and hazard imagery were called balanced landscapes. A balanced prospect refuge landscape occurred when opportunities for both a view (prospect) and cover (refuge) were *equally* presented in the landscape, Figure 3.4. A bridge that provided a view (prospect) and trees with low climbable branches (refuge) that were equally visible within one image represented a mixed or balanced landscape.



Photo: Ellen Vincent

Figure 3.1. Prospect symbolized by clear views, low turf, and a mountain



Photo: Al Watson

Figure 3.2. Refuge symbolized in tree with low climbable tree limbs



Photo: Getty Images

Figure 3.3. Hazard symbolized by a snowstorm



Photo: Ellen Vincent

Figure 3.4. Balanced prospect and refuge with low groundcover (prospect), trees and rock wall (refuge)

A major criticism of evolutionary theory and Appleton's prospect refuge theory in particular is by scientists who feel that cultural and/or environmental influences have a much greater role to play in our landscape preferences than does biology or genetics. Appleton replied to the criticism in the second edition of *The Presence of Landscape* (1996) in Chapter 11 when he agreed that culture was most definitely an important factor effecting preference, just as heredity was. "There is no suggestion that it [prospect refuge theory] should supersede other frames of reference which have been successfully employed in the various disciplines concerned with this problem" (Appleton, 1996, p. 71). Bell, Greene, Fisher, and Baum (2001) appear to concur with Appleton, and added, "Even the most biologically oriented researchers do not suppose that we all have identical

landscape preferences” (Bell Greene, Fisher, and Baum, 2001, p. 45). They optimistically conclude, “We wait for a theory of landscape aesthetics that successfully accounts for both culture and biology” (Ibid, p. 47).

Evolutionary theory gained momentum again in 1993 with the publication of *The Biophilia Hypothesis*, edited by Stephen Kellert and E. O. Wilson. Kellert is a social ecologist at Yale; and Wilson is an entomologist and naturalist, two-time Pulitzer Prize winner for non-fiction, and professor emeritus at Harvard.

“Biophilia” was the term used to express the innately emotional relationship between humans and other living organisms. These evolutionary connections were formed during human’s hunter gatherer days (Wilson, 1993, p. 32).

Biophilia is not a single instinct but rather a set of inherent rules that could be sorted and examined individually. Wilson claimed they fall along a series of emotional lines and include themes of attraction to aversion, awe to indifference, and peacefulness to fear (Ibid, p. 31). These ancient lessons-learned explain our aversion to snakes (biophobia) as well as our penchant for nature (Wilson, 1993; Ulrich, 1993; Heerwagen & Orians, 1993).

Evolutionary theories are ideal for interdisciplinary research because they provide both a biological and psychological explanation for human’s inherent need for nature. This is important to nature health studies as interdisciplinary research is often weak in theory (RMNO, 2004; Dilani, 2005). Appleton’s prospect refuge theory also offered extremely clear landscape category titles and definitions that easily translated into functional operational definitions for

research use. Prospect refuge theory has been a popular topic for research studies during the past 30 years, especially in student theses projects (Yeates, 1997; Ramanujam, 2006; Juras, 1997; Herzog & Kutzli, 2002; Fischer & Shrout, 2006; Makhzoumi & Zako, 2007). There is no doubt however that the need for an effective cultural theory that can also be used in research is needed to compliment the evolutionary theories.

Kaplan's Theories

The timeline shows how productive Rachel and Stephen Kaplan have been over a 30 year period. Rachel Kaplan holds degrees in philosophy and psychology (Ph.D.) and Steven Kaplan holds a Ph.D. degree in psychology. The Kaplan's are prolific authors and have trained many researchers and professors. They are considered the pioneers of environmental psychology, being among the first to develop theoretical models of landscape preference (Carlson, 2007). The Kaplan's hold a cognitive view regarding preference, believing that knowledge and information about the nature of the object being appreciated is central to its aesthetic appreciation (Carlson, 2007).

Environmental preferences and restorative environments are two of their leading areas of discovery. Environmental preferences describe how people interact with preferred landscapes while restorative environments describe the type of environments that help people recover from mental fatigue.

Preferred environments are those that people can understand (make sense of) and want to go to (involvement) either now or later (Kaplan & Kaplan, 1982, p. 81). In *Cognition and Environment* (1982) a matrix for environmental preference is presented, Table 3.2. The four landscape qualities or components that people have an innate preference for include coherence, legibility, complexity, and mystery.

Table 3.2. Preference Matrix Framework (Kaplan & Kaplan, 1982, p. 81)

	MAKING SENSE	INVOLVEMENT
Present or immediate	Coherence	Complexity
Future or promised	Legibility	Mystery

Coherence refers to how easy it is to understand the components of the landscape. When components fit together well and there is some degree of repetition the landscape is high in coherence (Kaplan & Kaplan, 1982). Complexity in the landscape scene holds the viewers attention, providing “visual richness” (Kaplan & Kaplan, 1982, p. 83). Too little complexity may be boring while too much may be chaotic. Mystery invites the viewer to travel deeper into the scene, to explore or find out more. The scene will contain tantalizing hints of what is to come. Legibility is the assurance that the viewer will not get lost in the scene (Kaplan & Kaplan, 1982).

The concept of restorative environments appeared in *The Experience of Nature* (1989). Restorative environments offer a “concrete and available means of reducing suffering and enhancing effectiveness” (Kaplan & Kaplan, 1989, p. 176). The suffering the Kaplan’s are referring to is mental fatigue. Stress differs from mental fatigue because stress is an anticipated event that has been evaluated as harmful or threatening (Kaplan & Kaplan, 1989). Mental fatigue however may be caused by the same event but also may occur when there is no evidence of a harm or threat to well-being. Mental fatigue is caused by too much ‘directed attention’. (Ibid, p. 179).

William James (1842-1910) renowned American philosopher, psychologist, physiologist, and Harvard professor (Goodman, 2008) developed the concept of two types of attention: involuntary and voluntary. Involuntary attention required no effort at all. It is a compelling type of attention that automatically attracts. A flower blooming, geese flying, or bells of an ice cream truck are possible sources that elicit involuntary attention. James mentioned “strange things, moving things, wild animals”, as examples as well (Kaplan & Kaplan 1989, p. 179). The other type of attention “voluntary attention” however requires forced effort to pay attention to some stimuli. The Kaplan’s renamed this second type of attention “directed attention” to encourage clarity (Kaplan & Kaplan, 1989, p. 179). Directed attention may occur while studying for a test, working long hours, or when people “push” themselves to stay focused. James identified the mechanism behind mental fatigue as ‘inhibition’ (Ibid). In order to

stay focused on the task at hand everything else gets suppressed. The Kaplan's concluded that when people experience mental fatigue the underlying cause is fatigue of directed attention (Kaplan & Kaplan, 1989). People suffering from mental fatigue are likely to have poor judgment, make mistakes, be irritable, and be socially unavailable or unreliable (Ibid).

The Kaplan's then investigated ways people could recover from mental fatigue and developed the restorative environments concept as a result (Kaplan & Kaplan, 1989). While sleep was recognized as a good recovery activity, they wanted to know how people could recover during the day. Through their research they identified four different aspects to a restorative environment, being away, extent, fascination, and action and compatibility. These four aspects are described in Image Categories for Restorative Environments, Appendix A.

The first component of a restorative environment is "being away" (Ibid, p. 183). This implies being away, either physically or emotionally from the source of fatigue. The second component is "extent" (Ibid). Connectedness and scope make up extent and it resembles being in a "whole other world". Extent may be experienced physically or perceptually and a cognitive map may be built from the experience. A third component of the restorative environment is "fascination" (Ibid, p. 184). This element calls upon involuntary attention. Fascination requires no effort. The fourth restorative environment component is "action and compatibility" (Ibid, p. 185). The degree of compatibility between a person's desires and the capacity of the environment determines how restorative this

concept is. An example of frustrated action and compatibility occurs when one wants to read a good book outdoors and a storm blows in. The conclusion was that the ideal restorative environment would be one that contained all four components and allowed directed attention to rest. They hypothesized that a preferred environment would be restorative and had found from previous studies that people preferred natural environments (Kaplan & Kaplan, 1989). In addition, they claimed the concept of restoration through experiences in nature also offered mental and physical health benefits in addition to the recovery of directed attention (Kaplan & Kaplan, 1989).

The preference matrix of 1982, previously described, continued to be used as a framework for analysis to make sense of the research data they were acquiring. By 1989 in *The Experience of Nature*, it appeared that the most preferred scenes contained 'mystery' (Kaplan & Kaplan, 1989 p. 57). Scenes high in mystery contained partially hidden information and an invitation to explore the scene more, Figure 3.5.



Photo: Ellen Vincent

Figure 3.5 Wondering what is around the bend adds mystery to the landscape

In 1998, Kaplan, Kaplan, and Ryan published *With People in Mind: Design and Management of Everyday Nature*. They had found five preference patterns in restorative environments. They included quiet fascination; wandering in small spaces; separation from distraction; wood, stone, and old; and the view from the window. “Quiet fascination”, unlike noisy fascination, permitted reflection. Viewing natural scenes was mentioned as a way to evoke quiet fascination. Activities such as gardening, fishing, and bird watching also fit the pattern definition (Kaplan, Kaplan, & Ryan, 1998). The term “soft fascination” appeared in an

earlier publication (Kaplan & Kaplan 1989, p. 176). Soft fascination occurs when people view clouds, sunsets, scenery, the interplay of light on water, or blooms waving in the wind, Figure 3.6. People exposed to soft fascination tended to experience a reflective quiet mode that was thought to be conducive to healing (Kaplan & Kaplan, 1989). The involuntary attention triggered by soft fascination views or images had to be effortless in order to restore energy rather than cause fatigue.



Photo: Ellen Vincent

Figure 3.6. Soft fascination scene results in personal reflection

“Wandering in small spaces” is quite restorative if the space has “extent” (Kaplan, Kaplan & Ryan, 1998, 71-72). The space will feel like another world and will seem to offer more than can be seen. Often, these are small spaces with

depth and mystery, Figure 3.7. Japanese gardens were mentioned as ideal places to experience extent due to the strategic placement of plants, paths, and the resulting views. “Separation from distraction” implies that “extent” occurs without interruption, (Kaplan, Kaplan, & Ryan, 1998, p. 73). Enclosures in the form of hedges or walls may surround a small park in order to reduce visual distractions such as traffic, and auditory distractions such as noise. “Wood, stone, and old materials” were ideal components for enhancing restorative experiences in a natural setting. These materials mimicked the natural setting and did not provide distractions (Ibid, p. 75). “The view from the window” was considered restorative if the view was of trees, weather, animal life, or water (Ibid, p. 76). Nature scenes, they found, allowed the mind to wander and recover from fatigue.



Photo: Ellen Vincent

Figure 3.7. Actual wandering, or imagining wandering in small spaces is restorative

The reasonable person model is the Kaplan's latest theoretical contribution and claims that people prefer environments that allow them to process information easily. In fact, people are more reasonable (effective and likely to engage in meaningful actions) in these environments that support their informational needs (Kaplan & Kaplan, 2003, 2009). Both attention restoration theory and the reasonable person model claim that exposure to "the nearby

natural environment, although often neglected, can serve as a remarkable effective resource” (Kaplan & Kaplan, 2003, p. 1484).

The contributions of the Kaplan’s are perhaps best detected by the high frequency their theories have been cited by other researchers (Tennesson & Cimprich, 1995; Hartig, 1993; Hartig, Evans, Jamner, Davis, & Garling, 2003; Berto, 2005). Stamps (2004) identified 61 papers in a 30-year time frame devoted to Kaplan’s environmental preference theories. Their use of models has improved methods within the field of environmental psychology as other people emulate or expand upon their theories and methods. By graciously staying fixed on their objective, “to reduce suffering and enhance effectiveness” (Kaplan & Kaplan, 1989, p. 176), the Kaplan’s continue to contribute.

Theory of Positive Distraction to Reduce Stress

Roger Ulrich developed the theory of positive distraction and promoted the concept of emotional congruence; both of which contributed greatly to the effect of visual art on medical outcomes. He claimed that nature is an ideal positive distraction (Ulrich, 1990; 1991b). Positive distractions are environmental features or conditions that reduce stress. Music, companion animals, laughter, some art, and nature all qualify as positive distractions. A study by Ulrich and Simons (1986) showed recovery from stress in as little as four to six minutes after viewing nature. The concept of emotional congruence, according to Ulrich and Gilpin (2003), understands that patients perceive and interpret art in ways that

match their present emotional state. The belief is that certain types of art, specifically abstract and ambiguous art should be avoided in patient rooms and treatment areas. Stressed or frightened patients were especially vulnerable to art that was not realistic (Ulrich, 1991b; Ulrich, Lunden, & Eltinge, 1993; Ulrich & Gilpin, 2003). In addition, Ulrich spent considerable time comparing urban and natural environments and concluded that scenes with natural elements were more restorative than urban scenes lacking natural features (Ulrich, 1979; 1981; Ulrich & Simons, 1986; Ulrich, Dimberg, & Driver, 1990; Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991; Ulrich, Simons, & Miles, 2003).

Significant Concepts for Healthcare

In addition to theories, significant concepts developed that contributed to the use of nature in healthcare settings. Identification of hospitals as unnecessarily stressful places emerged from the personal experiences of Norman Cousins and Angelica Thieriot and was further supported by the research conclusions of Johnston and Wallace and others. The reforms instituted by the non-profit organization Planetree and the therapeutic potential of healing gardens also focused attention on nature's potential to stimulate positive medical outcomes. This section concludes with a role for nature in evidence based design within the healthcare setting.

During the late 1970s and the 1980s hospitals were clearly identified as stressful places, in direct contradiction to the original intent of medicine to "Do No

Harm” as stated in the Hippocratic oath. Norman Cousins (1979), in *Anatomy of an Illness* found the hospital environment so stressful that he checked out of the hospital and into a nearby hotel in order to improve his chances for recovery. Johnston and Wallace (1990) edited a book titled *Stress and Medical Procedures* that advanced the understanding that stress can undermine the health benefits being sought in the healthcare environment. Johnston stated, “Surgery is a threatening event with many unpredictable and uncontrollable features,” (Johnston, 1988, p. 79). Angelica Thieriot entered the hospital with a life threatening condition and after being treated, left the hospital feeling “abused, traumatized and dehumanized” (Frampton, Gilpin, & Charmel, 2003, p. 3). During the following year her son and her father-in-law were hospitalized and she experienced the hospital from the perspective of a family member of a patient. She claimed the experience was as “depersonalizing and terrifying” as her own experience as a patient had been (Ibid, p. xxviii). She later founded the Planetree organization to foster patient centered care in healing environments. *Putting Patients First* (Ibid) describes Planetree reforms and contains a chapter that advocates using nature based art in healthcare environments to reduce stress (Ulrich & Gilpin, 2003), Figure 3.8.

The therapeutic benefits of nature in the form of indoor and outdoor gardens for healthcare settings appeared in Cooper Marcus and Barnes (1999) *Healing Gardens: Therapeutic Benefits and Design Recommendations*. Specific definitions for the term healing and therapeutic were provided by the authors.

Three therapeutic aspects were identified as relief from physical symptoms, stress reduction, and improvement in overall sense of well-being and hopefulness. The book also provided design guidelines for the installations of healthcare gardens.

Using nature to reduce stress in healthcare settings gained momentum in the 2000s when the Center for Health Design produced a scorecard for evidence based design that included “providing positive distraction” as one means to “reduce stress and improve outcomes” (Center for Health Design, 2005). Nature was included as a positive distraction in the report to Center for Health Design that informed the scorecard (Ulrich, Zimring, Quan, Joseph, & Choudhary, 2004).



Photo: Ellen Vincent

Figure 3.8. Nature art on the walls at Steadman Hawkins Clinic of the Carolinas in Greenville, SC.

Popular literature (Norman Cousins, 1979) and material geared for scientists (Johnston & Wallace, 1990) converged during the last 30 years to acknowledge hospitals as stressful places. In addition, publications written for architects and designers (Cooper Marcus & Barnes, 1999; Center for Health Design, 2005) provided solutions that advocated using nature to reduce stress and stimulate positive emotions within healthcare institutions.

The importance of reducing stress in the hospital environment is evident in order to improve medical outcomes. Understanding that mental fatigue has serious behavior and health consequences just as stress does, has stimulated interest in both empirical research within the scientific community and in the creation of restorative environments in the real world setting. A large number of nature and health studies measure recovery from stress or mental fatigue (Kaplan, 1995; Tennessen & Cimprich, 1995; Fisher & Reason, 1988; Kuo & Sullivan, 2001; Laumann, Garling, & Stormark, 2003; Staats & Hartig, 2004; Sponselee, deKort, & Meijnders, 2004; Berto, 2005; Kweon, Ulrich, Walker, & Tassinary, 2008).

Studies that investigate the use of nature to stimulate recovery from mental fatigue and/or stress also have the capacity to inform research concerned with relief from pain. Pain and stress are often times linked (Melzack, 1999) and both conditions are affected by psychological and physiological factors (Gatchel & Turk, 1999; Turk & Gatchel, 2002; Turk & Winter, 2008). For this reason, pain

treatment programs often incorporate integrated approaches, including psychologically enhanced environments (Park, Matson, & Kim, 2004).

The next segment of the timeline is called significant research and focuses on the research studies conducted during the past 30⁺ years that have both informed and inspired contemporary studies.

PART II: SIGNIFICANT RESEARCH

Introduction

Research within interdisciplinary fields of study is often difficult. This holds true for nature and health research. Devlin and Arnelli (2003) suggest that medicine historically has not been focused on the physical environment's effect on patient well-being. Moreover, architecture is not traditionally research based, and research within a clinical setting is extremely difficult. Wallace and Johnston (1990) mention that there are ethical limits to the intensity of the measures being used in clinical research due to the condition of the patient. Patients are often too ill to participate fully in psychological and physiological data collection processes.

Other research areas of concern within nature and health research include but are not limited to: a lack of theory to philosophically ground the work (RMNO, 2004; Dilani, 2005); which was addressed in Part I: Theories and Concepts, as well as a lack of randomization and replication capacity (Stamps, 2004; Dilani,

2001). In addition, replication capacity is often hindered by use of unclear terminology, lack of operational definitions, and use of multiple variables (Ruso, Renninger, & Atzwanger, 2003; Dijkstra, Pieterse, & Pruyn, 2006).

Acknowledging the difficulties inherent to conducting interdisciplinary research on nature and health makes the contributions outlined in this section all the more noteworthy. Significant research pertaining to nature and health over the past 34 years, 1975-2009, is identified in Table 3.3.

This chapter includes five major headings: Views of Nature on Health Studies, Garden Studies in Healthcare Settings, Methodology Improvements for Nature and Health Studies, Virtual Nature in Healthcare Studies, and Critical Reviews of the Literature. Views of Nature on Health mention several significant studies from the 1980s that are widely cited. Garden Studies in Healthcare Settings includes work that has contributed to understanding the effects of both outdoor gardens and indoor gardens on health. Methodology Improvements mention physiological data collection measures, lessons from field studies, and the role of stressors in simulated studies. Virtual Nature is the next area of significant research and includes nature based wall art, concepts of presence and realism in virtual environments stimuli, and the use of nature videos as therapeutic interventions. Critical Reviews of the Literature mentions literature reviews that contain information useful to nature and health studies.

The studies mentioned here are by no means inclusive, rather they are examples of fine work that have advanced the understanding of nature and

health using scientific application. In some instances the contributions are found in the actual research results, but more often it is the identification of what didn't work, for it is in the suggestions for improvements that great advancements can be made in the field of nature and health research.

Table 3.3. 30+ year timeline of significant research for therapeutic benefits of nature on health

Year	Contribution	Author
1981	Nature views in prisons result in reduced health complaints	Moore
1984	In-hospital research: nature views from hospital windows are more therapeutic than views of a brick wall, published in <i>Science</i>	Ulrich
1985	Nature views in prison reduce health complaints	West
1986	In-hospital research: person-window transactions in the hospital environment	Verderber
1987	In-hospital research: window views enhance health in hospitals	Verderber & Reuman
1990	Nature art reduces anxiety in dentist waiting room	Heerwagen
1990	Meta-analysis of photographs in simulated environments	Stamps
1991	Field study of restoration using multiple methods	Hartig, Mang, & Evans
1991b	Nature art is preferred by psychiatric patients over abstract art	Ulrich
1993	Meta-analysis of simulation effects	Stamps
1993	Nature art preferred by open heart surgery patients	Ulrich, Lunden, & Eltinge
1993	Field study of restorative environments using multiple methods	Hartig
1995	Hospital gardens reduce stress	Cooper Marcus & Barnes
1999	Hospital gardens case studies	Cooper Marcus & Barnes
2002	Gardens in residential care facility study	Rodiek
2002	Indoor plants effect on pain in simulated hospital patient room	Park, Mattson, & Kim
2003	Restoration of blood donors using nature videos and multiple methods	Ulrich, et al.
2003	Restoration in natural and urban field settings using multiple methods	Hartig, et al.

2004	Literature review on nature and health	RMNO
2004	Meta-analysis of mystery, complexity, legibility, and coherence	Stamps
2004	Literature review of physical environments effects on health outcomes	Ulrich, et al.
2004	Presence research in virtual environments	IJsselsteijn
2004	Role of presence in stress restoration	Sponselee, et al.
2004	Nature based wall art preferred over abstract art	Ulrich, et al.
2005	Garden access for elderly in assisted living facilities	Rodiek
2006	Stress restoration in a mediated environment	de Kort, et al.
2006	Literature review of effects of environmental stimuli on psychological health	Dijkstra, Pieterse, and Pruyn
2008	Effects of indoor plants in hospital patient room	Park & Mattson
2008	Literature review of evidence based healthcare design	Ulrich, et al.
2009	Literature review of psychological benefits of indoor plants	Bringslimark, Hartig, & Patil

Views of Nature on Health Studies

Therapeutic connections between nature, design, and patient wellness peaked in the mid 1980s. Roger Ulrich (1984) and Stephen Verderber (1986; Verderber & Reuman, 1987) conducted research within the hospital environment on therapeutic outcomes relating to windows. Views of nature helped post operative surgery patients recover faster after surgery and require less pain medication during recovery (Ulrich, 1984). Through questionnaires patients and staff clearly indicated they preferred windows and views from their windows (Verderber & Reuman, 1987). Ulrich mined records, and Verderber conducted surveys. Both drew attention to the therapeutic aspects of nature views within the hospital setting and to the role of architecture as a vehicle for therapeutic benefits. These key studies are still regularly cited in the literature. Relations

between the healthcare profession and academia were strengthened by this in-hospital research implementation, rigorous design, and beneficial therapeutic and economic outcomes.

Two other significant research studies involving views of nature took place around the same time but were conducted within the prison setting (Moore, 1981; West 1985). These studies both found that prisoners with views of nature had fewer health complaints than those without views.

Garden Studies in Healthcare Settings

Outdoor Garden Studies

The beneficial role of gardens for healthcare environments was supported by the work of Cooper Marcus and Barnes (1995; 1999) and Rodiek (2002; 2005). Cooper Marcus and Barnes conducted a survey of hospital outdoor space and asked participants where they go when they feel stressed. Ninety-five percent of the respondents claimed they experienced a positive shift in mood, moving from anxiety, stress or depression, into calm and balanced states of mind after spending time outdoors (Cooper Marcus & Barnes, 1999). The specific aspects of the outdoor environment most mentioned for triggering a positive mood shift among two-thirds of respondents were visual and plant related. Viewing trees, flowers, and greenery were identified as key to mood improvement. The authors concluded from the study that the survey respondents felt better outside than inside. Results drew attention to the lack of nature within

the hospital building. This study was followed by a collection of case studies in *Healing Gardens* (1999). The case studies focused on gardens within acute care general hospitals, psychiatric hospitals, nursing homes, hospice care, and Alzheimer's treatment centers. The studies indicated that the presence of gardens, when properly constructed to accommodate the needs of the specific population being served, had the potential to enhance mood for patients and staff.

Rodiek (2002) studied the effects of gardens on the elderly at a residential care facility and contributed to nature and health studies by using empirical measures to study health outcomes. At the residential care facility, participants were randomly assigned to the garden or non-garden interior setting. Participant's mood and stress levels were assessed before and after their sessions. Mood was assessed by using a psychological survey specific to the elderly and stress was measured using salivary cortisol. Results from the cortisol responses showed that elderly people in the garden had lower stress levels than their indoor counterparts.

Rodiek (2005) again contributed sound methodology to the field of nature and health with another study of gardens for the elderly. While evidence suggests that gardens have the potential to reduce stress and improve mood, it was reported that gardens were not being fully used in some assisted living facilities. Therefore, the role of environmental features such as shade, seating, views, etc., was investigated in the use of outdoors areas by the elderly. The

research design emphasized random selection and the survey was pretested. Both facilities and participants were randomly selected. Participants were 108 elderly residents of 14 assisted living facilities from a 12 county region of southeastern Texas. Participants filled out survey questionnaires that contained both closed and open ended questions. Focus groups were conducted at seven of the facilities after the survey questionnaires had been completed. Findings indicated that environmental features did play a role in outdoor usage. Accessibility was an impediment to venturing outdoors for the elderly, and built paths and shelter from sun and rain fostered usage of the outdoor spaces. Landscape features that were reported to entice participants to venture outdoors included greenery, flowers, wildlife, and water elements.

Indoor Garden Studies

Indoor garden studies were implemented in a two phase experimental study by Park, Mattson, and Kim (2004) first in a simulated hospital patient room using female college students then in a real hospital using appendectomy post surgery patients (Park & Mattson, 2008). Findings from the first study in the simulated setting indicated that flowering plants had the most positive effects on pain tolerance time, pain intensity, and pain distress when compared to the group without plants. Results from the second study conducted in the hospital found that participants with flowering and non-flowering plants in their room needed less potent analgesics for pain and had lower systolic blood pressure readings and heart rate responses than those who did not have plants in their rooms.

Significant psychological results for the patients with plants included higher satisfaction with their rooms. They rated their rooms as more relaxing, comfortable, colorful, and pleasant smelling, calming, and attractive compared to those in the control rooms. Other survey results within the same study showed that the majority of patients in the rooms with plants identified the plants as the most positive quality of the room whereas the control group reported watching television as the most favored aspect of their rooms. Results emphasized the benefits of using indoor plants as a low cost therapeutic intervention. The attention to design controls, and use of multiple data collection measures contributed to the field.

Methodology Improvements for Nature and Health Studies

Physiological Measures

A practice that strengthened research for nature and health studies is the practice of obtaining physiological data in addition to psychological data in research experiments. Physiological data offer objective indicators that are automatically produced without conscious deliberation (IJsselsteijn, 2004). This reduces subjective biases that are suspected to be common occurrences in research studies using self report surveys. Prior to the 1980s psychological data in the form of self-reports and survey questionnaires was the normal means of measuring preference and therapeutic benefits. The correlation of objective and

subjective data have the potential to achieve greater reliability for nature and health research than does using only one type of measure.

Physiological data that have been collected include heart rate, blood pressures, skin conductance levels, saliva samples, muscle tension, and brain electrical activity (alpha waves). In the “View through a Window May Influence Recovery from Surgery” (1984) Ulrich assessed medical records for both vital sign (physiological) and psychological data, subjected the data to statistical analysis, and published the work in *Science*, a respected journal. Other researchers who have designed and implemented studies that included physiological data collection techniques are listed in Table 3.4.

Table 3.4. Studies using physiological indicators

Author/Year	Physiological measure	Study Title
Ulrich (1981)	Brain electrical activity Alpha waves	Natural versus urban scenes
Ulrich & Simons (1986)	Blood pressure Muscle tension Skin conductance	Recovery from stress during exposure to everyday outdoor environments.
Heerwagen (1990)	Heart rate:	The psychological aspects of windows and window design
Ulrich, et al. (1991)	Electrocardiogram (EKG); Systolic blood pressure Spontaneous skin conductance (SCR); Frontalis muscle tension (EMG)	Recovery from stress during exposure to everyday outdoor environments
Hartig, Mang, & Evans (1991)	Blood pressure and pulse Skin conductance	Restorative effects of natural environments
Hartig (1993)	Saliva samples (cortisol), Blood pressure Heart rate (systolic, diastolic blood pressure and heart rate)	Testing restorative environments theory

Parsons, et al. (1998)	Facial EMG, EOG, and ECG (heart rate); Blood pressure Skin conductance	The view from the road: Implications for stress recovery and immunization
Fredrickson & Levenson (1998)	Heart period (HP; interbeat interval Electrocardiogram(ECG); Pulse transmission time in the ear (PTE); Pulse transmission time to the finger (PTF)	Positive emotions speed recovery from the cardiovascular sequelae of negative emotions
Rodiek (2002)	Salivary cortisol	Influence on an outdoor garden on mood and stress in older persons.
Ulrich, Simons, & Miles (2003)	Blood pressure Pulse rate	Effects of environmental simulations and television on blood donor stress
Laumann, et al. (2003)	Heart rate: HR and IBIs using electrodes between ribs.	Selective attention and heart rate responses to natural and urban environments.
Sponselee, de Kort, & Meijnders (2004)	Heart rate Skin conductance	Healing media: The moderating role of presence in restoring from stress in a mediated environment.
Park, Mattson, & Kim (2004)	Brainwave activities (EEG) Electrodermal activities (EDA) Finger skin temperatures	Pain tolerance effects of ornamental plants in a simulated hospital patient room
de Kort ,Meijnders, Sponselee, & IJsselstein (2006)	Heart rate Skin conductance	What's wrong with virtual trees? Restoring from stress in a mediated environment
de Kort and IJsselstein (2006)	Skin conductance Heart rate	Reality check: The role of realism in stress reduction using media technology
Kahn, et al. (2008)	Heart rate	A plasma window display?-The shifting baseline problem in a technologically mediated natural world.
Berto, Massaccesi, & Pasini (2008)	Saccades and fixations using Eye Position Detector System (EPDS) plus a video camera attached to record eye movements	Do eye movements measured across high and low fascination photographs differ? Addressing Kaplan's fascination hypothesis
Park & Mattson (2008)	Blood pressure Heart rate Body temperature Respiratory rates	Effects of flowering and foliage plants in hospital rooms on patients recovering from abdominal surgery

Lessons from Field Studies

Field studies of nature and health are extremely complicated to design and implement due to the large number of variables in the real environment. Hartig, Mang, and Evans (1991) in “Restorative Effects of Natural Environment Experiences” conducted a quasi experimental field study and a true experiment to assess restorative experiences in nature. Timing was identified as critical to collecting beneficial physiological data. Fifty minutes passed between the treatment and the collection of heart rate and blood pressure in one study and no significant difference was found between the nature and non nature exposure groups. Hartig (1993) identified additional areas for improvement within field study research on nature and health with his thesis dissertation *Testing Restorative Environments Theory*. Items noted were that very diverse environments should be compared, that the presence of a research assistant during the treatment time probably reduced realism, and that the frequent interruptions caused by data collection, salivary cortisol in particular, most likely reduced the power of the treatment. Additional contributions to methodology and design were apparent in an experimental field study by Hartig, Evans, Jamner, Davis, and Garling (2003) that compared restoration in natural and urban environments. Diverse environmental conditions, random assignments to the natural or urban field settings and use of multiple methods to collect psychological and physiological data increased internal validity and reliability. An ambulatory blood pressure monitor was used to collect systolic and diastolic

blood pressure data during the nature and urban walks. Findings from this study indicated that participants assigned to the nature walk showed increased positive affect or mood and decreased anger by the end of the walk while participants on the urban walk reported decreased positive affect and increased anger by the end of their walk.

Simulated Stressors

Clinical research on patients is not always practical or ethical (Wallace and Johnston, 1990). Patients may be too anxious, tired, or ill to participate in intensive data collection procedures. Simulated studies in laboratories are an effective way to study recovery from stress or pain prior to conducting clinical experiments in the real world setting. Simulation studies often require that participants be subjected to stress or pain treatments in order to create an opportunity for restoration. Several studies cited weak stressors as a possible cause for failure to obtain hypothesized results in nature and health studies (Sponselee, de Kort, & Meijnders, 2004; Hartig & Staats, 2006; de Kort & IJsselsteijn, 2006; Kweon, Ulrich, Walker, & Tassinary, 2008). Use of reliable stressors, such as the cold pressor treatment mentioned below for pain has made simulations studies more realistic.

An effective pain stressor used by Park, Mattson, and Kim (2002) in a simulated hospital patient room utilized the cold pressor task. This treatment induces pain by asking participants to plunge their hand up to the wrist, into a container of ice water. The cold pressor treatment has a long history of use in

cardiovascular research. The hand immersion is associated with heart rate acceleration (Saab, Llabre, Hurwitz, Schneiderman, Wohlgemuth, Durel, et al., 1993) as well as blood pressure elevation. It has frequently been used in studies dealing with experimental pain and is routinely used in experimental psychology practice (McClelland & McCubbin, 2008). Stress inducers in the simulated or laboratory setting often included mathematical exercises (de Kort, Meijnders, Sponselee, & IJsselsteijn, 2006; de Kort & IJsselsteijn, 2006;) proof reading tasks (Laumann, Garling, & Stormark, 2003) and computer generated tasks involving speed, matching, or object detecting (Kweon, Ulrich, Walker, & Tassinari, 2008). More extreme and possibly controversial stress inducers included displaying frightening movies that showed animals being killed (van den Berg, Koole, & van der Wulp, 2003) or work place accidents (Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991; Parsons, Tassinari, Ulrich, Hebl, & Grossman-Alexander, 1998).

Virtual Nature in Healthcare Studies

Art on the Wall

Despite the mounting evidence showing that nature has the power to reduce stress, it is often times significantly absent from healthcare environments. Multi-story hospitals may not be able to provide nature views for patients on the higher floors. Modernist block hospitals often lack access to nature as some treatment and diagnostic areas are located in the windowless center of the structure (Verderber & Fine, 2000). Some hospitals may occupy buildings that

were designed with small or high windows that prohibit a patient's view. Some hospitals may be built in high density areas that do not provide space for landscape plantings or the view from the patient's window may be of another building or of a parking lot. The lack of a view from the window in the healthcare setting may result in interest in art on the wall, or televised videos as affordable therapeutic interventions. Research is limited on the therapeutic effects of interior art, yet three cases mentioned in the literature are those by Heerwagen and Orians (Heerwagen, 1990) and by Ulrich, Lunden, and Eltinge (1993).

Art on the wall was studied in a windowless dental fears clinic at University of Washington. It is an oft cited study (unpublished) conducted by Heerwagen and Orians (Heerwagen, 1990). The dental clinic catered to people with strong fears of dental visits. A wall mural of a landscape painting was compared to a blank white wall in the waiting room of the clinic. Participants, 20 per treatment group, were told that doctors' and dentists' office waiting times were being studied. The hypothesis expected people to rate the waiting room with the landscape mural as more comfortable, relaxing, and attractive. This did not happen and no significant differences were found between the two groups regarding perceived environmental differences. What were different however were responses to a psychological assessment scale and heart rate. Analysis of the affective scales showed patients in the waiting room with the mural felt calmer and less tense than those in the plain room. For patients whose heart rate increased during the waiting period, the increase was less for those in the mural

condition. This study stresses the importance of not relying solely on participant preference responses to environmental conditions (mediated environments) to draw conclusions about therapeutic interventions, but rather, emphasizes the need to use multiple measurements, psychological and physiological, to determine the effects of the experimental stimuli.

The therapeutic benefits of art was studied at Uppsala University Hospital in Sweden (Ulrich, Lunden, & Eltinge (1993) using 166 open heart surgery patients in intensive care units. Participants were assigned to one of six treatment conditions. Two groups received a picture dominated by trees or water; two groups received abstract pictures with similar complexity as the nature images; and two groups received control conditions of a white panel with no picture. The pictures were color photos, 60 cm (23.6 in.) by 40 cm (15.7 in.) mounted at the foot of the patient bed. Results showed that the patient group exposed to the nature image dominated by water reported less postoperative anxiety than patients in the other five conditions. This group also required fewer doses of strong analgesics and instead received moderate strength pain medications. Several patients reported negative affective reactions to an abstract picture dominated by rectilinear forms that caused the investigators to remove the picture.

Ulrich reported on a 1986 study of psychiatric patients who physically attacked abstract wall art (Ulrich, 1991b). Seven paintings and prints had been physically attacked more than once and had therefore been removed from the

walls. Paintings and prints of natural landscapes dominated by water, flowers, or trees, however were not attacked. Ulrich reported that the abstract art lacked clarity, and displayed disorganized shapes and colors. Ulrich attempted to explain the situation, “Perhaps, for some patients, an abstract painting of unintelligible disorder displayed prominently in their room might threaten whatever fragile security and sense of order they retain” (Ulrich, 1991b, p. 17).

Studies of therapeutic art interventions raise important questions for nature and health research regarding the effectiveness of various types of interventions. For instance, did image size have an effect on outcome? Heerwagen and Orians used a wall mural while Ulrich, Lunden, and Eltinge used large photographs at the foot of the bed. Did quality and content of the image effect the response of the viewer? Apparently abstract art evoked anger in psychiatric patients. Some of these other issues, such as size and visual and experiential realism, are specific to virtual environments research, which investigates the role of mediated environments. Virtual environments interventions have historically been used in phobia treatments (IJsselsteijn, 2004; Krijn, Emmelkamp, Olafsson, & Biemond, R., 2004).

Presence and Realism in Virtual Environments

Virtual environments research is primarily concerned with degrees of immersion and presence within the mediated environments. Immersion describes the physical properties of the media technology and is measured by the extent the technology can block out sensory input or distraction from other stimuli (the

real world). Presence refers to the participant's experience in the created environment and is measured by how present they feel in the created (mediated) environment (deKort, Meijnders, Sponselee, & IJsselstein, 2006). IJsselstein (de Kort & IJsselstein, 2006) describes the difference between immersion and presence as such: "Presence can be conceptualized as the experiential counterpart of immersion-the human response" (Ibid, p. 136). Whereas art on the wall or screen has low immersion capabilities, it does have the potential for high degrees of presence, a sense of being there, in the image.

Progress toward understanding and studying the concept of presence occurred in 2004, with W.A. IJsselstein's thesis *Presence in Depth*. This document served as an introduction to understanding the concept of presence (feeling really there) in virtual environments as well as to study techniques for investigating presence. As with any young field of study, investigative techniques and strategies associated with presence are still in the developmental stage. Sponselee, de Kort, and Meijnders, (2004) studied the role of presence in media being used as a restorative agent. They suspected that presence, the sense of actually being in the presented environment, was a means to enhance restorative effects. They tested this by manipulating the screen size. High presence was represented by a large projection 110 cm x 145 cm (43.3 in. x 57.1 in.) while low presence was depicted by a smaller image 47 cm x 60 cm. (18.5 in. x 23.6 in.). Participants were subjected to stress in the form of mathematical tests combined with loud industrial noise. Then, each group watched a 10-minute nature film.

Screen size did not produce any significant differences in presence, but it was noted that for both screen sizes, respondents' positive affect (mood) was higher after the restorative nature film than before the film. So while this study failed to prove its hypothesis regarding presence as expressed by screen size, it did find that the nature film for both groups had a mood elevating effect. De Kort, Meijenders, Sponselee, and IJsselstein (2006) also measured presence by manipulating screen size and they too found no supportive evidence that size was related to presence.

Screen size was again manipulated in a restorative environments study by de Kort and IJsselsteijn (2006), to see whether experiential realism had an effect on the restorative effects of a nature film. The large screen represented high experiential realism and the small screen represented low experiential realism. A mathematical task and loud industrial noise were administered to induce stress in the participants. One group of participants then watched a nature film on the large screen while the second group watched the same film on a small screen. Results showed that screen size did contribute to the restorative effect of the nature film through the physiological indicators of skin conductance and heart rate responses.

Virtual environments presence studies of restorative environments show that more research is needed to better understand the therapeutic effects of the mediated environment upon the user, even when the stimuli is a still photographic image. The role of presence and the effects of experiential realism

are still in their infancy, but the studies mentioned drew attention to the complex relationship between the user (viewer) and the mediated (therapeutic) environment.

Nature Videos

Nature videos are more commonly used in research studies to test the restorative or therapeutic effect on stress than are still photographic images or paintings (Ulrich & Simons, 1986; Frederickson & Levenson, 1998; Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998; Laumann Garling, & Stormark, 2003; Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991; Ulrich, Simons, & Miles, 2003; Sponselee, de Kort, & Meijnders, 2004; de Kort, Meijnders, Sponselee, & IJsselstein, 2006). Two nature videos were used in experimental pain studies (Miller, Hickman, & Lemasters, 1992; Tse, Ng, Chung, & Wong, 2002)

The use of nature videos presents a research dilemma of sorts, for while the videos may be effective at reducing stress, it remains unclear as to which images within the video were more therapeutic than others. Additionally, some studies combine music or other sounds with the images that then introduces multiple variables (auditory and visual) that cannot always be effectively separated out to know which variable or combination of variables caused the reduction of stress or pain. The other research difficulty associated with the use of nature videos pertains to replication. It is often difficult to imagine reproducing “nature films” when the content was not systematically categorized or described

in meticulous detail. So while the literature shows that nature views have therapeutic value, it remains unclear as to which views have more therapeutic value than others, in various stressful or painful situations.

Critical Reviews of the Literature

Literature reviews provide a critical analysis of published scholarly work. Though aspects of each review are mentioned here, the entire literature review should be read for in-depth understanding. The literature reviews mentioned below have each suggested improvements to aspects of nature and health studies.

Stamps (1990, 1993, 2004) conducted meta-analysis (use of statistics) on subjects that pertain to nature and health research. One study that examined 11 papers that contained 152 environments evaluated by more than 2,400 respondents affirmed that photographs were viable surrogates for real environments (Stamps, 1990). It was also found, using 1,215 scenes and 4,200 respondents that color photographs were more valid for use in simulation than were black and white photographs (Stamps, 1993). In another study a meta-analysis was conducted on published research that used the Kaplan's environmental preference predictors of mystery, complexity, legibility, and coherence (Stamps, 2004). Twenty-eight papers covering 1,820 scenes and 6,288 participants contained the necessary data needed for a quantitative review. Several aspects were detected that resulted in "dubious studies" (Stamps, 2004,

p. 12). First, many of the studies interpreted Kaplan's categories in very different ways, using different words and different survey questions. Also, the use of expert panels, which allows researchers to substitute their own impressions for those of another population, was identified as a serious methodological problem.

A team from Texas A&M and Georgia Tech conducted a review of the literature looking for evidence based outcomes of the physical environment on patients and staff. They sorted the relevant literature (600 studies) into four categories. Category three, "Reduce stress and improve outcomes" included nature (Ulrich, Zimring, Quan, Joseph, & Choudhary, 2004, p. 3). Nature, they found, was used as a positive distraction to effectively reduce stress. The supportive studies mentioned in the report used visual and auditory stimuli in the form of art on the wall or on a ceiling panel, scenic nature videos, and gardens. A second review of the research literature on evidence-based healthcare design followed and it also included nature as an effective distraction from pain and stress (Ulrich, Zimring, Zhu, DuBose, Seo, Choi, et al., 2008).

Several literature reviews, all from the Netherlands, have provided insightful assessment of the research conducted on nature and health. Van den Berg (2005) identified 23 studies concerning views of nature and health outcomes. It was reported that there was substantial evidence that viewing nature was linked to stress reduction but also concluded that more clinical evidence of health outcomes was needed. A literature review by Dijkstra, Pieterse, and Pruyn (2006) identified 500 studies that used environmental stimuli

interventions to effect health that were controlled clinical trials, and were published in peer reviewed journals. Only 30 of the studies met all their criteria for review and the authors concluded that the effects of specific environmental stimuli were very limited. Furthermore, they suggest that, “The field thus appears to be in urgent need of well-conducted, controlled clinical trials. At present, and on the basis of the available research, it would be premature to formulate evidence-based guidelines for designing healthcare environments” (Dijkstra, Pieterse, & Pruyn, 2006, p. 167).

The Health Council of the Netherlands and the Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment concluded from a review of the literature that only two convincing studies sufficiently linked nature and health, one by Takano, Nakamura, and Watanabe (2002) and the other by de Vries, Verheij, Groenewegen, and Spreeuwenberg (2003). These two studies were neither simulated nor were they clinical. Rather, these were epidemiological studies that compared people’s general health to the presence of green space near their residences. The literature review concluded that most studies conducted to explore the health effects of a view of nature were “either insufficiently sound or too poorly reported to permit evaluation” (RMNO, 2004, p. 43).

A literature review on the psychological benefits of indoor plants examined 21 papers (Bringslimark, Hartig, & Patil, 2009). Reviewers suggest that evidence exists that indoor plants can provide psychological benefits such as

reduced stress and increased pain tolerance. The methods and results used in the studies however indicated that general claims that indoor plants are therapeutic should be avoided. The benefits derived from indoor plants appear to be contingent on the environmental context and characteristics of the participants. Recommendations for improvements to experimental design include working from theory and previous empirical work, careful manipulation of exposure times, and including an effective stressor to ensure that participants have potential for restoration. Additional recommendations suggested more relevant measures of visual attention, repetition of previously used measures, and measurement of additional variables that could explain the benefits of exposure to indoor plants. Reporting was also identified as an area in need of attention as missing details regarding methods, analysis, and results were common. The reviewers noted that the majority of research pertaining to indoor plants has traditionally been generated by departments of horticulture and published in horticultural journals. They call for greater collaboration between environmental psychologists and horticulturists to “move the field forward” (Bringslimark, Hartig, & Patil, 2008, p. 11).

Acknowledging the difficulties inherent in interdisciplinary research, specifically nature and health, the contributions to the field over the past 30⁺ years are impressive. Significant research influencing nature and health all point to the growing and important nature of interdisciplinary work. Fields of psychology, architecture, environmental studies, and neuroscience are all

converging to investigate and understand the relationship between nature and health. This has resulted in greater visibility on the world stage and thereby greater access to strong rigorous research practices and theories for consideration and use. The past 34 years has shown remarkable achievements in developing theory, methodology, and design.

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CHAPTER FOUR
A METHODOLOGY FOR SELECTING NATURE IMAGES FOR
APPLETON'S PROSPECT REFUGE THEORY

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Abstract

It is known that exposure to surrogate nature views, represented on a screen or wall, have the potential to cause a psychological and physiological shift towards wellness. What is not largely known is which images are more therapeutic than others. What is also not known is how to select nature images that can be replicated for use in experimental studies. Using Appleton's prospect refuge theory of landscape preference, a sequential method of design utilized focus groups, a sorting task, and content validity analysis to arrive at the most representative images to use in future experiments. The results of the present study, a methodology, will be used in future experiments to investigate the health benefits of nature images in real hospital settings. Due attention was given to creating a randomized and replicable methodology within an interdisciplinary framework.

Introduction

The therapeutic benefits of nature make intuitive sense, and history abounds with nature health associations. Historical examples include the pilgrimages of the Greeks to the temples of Asclepius, and the medieval monks' use of monastic cloister gardens to serve infirmaries (Peplow & Peplow, 1988). More recently, the Planetree model celebrates nature as an essential component of the healing environment (Frampton, Gilpin, & Charmel, 2003). Despite these

convincing precedents, research has not kept pace to provide knowledge and comprehension of the therapeutic benefits of nature (van den Berg, 2005).

In a recent study, The Health Council of the Netherlands and the Dutch Advisory Council for Research on Spatial Planning, Nature, and the Environment [RMNO] conducted a review of research regarding connections between exposure to nature and improved health (RMNO, 2004). The Council Committee reported the results of two epidemiological studies, Japanese and Dutch, as “the first indication of a positive link between nature and health” (RMNO, 2004, p. 43). The study from Japan compared five years of data between easy to access green spaces and mortality rates in over 3,000 elderly residents of Tokyo (Takano, Nakamura, & Watanabe, 2002). The study concluded that individuals living in areas with easy access to green spaces (nature) lived longer than those who did not have easy access to green spaces. In the Dutch study, health data was collected from 10,000 people throughout the Netherlands and combined with land use data (de Vries, Verheij, Groenewegen, & Spreeuwenberg 2003). This study, through self reports of symptoms and perceived general health, showed that living in a green environment resulted in better health.

With regards to linking a view of nature to health benefits in the hospital, the Council Committee found one study to be supportive. Ulrich’s (1984) retrospective study of patient records showed that post-surgery patients with a view of nature from their window recovered faster than those who had a view of a

brick wall (RMNO, 2004). The Council Committee attributes the results to reduced stress among nature viewing patients.

Research studies linking views of nature with reduced stress in healthcare settings are prevalent. Kaplan and Kaplan (1989; Kaplan & Peterson 1993; Kaplan 1995) have described the role of nature in creating ideal restorative environments that help alleviate stress by reducing directed attention fatigue. Heerwagen (1990) found dental patients reported less anxiety when a landscape mural was present in the waiting room. Likewise, Ulrich, Lunden, and Eltinge (1993) found that open heart surgery patients in Uppsala, Sweden reported less anxiety when a nature photograph dominated by water was present than did patients with a view of an abstract picture or a blank white panel. Ulrich (1991; Ulrich, Zimring, Quan, Joseph, 2006; Ulrich, Zimring, Quan, Joseph, Choudhary, 2004) reported that nature served as an effective positive distraction which alleviates stress in healthcare settings. Cooper-Marcus and Barnes (1999) found hospital gardens reduced stress and improved patient outcomes by providing opportunities for positive escape and increased sense of control. In another study, Ulrich, Simons, and Miles (2003) reported lower stress levels among blood donors who were exposed to a video tape of nature settings than those who were exposed to regular television programming or a video tape of an urban environment.

Views of nature and their effect on patient pain levels are less frequently studied in healthcare settings. Diette, Lechtzin, Haponik, Devrotes, and Rubin

(2003) conducted a study of patients undergoing flexible bronchoscopy procedures at John Hopkins Hospital. During the procedure one group was exposed to a combination of a nature mural plus nature sounds while the second group received treatment as usual. The treatment group who received the nature intervention reported less pain than the group that was not exposed to nature. In another study, Tse, Ng, Chung, and Wong (2002) tested the effects of a nature video on pain levels of healthy college students in Hong Kong by administering a pain stressor in the form of a tourniquet. One group watched a nature video while the other watched a blank screen. Findings showed that participants exposed to the nature video had higher pain threshold and pain tolerance than the group that did not have the nature video to view. Ulrich (1984; Ulrich, Lunden, Eltinge 1993; Ulrich, Zimring, DuBose, Seo, Choi, et al 2008) reported patients with views of nature required less strong pain medication than those who did not have nature views. Miller, Hickman, and Lemasters (1992) combined a video of scenic nature with the sound of music to test the combined effects on pain and anxiety in burn patients at University of Cincinnati Medical Center's University Hospital Burn Special Care Unit. Patients exposed to the nature visual/music intervention reported reduced levels of pain intensity, pain quality, and anxiety during dressing changes.

Hospitals across the world are beginning to display art on their walls in order to facilitate wellness with little research to guide their selection (Ulrich & Gilpin, 2003; Dilani, 2001). In Australia, the United Kingdom, and the United

States art work is created by hospital patrons (Sutton, 2005), purchased from local artists, or loaned to hospitals through a non-profit organization for use on healthcare walls. Though this practice of featuring local art in hospitals has the benefit of establishing positive relationships between the local arts community and the hospital, the selection of art work is not based on patient therapeutic needs. One art installation at Duke Medical University, a rooftop sculpture called The Bird Garden, caused patient complaints and ultimately the installation was removed due to its contra-therapeutic effect (Ulrich 1999). The need for research that identifies the types of nature views with positive impacts upon patients in pain in healthcare settings is apparent (Malenbaum, Keefe, Williams, Ulrich, & Somers, 2008; RMNO, 2004).

Criticisms concerning the research on the therapeutic benefits of nature views on health in the healthcare setting focus on methodology. The Health Council of the Netherlands and the Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment concluded from a review of the literature that only two convincing studies sufficiently linked nature and health, one by Takano et al. (2002) and the other by de Vries et al. (2003). They reported that most studies conducted to explore the health effects of a view of nature were “either insufficiently sound or too poorly reported to permit evaluation” (RMNO, 2004, p. 43). In another study, Dijkstra, Pieterse, and Pruyn (2006) found over 500 papers that contained physical stimuli interventions on patient health in healthcare settings. Their search involved 17 different

environmental stimuli interventions, one of which was nature. They found only 30 studies that met the criteria for relevance and methodology, which also were published in a peer reviewed journal. Only 18 of those studies were controlled clinical trials and two studies involved nature. While the studies in general did support the concept that the physical environment does affect the health and well-being of patients, a major conclusion is that the use of multiple stimuli (e.g. music and visual art) compromise research results, and inconsistent effects were also found regarding nature research. In summary, the authors stated, “The field appears to be in urgent need of well-conducted controlled clinical trials”; and, “At this stage, formulating guidelines for evidence-based design of healthcare facilities seems premature” (Dijkstra et al. 2006, p. 179). One question that arises from reviews of the literature is why is nature-health research limited within healthcare settings? Devlin and Arnelli (2003) suggest that medicine historically has not been focused on the physical environment’s effect on patient well-being. Moreover, architecture is not traditionally research based, and research within a clinical setting is extremely difficult.

Research areas of concern within the therapeutic benefits of nature on patients in the healthcare setting include, but are not limited to: a lack of theory to philosophically ground the work (RMNO, 2004; Dilani, 2005); a lack of randomization and replication capacity (Stamps, 2004; Dilani, 2001). In addition, replication capacity is often hindered by use of unclear terminology, lack of

operational definitions, and use of multiple variables (Ruso, Renninger, & Atzwanger, 2003; Dijkstra et al., 2006).

Therefore, the purpose of this study aims to address this gap in the literature to establish a sound methodology linking nature to therapeutic outcomes. To achieve this outcome, two phases are necessary. First, nature images need to be selected in a replicable process informed by theory. Second, the nature images need to be empirically tested on measurable health outcomes. This paper reports on the first phase. In the next section, the theory informing phase one (image selection) is reviewed.

Evolutionary Theory for Landscape Preference

Theories associated with the therapeutic potential of nature, and nature images, are typically landscape preference and aesthetic theories. Landscape preferences have been extensively described by Appleton (1975, 1996), Kaplan and Kaplan (1989), and Ulrich (1991, 2008). They all consider an evolutionary explanation for people's preferences for certain types of environments as valid. Evolutionary explanations for human environmental preferences claim that humans developed an innate predisposition for certain types of environments during the long developmental stage as hunters and gatherers. For foragers and hunters, habitat selection was linked to survival. Over time, this preferential choice for habitat became neurologically "hardwired" and contributed to our modern day landscape preferences (Edelman, 1987). In essence, these

evolutionary theories and explanations agree that our modern day environmental preferences have biological roots in the past (Ruso et al., 2003).

Appleton's prospect refuge theory is an evolutionary theory that claims humans (as hunter gatherers) developed an ability to assess the environment for selection of habitats that would ensure survival (Appleton, 1975, 1996). "To see without being seen" is the viewer's ideal objective in prospect refuge landscapes. Appleton's extensive examination of landscape paintings led to major category titles and operational definitions for landscape features and content. Category titles included prospect, refuge, and hazard.

Prospect characteristics present real or symbolic access to a view in landscape images. Clear skies, low ground cover vegetation, and ideal viewing advantages (from a high space for instance) that allow the viewer to survey their surroundings all characterize prospect landscapes. Refuge in the landscape meanwhile presents real or symbolic situations for hiding or sheltering. Refuge characteristics include dim light and places to hide from inclement weather or people. Hazard in the landscape presents incidents or conditions that pose real or symbolic threats to life and well-being. A fierce storm, a bramble field that impedes locomotion or movement, or a forest fire all characterize hazard landscapes. Landscapes may contain multiple types of imagery and are named by the dominant feature (e.g. prospect-dominant, refuge dominant.) Landscapes with equal amounts of prospect, refuge, and hazard imagery are called balanced landscapes. A balanced prospect refuge landscape may occur when

opportunities for both a view (prospect) and cover (refuge) are *equally* presented in the landscape. A bridge that provides a view (prospect) and trees with low climbable branches (refuge) that are equally visible in one image represent a mixed or balanced landscape. In the present study balanced landscapes are referred to as mixed prospect and refuge landscapes.

A major criticism of evolutionary theory and Appleton's prospect refuge theory in particular is by scientists who feel that culture or environment has a much greater role to play in our landscape preferences than does biology or genetics. Appleton replied to the criticism in the second edition of *The Presence of Landscape* (1996) in Chapter 11 when he stated that culture is most definitely an important factor, as is heredity. Only he leaves the cultural aspect for someone else to develop and study. "There is no suggestion that it [prospect refuge theory] should supersede other frames of reference which have been successfully employed in the various disciplines concerned with this problem" (Appleton, 1996, p. 71). Bourassa (1991) also presents arguments against a solely biological theory of landscape preference, and he claims that a three-tiered approach is needed, which applies cultural and personal aspects as well as biological to the landscape preference model. This lays the groundwork for an interdisciplinary response to landscape preference. Bell, Greene, Fisher, and Baum (2001) summarize the situation with, "Even the most biologically oriented researchers do not suppose that we all have identical landscape preferences" (Bell et al., 2001, p. 45). They optimistically conclude, "We wait for a theory of

landscape aesthetics that successfully accounts for both culture and biology” (Ibid, p. 47).

Photographs as Surrogates for Real Landscapes

Over the past 30 years research evidence suggests a high correlation between photographs and on site judgments (de Kort & IJsselsteijn 2006; Laumann, Garling, & Stormark, 2001; Shang & Bishop, 2000; Stamps, 1990, 2007, 2008; Kaplan & Kaplan, 1989; Zube, Pitt, & Anderson, 1975). Stamps conducted a meta-analysis to determine the correlation between photographs and on-site preference judgments. He concluded, “It will be next to impossible to overturn that validity [that photographs are valid for assessing environmental preferences] through additional empirical research” (Stamps, 1990, p. 912). In 2007 and 2008 Stamps examined the perception of spaciousness using virtual environment simulations and still photographs. He concluded that for scientific purposes the two media were the same, though still photos are much less expensive.

Though photographs in research settings appear to be suitable surrogates for the real nature experience, evidence suggests that the selection of images for use in a healthcare setting has the potential to do harm (Ulrich & Gilpin 2003, de Kort & IJsselsteijn 2006). Ulrich and Gilpin (2003) developed a series of guidelines for selecting artwork for the healthcare setting. They claim that stressed patients should not be exposed to surreal or ambiguous art. Ulrich (1991) found in an earlier report that psychiatric patients in Sweden attacked

abstract and ambiguous art on the wall, while no attacks were made on landscape or flower prints. Patients' negative reactions to The Bird Garden at Duke Medical University may also support an aversion to abstraction (Ulrich, 1999). De Kort and Ijsselsteijn (2006) warn that aesthetic assessments of nature are more restrictive than using nature for its restorative or therapeutic powers. "It would be very dangerous to simply assume that any photorealistic representation will do or that each representation will be as effective as the next" (de Kort & Ijsselsteijn 2006, p. 232). Though photographs are often realistic for use in preference studies, other studies have found higher degrees of experiential realism when sound and motion are included (Laumann et al. 2001). The photograph is a still image that limits its interactive influence by not allowing the participant or viewer to control the media by navigation or manipulation (Ijsselsteijn, 2003). This passive engagement also has the potential to result in boredom for the viewer. This preliminary study (in order to clarify methodology and be replicable) used only one variable, visual art in a static photograph.

Methods

Research Design

This is the first phase of a two phase study. More specifically, phase 1 involves the selection of the nature view using an empirical process informed by theory. Phase 2 involves the testing of the selected images using an experimental design where physiological and psychological responses will be

recorded under five conditions (four nature image categories and one control) before, during, and after a pain stressor.

Appleton's prospect refuge theory was selected for use in this study due to its 30 years of use by researchers in the field and it contains clear operational definitions. In this study a fourth category was added to prospect, refuge, and hazard called "mixed prospect and refuge" to offer a selection with an equal amount of prospect and refuge imagery in the view.

A sequential methods design was created where each stage of the design informed the next stage (Tashakkori & Teddlie 1998), Table 4.1. The first stage involved investigator examination of 300 images for best fit within one of Appleton's four categories, resulting in 72 total images. The second stage involved focus group examination of the 72 images, which was then reduced to 20 images (five per category) that best fit one of the categories. Focus group feedback regarding the process and suggestions for improvement was a part of the second stage. The third stage involved examination of the 20 images for best fit to a category, which resulted in four images (one per category). In the fourth stage selections from stage three were examined and approved or reordered, resulting in four images (one image per category) for use in the clinical experiment, phase two of the study.

Table 4.1. Sequential methods design

Stage	1 Investigator select	2 Focus groups	3 Sorting task	4 Content validity
Who	Investigator	55 experts & students	100 students	Subject/Research experts
Level	Informal	Informal	Controlled	Informal
What	Identify images based on theory	Identify preferred category images	Identify preferred category images	Compare findings with category definitions and characteristics
Where	Computer	Classroom	Classroom	Conference room
How	Subjective selection based on Appleton's definitions	Sorting task using "most" to "least" scale	Sorting task using "most" to "least" scale	Content validity rating using "most" to "least" scale
Results	300 to 72 images	72 to 20 images (5 per category)	20 to 4 images (1 per category)	20 to 4 images (1 per category) for use in phase 2 experiment

Appleton's Prospect Refuge Categories

To select the image that best represented each of Appleton's (1996) prospect refuge theory categories operational definitions were created. This was accomplished using Appleton's original terminology rather than investigator's interpretations of Appleton's concepts. Category titles, operational definitions, and characteristics for each landscape category were assembled in chart form, Table 4.2. The four category titles were prospect, refuge, hazard, and mixed prospect and refuge.

Table 4.2. Sorting task chart

SORTING TASK CHART

For Prospect Refuge Hazard Theory Nature Image Classifications

Theory: To see without being seen involves utilization of environmental conditions that support biological survival and hence are a source of pleasure (p. 262).

Appleton, Jay. 1996. *The Experience of Landscape*. John Wiley & Sons: Chichester, England

Category Titles	Prospect	Refuge	Hazard
Operational Definitions	An environmental condition, situation, object, or arrangement that presents real or symbolic access to a view. Direct prospect: A view as directly observed. Indirect prospect: The imagined view from a secondary vantage-point. Primary vantage-point: A place from where a direct prospect is observed. Secondary vantage-point: a place or object, usually elevated that offers an extended view.	An environmental condition, situation, object, or arrangement that presents real or symbolic situations for hiding or sheltering. Refuges provide protection from hazards. Hides provide concealment from animate hazards. Shelters provide concealment from inanimate hazards.	Incidents or conditions that present real or symbolic threats to life and well-being. Prospect and refuge symbolism demand a hazard symbolism to make them work.
Characteristics & Symbols	Bright light & illumination. Clear atmosphere. Sun (primary); moon, lamp or fire light (secondary). Short or long views. Raised elevation; falling ground. Reflective surfaces: water, snow. Patterns of light reflected in water, Patches of blue in an overcast sky. Color blue.	Dim or dark light. Mist or light haze. Thin smoke from a chimney. Earth refuges: caves, rocks, hollows, ravines. Vegetative refuges: trees, grasses, reeds, shrubbery, vine walls. Artificial refuges: houses, ships. Nebulous refuges: mist, smoke. Accessible entry: openings such as	Harmful people. Harmful animals. Harsh wind, cold, rain, hail, snow, storms, earthquakes, volcanoes, avalanches. Aquatic hazards: rapids, storm waves, floods, tidal waves. Fire. Falling off cliffs, chasms, or precipices. Dense vegetation; cliffs; ravines; water bodies that impede

	The horizon; hill tops, mountain tops; vertical trees; off shore islands. Turrets, towers, some clearings. Convex or smooth, bare, (rock, sand, gravel, earth) surfaces. Carpeted surfaces of low growing vegetation (turf). Sunrise and sunset colors rich in yellow-orange-red.	windows, doors, overhangs, stairs; frayed or broken edges to woods. Concave surfaces: hollows, depressions. Arboreal surfaces: trees, tall grasses, bamboo. Color shades of gray, brown, or dull purple.	movement. Hedges, fences, prison walls, ditches, Deficiency hazards imply chronic condition that threatens well-being such as hunger or thirst or shelter. Dense fog.
	Prospect	Refuge	Hazard

A criterion for image selection was developed, Table 4.3. Only images that met all criteria were considered for inclusion in the study. Color photographs of landscapes with horizontal orientation were selected from royalty free sources. Images were realistic rather than impressionistic. To protect pictorial realism no rendering or alterations were made to the images after they were selected for use in this study (de Kort et al., 2006). Image scenes possessed dominant nature rather than built features, and contained minimal reference to animals, built structures, or equipment. Familiarity is often considered an alternative explanation for landscape preference. In order to reduce familiarity issues (confounding variables), images with people or recognizable places were not included for use in this study.

Table 4.3. Criteria for photographic image selection

Landscape
Horizontal orientation
Color
Dominant nature over built features
Limited reference to animals, structures, equipment
No distinguishable people
No national, international landmark places
Limited number of variables
Use royalty free and obtainable images

Photographic image selections were reproduced as 12.7 cm by 17.78 cm [5" X 7"] in size professionally printed images and centered on 21.59 cm by 27.94 cm [8.5" X 11"] size heavy weight paper for use in stages two through four. The type of printer and paper remained constant throughout the study to ensure consistency of color and quality. Ten sets of 72 images were printed for stage two focus groups and 20 sets of 20 images were reproduced for use in stages three (sorting task) and four (content validity). Identification numbers were randomly assigned to each image and placed on labels on the back of the photo, so as not to influence the viewers' judgment.

Sorting Task Instrument

For stage three, a directed sort and rank task was chosen to arrive at selections (Groat & Wang, 2002). Participants were provided with category titles, operational definitions, and instructions that included two sample photos for each category. The sample photos were not included in the sort task. Then the participants were asked to sort each of their images into one of the four categories. Then, for each category, they ranked the images from “most” to “least” suited to the category and recorded their selections on a score sheet.

Participant Selection

Focus groups participants (stage two) were recruited through personal email from the College of Architecture, Arts and Humanities and from the College of Agriculture, Forestry, and Life Sciences at Clemson University. One college class (Horticulture 101) of undergraduate students received extra credit for their participation. No others were compensated. The college class (Horticulture 101) was an introductory class that contained students from 17 different program areas and four different colleges. Fifty-five people attended the focus groups in 2008, which represented faculty (10 individuals), graduate students (14 individuals), and undergraduate students (31 individuals). The ethnicity of the participants consisted of 95% Caucasians (51 individuals), 4% Asians (3 individuals), and 1% African Americans (1 individual). Furthermore, the genders of the participants were 60% male (33 individuals) and 40% female (22 individuals).

Sorting task participants (stage three) were recruited by a generic college-wide email and by flyers that were posted in the college library, student union, and a variety of classroom buildings, Appendix C. The students were compensated \$10 per hour of participation. One-hundred students were randomly selected and assigned to a session in 2008, and 85% of participating individuals were undergraduate students and 15% were graduate students. All five university colleges were represented: 26% of participants were affiliated with the College of Business & Behavioral Science; 25% with the College of Agriculture, Forestry and Life Sciences; 33% with College of Health, Education, and Human Development; 9% with College of Architecture, Arts and Humanities; and 7% with College of Engineering and Science. The ethnicity of the participants consisted of 84% Caucasians, 12% African Americans, 3% Asian, and 1% American Indian or Alaskan Native. The genders of the participants were 65% female and 35% male. All sorting task participants provided informed consent before participating in the study. The study protocol was approved by Clemson University's Institutional Review Board and by the Department of Defense (DOD) Telemedicine and Advanced Technology Research Center (TATRC).

Survey Administration

Focus group participants (stage two) were welcomed and given a packet that included a demographic survey, a randomly shuffled set of 72 photographic prints, four category label tags, an operational category chart, and a score sheet.

First, they completed the demographic survey. Second, they orally received an orientation that defined Appleton's prospect refuge theory. Third, they were asked to place each image into one of the four categories of prospect, refuge, hazard, and mixed prospect and refuge. Fourth, they ranked the images within each category from 'most' to 'least' representative of the category and recorded their findings on score sheet. Finally, they were asked for their input for suggestions to improve the process. The investigator recorded comments and suggestions during the feedback process.

Sorting task participants (stage three) were randomly selected and assigned to sessions in classrooms. The rooms were windowless to reduce view distractions. The sorting task instructions were previously taped (using Garage Band program) to control the participant's reactivity. All vocalizations were recorded and printed on a hardcopy instruction sheet. After arriving, each participant received a packet that included a demographic survey, printed instructions which mirrored the audio recording (Appendix D, Sorting Task Script), an operational definition chart, a randomly shuffled set of 20 photographic prints, a set of four category label cards, and a score sheet, Appendix E. The investigator was present at each session to welcome the participants, operate the computer, deliver the recording, answer the questions, and give the remuneration. Once the group was assembled the investigator told the participants they would receive pre-recorded audio instructions to ensure that every group consistently received the same information. Participants first

completed the demographic survey, and then they received a taped orientation to the subject material with instructions. The orientation described each category, and the paper copy included two sample color photographs for each category, which were not used in the sorting task. Then, working alone at their own pace, participants sorted the 20 images into four piles of prospect, refuge, hazard, or mixed prospect and refuge. Next, they sorted their images within each category from “most” representative to “least” representative of the category. Lastly, they recorded their ranked selections on a score sheet. The image that best fit the category was first on the score sheet. Each participant was thanked and received an envelope containing \$10 for their one-hour contribution to the research project.

In stage four the content validity team met to conduct a content validity assessment on the images. The team consisted of four faculty subject matter and research experts who met once in 2008. The team viewed the twenty images ranked by the sorting task participants by using a content validity form, and they ranked each photograph according to their understanding of the subject material and their research experience. Scores were compared, dialogue ensued, and consensus was reached. The top selected image for the hazard category remained the same whereas the top selection for prospect, refuge, and mixed prospect and refuge was reassigned to one of the other images within the same category group. Category characteristic clarity was the main reason for reordering images.

Data Processing and Analysis

Focus group and sorting task responses were subjected to frequency analysis by ranking based on the sum of the responses, Table 4.4. Each participant's first place image selection received a score of "5", their second place selection received a score of "4", third place a "3", fourth place a "2", and fifth place a "1" within each category. The scores were totaled and the highest totals within each category were selected for inclusion in the next phase. Focus group scores were calculated based on the selections of the graduate and undergraduate students only. Faculty selections were excluded from analysis because the population sample of phase 2, the clinical experiment, was open to only students, not faculty. In multi-phase experiments the sampling of similar or like populations is the preferred method (Stamps, 2004).

Table 4.4. Sorting task frequency scores

Prospect			Refuge			Hazard			Mixed		
Image#	Avg.	Total	Image#	Avg.	Total	Image#	Avg.	Total	Image#	Avg.	Total
51	(6.00)	576	25	(5.26)	500	38	(6.86)	686	63	(5.03)	458
69	(5.90)	555	56	(5.51)	463	35	(4.77)	439	15	(5.17)	445
52	(4.62)	458	45	(4.59)	446	33	(4.85)	422	16	(4.83)	445
37	(4.22)	351	6	(5.66)	425	28	(4.72)	411	40	(4.82)	391
72	(3.93)	327	34	(4.89)	362	58	(4.37)	359	41	(4.79)	355

Results

Focus Group Feedback

Stage two focus groups ($n = 55$) comments were instrumental in creating the final instrument used in the controlled sorting task (stage three). Each of the ten groups commented on the high quality of the images and the materials.

Suggestions for improving the wording of the instructions occurred and were promptly implemented so that the next group could experience the alteration and have an opportunity to react to it. Consensus was that an adult needed to be present (in the room) while the controlled sorting task was implemented. Images that were disliked were noted as were areas of confusion. Conceptual confusion primarily existed in two areas. First, the categories of hazard and prospect were confusing to some people. Mountain scenes were most commonly mentioned as confusing while trying to sort them into a category pile. The common question that was raised, was the image prospect or hazard? The second area of confusion is closely related to the first area. Some individuals struggled while they sorted the images, should they follow the category descriptions as they were defined on paper or should they follow their instincts? For example, “Do I do what is described by Appleton or do what I personally feel?” Again, the mountain scenes were most often mentioned as the source of indecision. Water scenes were another area this concern involved. Some individuals admitted to possessing fear of water (rendering it a hazard), yet they suspected the images with water would be appreciated by most other people as prospect symbols.

Prospect Landscapes

The top five selected photographic images representing “prospect” by the graduate and undergraduate focus group participants (including the sorting task participants) are listed in descending order: image #51 sand beach, ocean, and sky; #69 a field of yellow flowers, green rolling hills, and blue sky; #52 stone

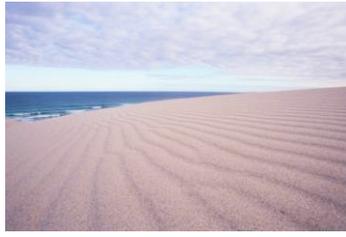
beach, ocean waves, and blue sky; #37 lake water, trees on horizon, and sky at sunset with the entire image bathed in gold; and #72 a field of flowers with brighter colored blooms in the foreground, Figure 4.1, Table 4.5. Content validity (expert) team selection for first place “prospect” image was image #69, a field of yellow flowers, green rolling hills, and blue sky. This image was considered more appropriate for research than the other images due to the fear of water that several participants in the focus groups possessed. This image will represent the category “prospect” in the next phase, the clinical experiment.

Table 4.5. Ranking of prospect image results by method

Ranking	Focus Group	Sorting Task	Content Validity
1st	51	51	69
2nd	69	69	
3rd	52	52	
4th	37	37	
5th	72	72	



#69 (Photo: Getty Image)



#51 (Photo: Getty Image)



#72 (Photo: Getty Image)



#52 (Photo: Getty Image)



#37 (Photo: Ellen Vincent)

Figure 4.1. Prospect image selections

Refuge Landscapes

The top five selected photographic images representing “refuge” by the graduate and undergraduate focus group participants (stage two) are listed in descending order: image #25 a dense bright green fern-like foliage and a thin tree trunk; #45 a screen or covering of weeping willow leaves/branches; #56 surface roots and buttress flare of a mature tree with foliage and sunlight at top; #6 a shallow stream with a stone drainage culvert and a foliated top; and #34 the soil floor, a slice of bright light, and tree canopy, Table 4.6. Stage three sorting task groups ranking for “refuge” images included, in descending order, #25, #56, #45, #6, and #34. Stage four content validity (expert) team selection for first

place “refuge” image was image #56, surface roots and buttress flare of a mature tree with foliage and sunlight at top, Figure 4.2. This image was selected for use due to its clarity and high number of representative refuge characteristics. This image will represent the category “refuge” in the next phase, the clinical experiment.

Table 4.6. Ranking of refuge image results by method

Ranking	Focus Group	Sorting Task	Content Validity
1st	25	25	56
2nd	45	56	
3rd	56	45	
4th	6	6	
5th	34	34	



#56 (Photo: Getty Image)



#25 (Photo: Getty Image)



#45 (Photo: Ellen Vincent)



#34 (Photo: Ellen Vincent)



#6 (Photo: Ellen Vincent)

Figure 4.2. Refuge image selections

Hazard Landscapes

The top five selected photographic images representing “hazard” by the graduate and undergraduate focus group participants (stage two) are listed in descending order: image #38 a forest fire; #33 rocky mountain peaks and a gray sky; #35 a tree barren of foliage on snowy rocks with a gray, blue, and pink sky; #28 brown and gray rocky mountain peaks and a gray sky; and #58 craggy mountain peaks with a blue sky, Table 4.7. Stage three sorting task groups ranking for “hazard” images included, in descending order, #38, #35, #33, #28, and #58. Stage four content validity (expert) team selection for first place hazard image was image #38, Figure 4.3. This image will represent the category “hazard” in the next phase, the clinical experiment.

Table 4.7. Ranking of hazard image results by method

Ranking	Focus Group	Sorting Task	Content Validity
1st	38	38	38
2nd	33	35	
3rd	35	33	
4th	28	28	
5th	58	58	



#38 (Photo: Getty Image)



#33 (Photo: Getty Image)



#35 (Photo: Getty Image)



#28 (Photo: Getty Image)



#58 (Photo: Getty Image)

Figure 4.3. Hazard image selections

Mixed Prospect and Refuge Landscapes

The top five selected photographic images representing “mixed prospect and refuge” by the graduate and undergraduate focus group participants (stage two) are listed in descending order: image #16 green fields, a stone wall, and a mature tree; #41 purple flower field in a frame of tree branches with roof tops in far distance; #63 clusters of trees with strong rays of light beaming down; #15 grass fields, a road curving out of sight, a stone wall, a tree with no foliage, and the roof of a barn-like structure; and #40 rows of orange blooming crops, a two-lane dirt track, and rows of trees with fields beyond, Table 4.8. Stage three sorting task groups ranking for “mixed prospect and refuge” images included, in descending order, #63, #15, #16, #40, and #41. Stage four content validity (expert) team selection for first place mixed prospect and refuge image was image #41, purple flower field in a frame of tree branches with roof tops in far distance. This image was chosen for high degree of balance (equal amounts of prospect and refuge). Three forms of refuge were evident (tree branches in frame at edges, rooftops in distance, and overcast sky). The clear view through the field of flowers in the center of the image well represented prospect. This image will represent the category “mixed prospect and refuge” in the next phase, the clinical experiment, Figure 4.4.

Table 4.8. Ranking of mixed prospect refuge image results by method

Ranking	Focus Group	Sorting Task	Content Validity
1 st	16	63	41
2 nd	41	15	
3 rd	63	16	
4 th	15	40	
5 th	40	41	



#41 (Photo: Ellen Vincent)



#63 (Photo: Getty Image)



#15 (Photo: Ellen Vincent)



#16 (Photo: Ellen Vincent)



#40 (Photo: Getty Image)

Figure 4.4. Mixed prospect and refuge image selections

Discussion

Reproducible concepts and random sampling are essential to the true experiment as well as to quasi-experimental or mixed method research design (Singleton & Straits, 2005; Stamps, 2004). To operationalize Appleton's categories for prospect refuge theory clear and accurate category titles were used for the study. The category titles and descriptions were gleaned directly from Appleton's original work (1996) rather than from investigators' interpretations. The four category titles were prospect, refuge, hazard, and mixed prospect and refuge. A descriptive summary table was created for participants that contained the categories and summary descriptive characteristics of each, Table 4.1.

In order to arrive at the image that best described each category the participants (focus groups, sort task participants, and research/subject experts) were asked to sort images into the categories defined by Appleton. The participants were not asked to judge the therapeutic value or their individual preference for any image they sorted, because preference is considered harder to judge than quality (Bell et al., 2001). Judgments of quality or value appear to be more consistent with less individual variation than do judgments of preference.

To appeal to multiple learning styles and to control the participant reactivity to the investigator, the instructions and orientation of the categories were not only printed on paper (visual), they were pre-recorded and delivered via

a computer program (auditory). Criteria for image selection was developed and used by the investigator in the initial selection of images, Table 4.3. Only reproducible images that other researchers could obtain were selected for experimental use. Royalty free Getty Images (www.gettyimages.com) that are available for sale and the investigator's own images, which can be shared with other researchers via email, were considered for use.

A universal sorting task recruitment email was sent college-wide to students in order to promote diversity. Recruiting from a wide variety of disciplines is preferable to relying on one-discipline convenience sampling. Research has shown that one landscape may influence affective evaluations of subsequent scenes in a predictable fashion (Bell et al., 2001), No image pile was like another and every pile of images was shuffled prior to each use to control for adaptation bias.

A research design using mixed methods, qualitative and quantitative, has potential to overcome the limitations inherent within each camp (Singleton and Straits, 2005). Landscape preference descriptive research that relies solely on artistic (design training) judgment may result in low reliability and validity (Bell et al., 2001). This study used a combination of stakeholder responses to increase validity. Faculty, graduate, and undergraduate students participated in the focus groups; graduate and undergraduate students participated in the sorting task; and faculty research/subject experts performed the content validity analysis on

the final image selections. Empirical data analysis using frequency means for the focus group and sorting task responses also enhanced validity.

However, Bell et al. (2001) claimed that mixed stakeholder data collection is normal. Stamps emphasized that using expert panels where researchers substitute their own impressions for responses from the intended population weakens results (Stamps, 2004). As a result, the present study only used undergraduate and graduate students in the controlled sorting task. This population mirrored the next phase (experiment) participant population. The decision to assemble research/subject matter experts to perform a content validity analysis on the students' selections was done to capture their relative experience and is a common practice in thesis dissertations.

Phase two of this study, a clinical experiment using healthy college students will test the therapeutic benefits of the four selected images (prospect, refuge, hazard, and mixed prospect and refuge) in a clinical experiment where participants undergo a pain stressor. Therapeutic aspects are defined by Cooper Marcus and Barnes (1999) as relief from physical symptoms, reduced stress, and improvement in overall sense of well-being. Psychological (self report surveys) and physiological data (heart rate and blood pressures) will be collected from participants in each image group as well as from a control group that does not view an image.

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CHAPTER 5
EFFECTS OF NATURE IMAGES ON PAIN IN A SIMULATED
HOSPITAL PATIENT ROOM

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Abstract

Background

Views of nature have been reported to relieve stress (Tennesson & Cimprich, 1995) and pain (Ulrich, 1984; Tse et al., 2002; Diette et al., 2003) making nature an ideal medium for use in healthcare settings. In hospitals whose design does not allow for a view of nature, virtual and surrogate views of nature may be a viable therapeutic option.

Objective

This study tests the effects of specific nature images, as defined by Appleton's prospect refuge theory of landscape preference (1975, 1996) on participants experiencing pain. The hypotheses were: (1) Nature views are variable in their impact on specific psychological and physiological health status indicators, and (2) Prospect and refuge nature scenes are more therapeutic than hazard nature scenes. The research question was (1) Which nature image categories are most therapeutic as evidenced by reduced pain and positive mood?

Methods

An experiment using mixed methods assessed the effects of four different nature scenes on physiological (blood pressure, heart rate) and psychological (mood) responses when a person was subjected to a pain stressor. Four groups were subjected to a specific nature image category of prospect, refuge, hazard, or mixed prospect and refuge while the fifth group received no image. The Short-Form McGill Pain Questionnaire and the Profile of Mood States survey instruments were used to assess pain and mood respectively. Continuous physiological readings of heart rate and blood pressures were collected. Pain was induced through a cold pressor task which required participants to immerse their non-dominant hand in ice water for up to 120 seconds.

Results

The mixed prospect and refuge image treatment showed significantly lower sensory pain responses while the no image treatment received significantly higher affective pain perception responses. The hazard image treatment had significantly lower diastolic blood pressure readings during the pain treatment yet also had significantly high total mood disturbance.

Conclusions

Nature views were variable in their impact on psychological and physiological health status indicators. While there was no clear “most” therapeutic image, the mixed prospect and refuge image shows significant potential to reduce sensory pain. The hazard image was the most effective at

distracting participants from pain, but should not be considered a positive distraction because it also received the highest mood disturbance scores of all groups.

Introduction

Pain and stress are commonly associated with medical treatments and especially surgery (Johnston, 1988; Kinsey & Saltmore, 1990). Pain and stress are often times linked (Melzack, 1999) and both conditions are affected by psychological and physiological factors (Gatchel & Turk, 1999; Turk & Gatchel, 2002; Turk & Winter, 2008). For this reason, pain treatment programs often incorporate integrated approaches, including psychologically enhanced environments (Park, Matson, & Kim, 2004).

Research studies linking views of nature with reduced stress in healthcare settings are prevalent. Kaplan and Kaplan (1989; Kaplan & Peterson 1993; Kaplan 1995) have described the role of nature in creating ideal restorative environments that help alleviate stress by reducing directed attention fatigue. Heerwagen (1990) found dental patients reported less anxiety when a landscape mural was present in the waiting room. Likewise, Ulrich, Lunden, and Eltinge (1993) found that open heart surgery patients in Uppsala, Sweden reported less anxiety when a nature photograph dominated by water was present than did patients with a view of an abstract picture or a blank white panel. Ulrich (1991; Ulrich, Zimring, Quan, & Joseph, 2006; Ulrich, Zimring, Quan, Joseph, &

Choudhary, 2004) reported that nature served as an effective positive distraction which alleviated stress in healthcare settings. Cooper-Marcus and Barnes (1999) found hospital gardens reduced stress and improved patient outcomes by providing opportunities for positive escape and increased sense of control. In another study, Ulrich, Simons, and Miles (2003) reported lower stress levels among blood donors who were exposed to a video tape of nature settings than those who were exposed to regular television programming or a video tape of an urban environment. What is not largely known is which type of nature images have positive or negative effects on human responses.

Views of nature and their effect on patient pain levels are less frequently studied in healthcare settings. Diette, Lechtzin, Haponik, Devrotes, and Rubin (2003) conducted a study of patients undergoing flexible bronchoscopy procedures at John Hopkins Hospital. During the procedure one group was exposed to a combination of a nature mural plus nature sounds while the second group received treatment as usual. The treatment group who received the nature intervention reported less pain than the group that was not exposed to nature. In another study, Tse, Ng, Chung, and Wong (2002) tested the effects of a nature video on pain levels of healthy college students in Hong Kong by administering a pain stressor in the form of a tourniquet. One group watched a nature video while the other watched a blank screen. Findings showed that participants exposed to the nature video had higher pain thresholds and pain tolerance than the group that did not have the nature video to view. Ulrich (1984; Ulrich et al. 1993; Ulrich

et al., 2008) reported patients with views of nature required less strong pain medication than those who did not have nature views. Miller, Hickman, and Lemasters (1992) combined a video of scenic nature with the sound of music to test the combined effects on pain and anxiety in burn patients at University of Cincinnati Medical Center's University Hospital Burn Special Care Unit. Patients exposed to the nature visual/music intervention reported reduced levels of pain intensity, pain quality, and anxiety during dressing changes.

Hospitals across the world are beginning to display art on their walls in order to facilitate wellness with little research to guide their selection (Ulrich & Gilpin, 2003; Dilani, 2001). In Australia, the United Kingdom, and the United States art work is created by hospital patrons (Sutton, 2005), purchased from local artists, or loaned to hospitals through a non-profit organization for use on healthcare walls. Though this practice of featuring local art in hospitals has the benefit of establishing positive relationships between the local arts community and the hospital, the selection of art work is not based on patient therapeutic needs. One art installation at Duke Medical University, a rooftop sculpture called The Bird Garden, caused patient complaints and ultimately the installation was removed due to its contra-therapeutic effect (Ulrich, 1999). The need for research that identifies the types of nature views with positive impacts upon patients in pain in healthcare settings is apparent (Malenbaum, Keefe, Williams, Ulrich, & Somers, 2008; RMNO, 2004).

There is also a need within this interdisciplinary field for research to be grounded in theory (RMNO, 2004; Dilani, 2005). Theories associated with the therapeutic potential of nature, and nature images, are typically landscape preference and aesthetic theories. Landscape preferences have been extensively described by Appleton (1975, 1996), Kaplan and Kaplan (1989), and Ulrich (1991, 2008). They all consider an evolutionary explanation for people's preferences for certain types of environments as valid. Evolutionary theory does not discount the role that culture has on peoples' landscape preferences (Appleton, 1996; Bell et al., 2001) yet it instead focuses on evolutionary or biological explanations for behavior.

Evolutionary Theory

Evolutionary explanations for human environmental preferences basically agree that humans developed an innate predisposition for certain types of environments during the long developmental stage spent as hunters and gatherers. For foragers and hunters, habitat selection was linked to survival. Over time, this preference choice for habitat became neurologically "hardwired" and has contributed to our modern day landscape preferences (Edelman, 1987). In essence, these evolutionary theories and explanations agree that our modern day environmental preferences have biological roots in the long distance past (Ruso et al., 2003).

Appleton's prospect refuge theory is a widely accepted evolutionary theory that claims that humans, as hunter gatherers, developed an ability to assess the

environment in order to select habitats that ensured survival (Appleton, 1975, 1996). “To see without being seen” is the viewer’s ideal objective in prospect refuge landscapes. Appleton’s extensive examination of landscape paintings led to major category titles and operational definitions for landscape features and content. Category titles included prospect, refuge, and hazard.

According to Appleton’s definitions, prospect in the landscape present real or symbolic access to a view in landscape images, which can include clear skies, low ground cover vegetation, and ideal viewing advantages (from a high space for instance) that allow the viewer to survey their surroundings. Refuge in the landscape meanwhile presents real or symbolic situations for hiding or sheltering. Refuge characteristics include but are not limited to dim light and places to hide from inclement weather or threatening people. Hazard in the landscape presents incidents or conditions that pose real or symbolic threats to life and well-being. A fierce storm, a bramble field that impedes locomotion, and a forest fire all are characteristics of hazard landscapes. Landscapes may contain multiple types of imagery and are named by the dominant feature (i.e. prospect-dominant or refuge-dominant). Landscapes with equal amounts of prospect, refuge, and hazard imagery are called balanced landscapes. A balanced prospect refuge landscape may occur when opportunities for both a view (prospect) and cover (refuge) are equally presented in the landscape. A bridge that provides a view (prospect) and trees with low climbable branches (refuge) that are equally visible in one image represent a mixed landscape. Appleton describes this fourth

category as a “compromise zone” (Appleton 1996, p. 191) because it provides both prospect and refuge within one image.

Methods

Research Design

An experiment was conducted using mixed methods in a between-group design to test the effects of specific categories of nature images on pain and mood levels. Institutional Review Board (IRB) approval was granted prior to starting the experiment and a registered nurse was on site during the cold pressor (pain) treatment. Individuals were excluded that had the following conditions: chronic illness, past or present injury to their hand/arm, Raynaud’s syndrome, arthritis, Lupus, skin disorders, open wounds, anemia, heart conditions, scleroderma, autoimmune disorders, or visual acuity disorders (color deficiency). The experiment was conducted over nine consecutive weeks in autumn 2008. Participants provided informed consent before participating in the study.

One hundred nine ($n = 109$) participants were randomly assigned to one of four nature image categories classified by Appleton’s prospect refuge theory. The image categories were prospect, refuge, hazard, or mixed prospect and refuge, defined previously. There was also a control group that did not view a nature image; instead they looked at a black screen. Images were previously selected using sequential methods that included focus groups, a controlled sorting task,

and content validity analysis (Vincent, Battisto, Grimes, 2009a). One image was selected to represent each of the four categories in the experiment as shown in Figure 5.1.



Prospect (Photo: Getty Image)



Refuge (Photo: Getty Image)



Hazard (Photo: Getty Image)



Mixed Prospect and Refuge (Photo: Ellen Vincent)

Figure 5.1. Images representing prospect, refuge, hazard, and mixed prospect and refuge

The duration for each investigation was approximately 60 minutes and divided into five periods: pre-reporting, resting, pain stressor, recovery, and post-reporting. For each participant in groups one through four, one image was projected onto a large nine-panel screen that occupied the participant's field of view. Group five (control) looked at a black screen. A pain stressor was

introduced after a 10 minute resting period. Physiological data were collected before, during, and after the pain stressor while psychological data was collected before and after the pain stressor.

Study Groups

Participants were recruited for two weeks through a universal email sent to all Clemson University students. Emails were also sent from the various college student services centers, and recruitment flyers were posted on bulletin boards in the college library, student union, and an assortment of classroom buildings, Appendix F. Fifteen dollars was offered as payment for up to 90 minutes of participation. Applicants were randomly selected and contacted by a scheduler who assigned them a day and time slot.

Participants were 109 healthy college students, including 56 females and 53 males. Eighty-six participants were undergraduate level and 23 were graduate level. The mean age of the sample was 21.50 (SD = 4.83). Racial representation included 85 White, 13 Asian, five African American or Black, three some other race (SOR), two American Indian or Alaskan Native, and one Native Hawaiian. Participants represented all five colleges within the university, which is preferable to one discipline convenience sampling. Seventy-seven participants had never stayed overnight as a patient in a hospital patient room while 32 participants had.

Study Site

The experiment was conducted in the School of Nursing's Clinical Learning and Resource Center at Clemson University in Clemson, South

Carolina, U.S.A. More specifically, the study took place in a simulated hospital patient room. The room was approximately 15.6' (4.75 m) x 18.6' (5.67 m). Participants lay in a hospital bed (Hill-Rom) that faced a nine-panel screen, with an overall size of 9' (2.74 m) long and 5'3" (1.62 m) high. The flat panel digital array was within the field of view, approximately 9.6' (2.93 m) away from the head of the bed. The bottom of the screen was 3'6" (1.11 m) off the floor as shown in Figure 5.2 and Figure 5.3. Instruments used for taking physiological recordings were placed to one side of the bed, slightly behind, with the machine's screen facing away from the participant. Wall paint was off-white, windows blinds were closed, and interior room lights were on. There was no art on the walls of the room.



Photo: Ellen Vincent

Figure 5.2. Participant viewing image

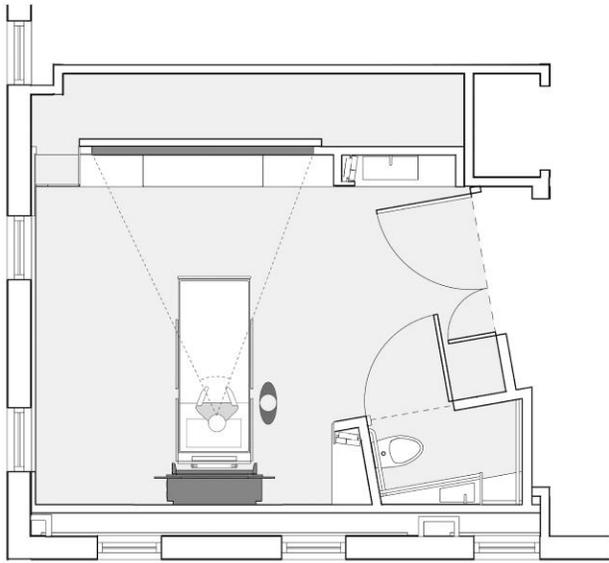


Figure 5.3. Floor plan of simulated hospital room

Data Collection Instruments

Physiological readings of systolic blood pressure, diastolic blood pressure, heart rate, and mean arterial pressure (MAP) were collected using the GE Dinamap Pro100 machine (Medical Solutions, Minneapolis, MN.) An appropriate sized arm cuff was attached to the participant's dominant arm. Systolic pressure is the maximum arterial pressure during contraction of the left ventricle of the heart and is represented as the first number in the blood pressure reading (Blakemore & Jennett, 2001). Diastolic blood pressure is the minimum arterial pressure during the relaxed state of the heart just before the next beat (Ibid). Measurements are in millimeters of mercury (mmHg).

The Short-Form McGill Pain Questionnaire (Melzack, 1987) was used to assess participants' response to the cold pressor treatment. This questionnaire is a pain assessment tool used in clinical and laboratory environments, with high reliability, sensitivity, and validity (McClelland & McCubbin, 2008). The Short-Form McGill Pain Questionnaire (SF-MPQ) contained 15 items with three scales; one for sensory pain (e.g. throbbing, shooting) one for affective pain (e.g. sickening, punishing-cruel) and the two subscales totaled together created a Total Pain Score.

The Profile of Mood States (McNair et al., 2003) instrument was used to survey participants' present emotional state. The survey has strong internal consistency and high validity (Lopez and Snyder, 2004). The Profile of Mood States (POMS) survey contained 65 items, six subscales (one positive emotion subscale is Vigor) and required participants to rate their present mood condition by circling a number from 0 "not at all" to 4 "extremely". Additionally, perceived presence and influence were surveyed using visual analogue scales and are reported elsewhere (Vincent, Battisto, Grimes, 2009b).

Stressor Task

This experiment used a cold pressor challenge to induce pain in the participant (McClelland and McCubbin, 2008). Participants immersed their non-dominant hand up to the wrist in a cooler of ice water for up to 120 seconds. They were instructed to remove their hand at any time if the pain became intolerable and to say "done" at the same time. The cold pressor treatment has a

long history of use in cardiovascular research. The hand immersion is associated with heart rate acceleration (Saab et al., 1993) as well as blood pressure elevation. It has frequently been used in studies dealing with experimental pain and is routinely used in experimental psychology practice (McClelland & McCubbin, 2008).

Procedure

The duration for each investigation was approximately 60 minutes and divided into five periods: pre-reporting, resting, pain stressor, recovery, and post-reporting as shown in Figure 5.4. Continuous physiological health (blood pressures and heart rate) readings were collected throughout the study. Psychological health measures of pain and mood were collected within two to four minutes after the cold pressor treatment and during the post-reporting period.

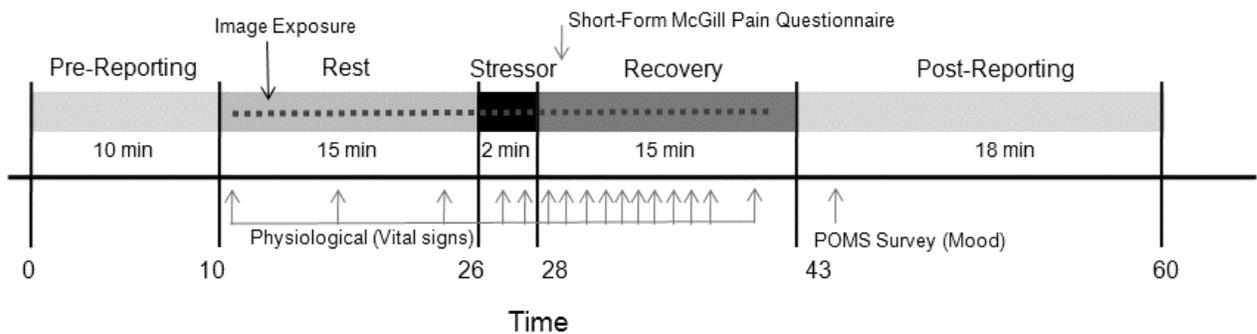


Figure 5.4. Timeline of events

When each of the participants arrived, they completed informed consent and then lay down in a hospital patient bed where they received instructions and an orientation from a script read to them by the investigator. An appropriate sized arm cuff was attached to their dominant arm to collect blood pressure data. After completing a one page demographic survey one image was projected onto the screen located on the wall directly across from the bed within the field of view. One group, the control group, did not receive an image and were asked to view the screen (which was black) in front of them. During the resting period, physiological readings (heart rate and blood pressure readings) were collected three times at five minute intervals. After the approximate 10-15 minute rest period participants were asked to immerse their hand in ice water for up to two minutes while they viewed the screen (image or no image) in front of them. They were instructed to remove their hand if the pain became intolerable and say "done" if they did so. Physiological readings were taken at one minute intervals during the cold pressor and for 10 minutes afterwards. Within two to four minutes of removing their hand from the iced water they completed the Short-Form McGill Pain Questionnaire. The Profile of Mood States (POMS) questionnaire was administered immediately after the arm cuff and image were removed, during the post treatment reporting time.

Limitations

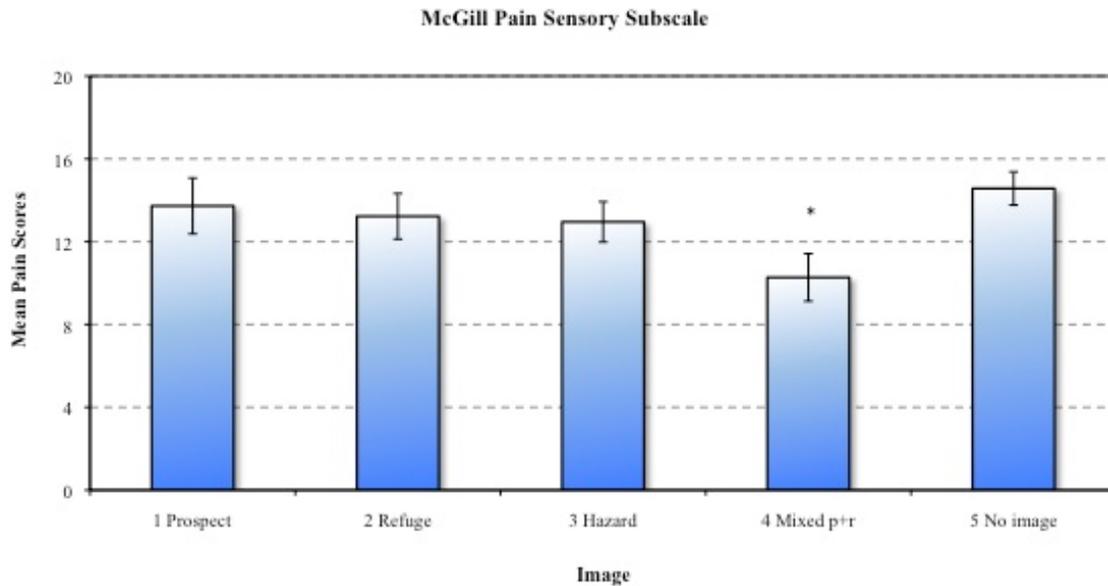
While instruments with high internal validity were employed in this research, external validity requires larger sample sizes and research duplication to increase vigor.

Data Analysis

Collected data were subjected to t-tests and repeated measures analysis of variance ($\alpha = 0.1$ to assess trends, SAS Institute Inc., Cary, NC). Cold pressor stressor effectiveness data was analyzed by individual and per treatment group.

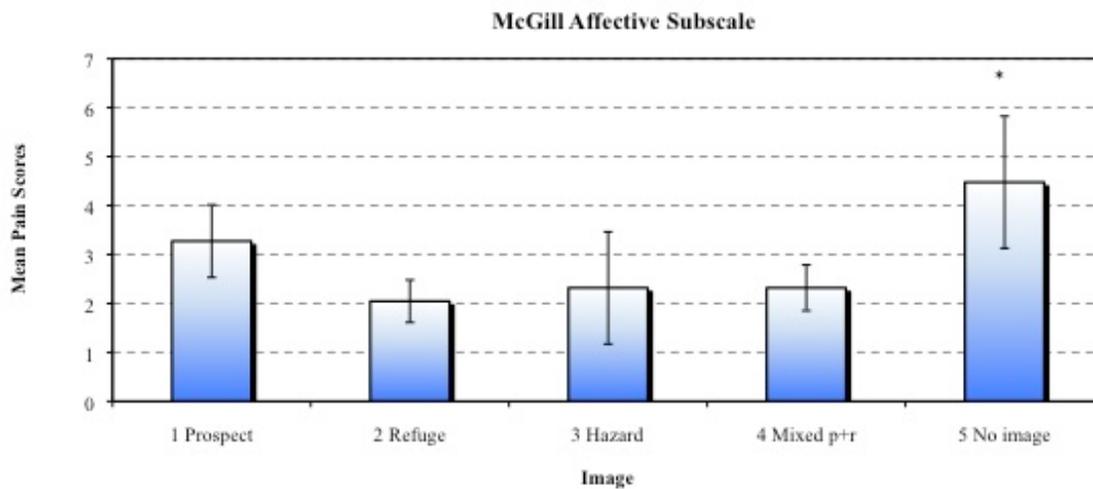
Results

The results showed statistical significance and indicated stressor effectiveness for all the physiological readings. In the Short-Form McGill Pain Questionnaire (SF-MPQ) sensory subscale the mixed prospect and refuge image received significantly lower responses than the other images and no image, Figure 5.5. The affective subscale of the Short-Form McGill Pain Questionnaire, Figure 5.6, showed significantly higher responses for no image than for refuge, hazard, and mixed prospect and refuge images. In the total pain score the no image treatment received significantly higher responses than the mixed prospect and refuge image ($\alpha = 0.1$, F Value = 2.87, df = 4, 104, $P = 0.0265$).



*Statistically significant $\alpha = 0.1$, F Value = 2.22, df = 4, 104, $P = 0.0715$

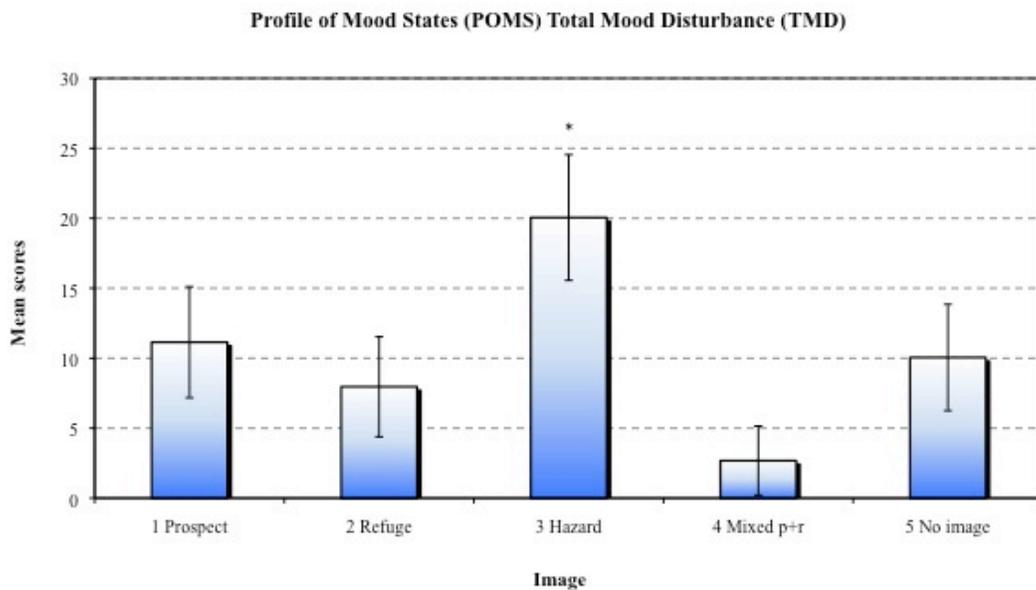
Figure 5.5. Short Form McGill Pain Questionnaire sensory subscale results



*Statistically significant $\alpha = 0.1$, F = 2.98, df = 4, 104, $P = 0.0226$

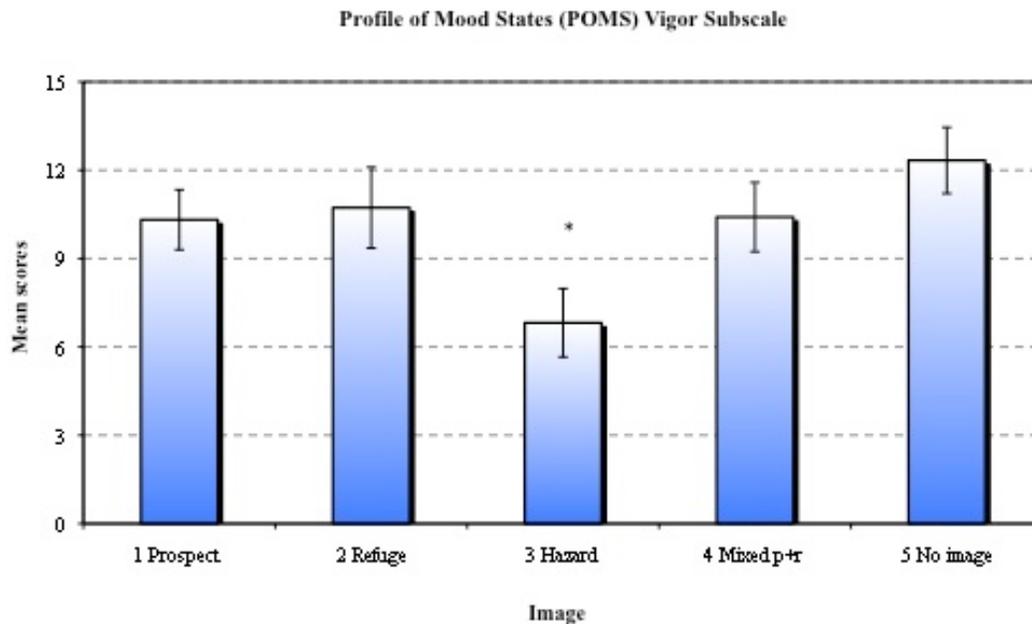
Figure 5.6. Short Form McGill Pain Questionnaire affective subscale results

The Profile of Mood States (POMS) survey indicated significant difference in mean scores for Total Mood Disturbance and for the subscale Vigor. The hazard image was significantly greater for Total Mood Disturbance than the other images and no image, Figure 5.7. Vigor, the only reverse scored, or positive emotion subscale showed significantly low responses for the hazard image, Figure 5.8. Participants that viewed the hazard image experienced both the highest amounts of mood disturbance and the lowest amount of vigor (positive emotion or mood) than those who viewed other images and no image.



*Statistically significant $\alpha = 0.1$, F value = 2.90, $df = 4, 104$, $P = 0.0253$

Figure 5.7. Profile of Mood States Total Mood Disturbance results



*Statistically significant $\alpha = 0.1$, F value = 2.93, $df = 4, 104$, $P = 0.0244$

Figure 5.8. Profile of Mood States subscale Vigor results

Diastolic blood pressure was the only physiological reading that showed statistical significance for changes over time, Figure 5.9, Table 5.1. The changes were most noticeable during the pain treatment (cold pressor) when the hazard image did not produce the diastolic elevation that the other groups did. The hazard image produced the lowest diastolic readings, though the prospect image was not significantly different from any of the other images.

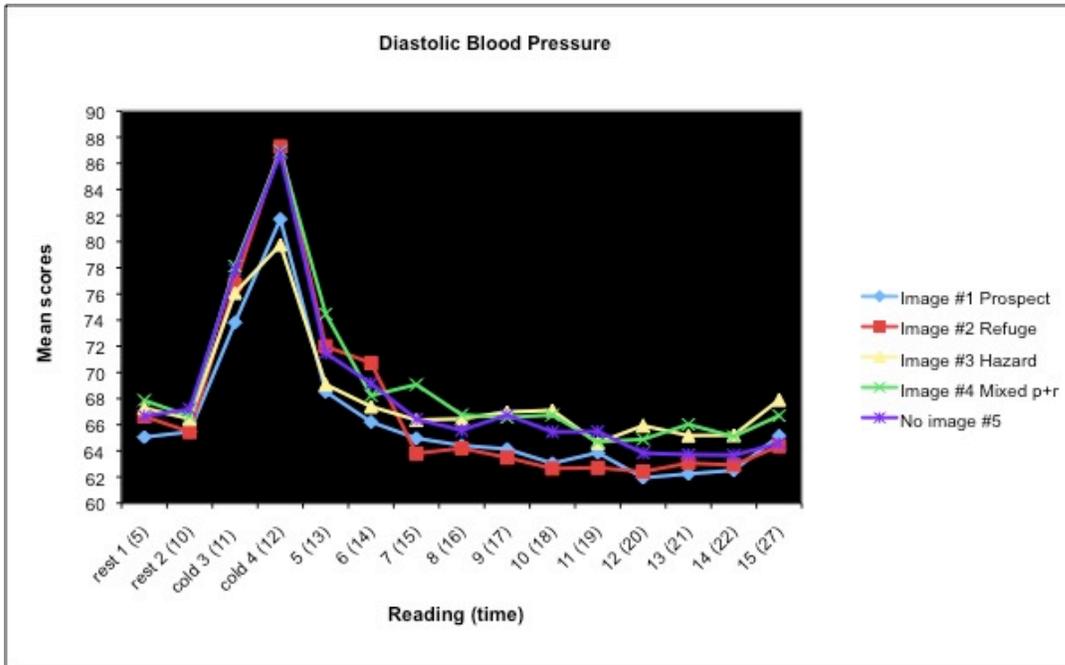


Figure 5.9. Diastolic blood pressure results

Table 5.1. Diastolic blood pressure statistical results

Effect	Numerator DF	Denominator DF	F value	Probability F
Image	4	104	0.57	0.6884
Reading	14	1245	118.88	<.0001 [†]
Image*Reading	56	1245	1.33	0.0561 [†]

[†]Statistically significant $\alpha = 0.1$ for changes over time

Discussion

Perceived pain levels did vary among the image categories. Participants with no image experienced greater pain levels in the affective pain ratings than participants who viewed image categories for refuge, hazard, and mixed prospect and refuge, There were no statistically significant differences in affective pain

ratings between no image and prospect however, which raises concern for the therapeutic value of the prospect image to positively affect pain in this study. The mixed prospect and refuge image category has never been used in a research experiment to our knowledge. This study found that this image category resulted in significantly less perceived sensory pain sensation as reported by the Short-Form McGill Pain Questionnaire, thereby making it a potentially effective therapeutic aid. The effectiveness of this image at reducing perceptions of sensory pain perhaps is due to the inclusion of both prospect and refuge characteristics within one image. The ability to shelter (safety) and to view (explore) may allow a person in pain to use the image during temporal shifts in pain. Alternatively, image complexity may have contributed to this result. These findings also suggest additional hypotheses for further research to explore.

Diastolic blood pressure response during the pain (cold pressure) treatment was lowest for the hazard image. Why would the hazard image (a forest fire) result in a lower diastolic pressure than the other images? To our knowledge the hazard category does not have a history of use in these types of experiments, so this is new information to process. One explanation may be found in the pain literature reports on the use of imagery. Turk (2002) claims imagery is a useful strategy for helping people to relax and feel distracted from pain. Syrjala and Abrams (2002) describe imagery as mentally picturing something/anything that makes you feel like you are there. Several of the participants who viewed the hazard image stated during their debriefing session

that they used the image of the fire to warm their hand that was painfully immersed in the iced water. It may be then that some participants in this study incorporated the qualities of the image (heat) into a sensory experience for themselves that resulted in lower diastolic blood pressure. Researchers have described a reverse sensory situation with patients who used imagery to blow imaginary freezing arctic air onto and into body parts experiencing brief burning or hot pain (Syrjala & Abrams 2002). While the existence of heat (the forest fire) and cold (ice water pain stressor) is in fact an unexpected confounding variable in this research, it poses interesting hypotheses for future studies examining the use of specific images for distraction from different types of pain sensations. It would be incorrect however to describe the hazard image category as an effective distraction for pain over time, as its viewers reported the highest total mood disturbance and lowest response to the vigor subscale in the Profile of Mood States. So while the hazard image appeared to be effective at distracting viewers during the pain treatment it did not result in positive emotions or feelings of well-being immediately afterwards.

These results are preliminary and a follow up study is being conducted in a hospital patient care unit. More specifically, we need to assess the reproducibility of the image category results with different representative images. We also recommend further study of these effects using different pain modalities, such as pressure, ischemic and heat stimuli. These findings need to be extended to clinical settings for assessment of therapeutic efficacy during painful

medical procedures and pain-associated clinical conditions such as post operative recovery. Finally, the restorative impact of nature images may also provide longer term benefits for persons suffering chronic pain and discomfort. This study presents a methodology for testing the effects of nature images on physiological and psychological responses.

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CHAPTER 6

THE EFFECTS OF PRESENCE AND INFLUENCE IN NATURE IMAGES IN A SIMULATED HOSPITAL PATIENT ROOM

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Abstract

Objective

Research questions include: (1) Is there a significant difference in the level of perceived presence between the selected images? (2) Is there a significant difference in the level of perceived influence between the selected images? (3) Is there a correlation between levels of presence and levels of influence? The hypothesis is that higher degrees of presence and/or influence in the still photograph make it more effective at holding the viewer's attention, which therefore may distract the viewer from pain, and therefore be considered therapeutic.

Background

Nature images are frequently used for therapeutic purposes in hospital settings. Nature images may distract people from pain and promote psychological and physiological well-being, yet limited research is available to guide the selection process of nature images (Malenbaum et al., 2008; van den Berg, 2005; RMNO, 2004).

Methods

109 college students were randomly assigned to one of four different image categories defined by Appleton's (1975, 1996) prospect refuge theory of landscape preference. These categories included prospect, refuge, hazard, and mixed prospect and refuge. A control group was also included. Each investigation was divided into five periods: pre-reporting, rest, a pain stressor (hand in ice water for up to 120 seconds), recovery, and post-reporting. Data were collected on a continuous basis on presence and on influence using visual analogue scales. Physiological readings (vital signs) were measured repeatedly using a Dinamap automatic vital sign tracking machine. Psychological responses (mood) to the image were collected using a reliable instrument, the Profile of Mood States (POMS).

Results

No significant statistical difference was found in the levels of presence between the four image categories. Levels of influence however differed and the 'hazard' nature image category had significantly higher influence ratings and lower diastolic blood pressure readings during the pain treatment. A correlation ($r = .62$) existed between presence and influence, as one rose so did the other. Mood state was significantly low for the hazard nature image after the pain stressor experience.

Conclusions

Though the hazard image caused distraction from pain it is non-therapeutic due to the low mood ratings it received. These preliminary findings stimulate interest for additional research into the visual effects of nature images on pain.

Introduction

There is a limited amount of research literature that examines views of nature and its effect on patient pain levels. Diette, Lechtzin, Haponik, Devrotes, and Rubin (2003) conducted a study of patients undergoing flexible bronchoscopy procedures at John Hopkins Hospital. During the procedure one group was exposed to a combination of a nature mural plus nature sounds while the second group received treatment as usual. The treatment group who received the nature intervention reported less pain than the group that was not exposed to nature. Tse, Ng, Chung, & Wong (2002) tested the effects of a nature video on pain levels of healthy college students in Hong Kong by administering a pain stressor in the form of a tourniquet. One group watched a nature video while the other watched a blank screen. Findings showed that participants exposed to the nature video had higher pain threshold and pain tolerance than the group that did not have the nature video to view. Ulrich (1984; Ulrich, Lunden, & Eltinge 1993) reported gallbladder surgery patients with a view of nature required less strong pain medication than those who did not have

nature views. Miller, Hickman, and Lemasters (1992) combined a video of scenic nature with the sound of music to test the combined effects on pain and anxiety in burn patients at University of Cincinnati Medical Center's University Hospital Burn Special Care Unit. Patients exposed to the nature visual/music intervention reported reduced levels of pain intensity, pain quality, and anxiety during dressing changes.

Hospitals across the world are beginning to display art on their walls in order to facilitate wellness with little research to guide their selection (Ulrich & Gilpin, 2003; Dilani, 2001). One art installation at Duke Medical University, a rooftop sculpture called The Bird Garden, caused patient complaints and ultimately the installation was removed due to its counter therapeutic effect (Ulrich 1999). There remains a need for research that identifies the types of nature views with positive impacts upon patients' pain in healthcare settings (Malenbaum, Keefe, de C. Williams, Ulrich, & Somers, 2008; RMNO, 2004).

This exploratory study has two purposes. One is to examine the role of perceived presence and of perceived influence in a simulated clinical environment using still photographs representing four image categories defined by Appleton (1975, 1996). A secondary purpose is to test the methodology in a controlled simulated clinical setting, specifically a hospital patient room, prior to conducting the study in a real hospital setting. Research questions include: (1) Is there a significant difference in the level of perceived presence between the selected images? (2) Is there a significant difference in the level of perceived

influence between the selected images? (3) Is there a correlation between levels of presence and levels of influence? The hypothesis is that higher degrees of presence and/or influence in the still photograph make it more effective at holding the viewer's attention, which therefore may distract the viewer from pain, and therefore be considered therapeutic.

The Role of Presence in a Mediated Environment

Presence, as a state of being, has largely been studied by virtual environments (VE) researchers since the early 1990s (IJsselsteijn, 2004). One accepted definition of presence reported by IJsselsteijn is from Lombard and Ditton that claims presence is the “perceptual illusion of non-mediation” (IJsselsteijn, 2004, p. 136). Grigorovici (2003) further described presence as competition between the virtual environment and the physical environment for the user's attention. The virtual environment is successful when the user believes the virtual environment is real, which causes the user to react as if it was real. Non-interactive media environments also have the potential to create a convincing sense of presence (IJsselsteijn, 2004). Presence may be experienced in either the physical and/or social realm. Within the physical category, presence refers to the feeling of being physically located in the mediated space. Presence in the social category implies a feeling of being together with a distantly located or virtual communication partner. A painting or photograph has the potential to create a physical sense of presence, while an email might create a social sense of presence (IJsselsteijn, 2004, p. 136). The present study uses still photographic

images of landscapes, and therefore is a non-interactive media environment concerned with the physical realm of presence. In this study, viewers are asked to what degree they feel a sense of presence in the image.

Virtual environments (VE) researchers using nature in the mediated environment have found that presence, or a sense of being, is a contributing factor in the success of using VE in therapeutic environments (de Kort, Meijnders, Sponselee, & IJsselsteijn, 2006; Sponselee, de Kort, Meijnders, 2004). Virtual environments technology has successfully been used in psychotherapy for treatment of phobias (IJsselsteijn, 2004). De Kort and IJsselsteijn (2006) suggest that experiential realism, rather than just visual realism, is responsible for the effectiveness of VE therapy. The possibility exists therefore that by displaying photographic images with high levels of presence, that create a sensation of 'being there' in the image, the viewer may feel distracted from stress and/or pain in the healthcare environment.

De Kort et al., (2006) report that underlying factors contributing to a sense of presence include 'physical space', 'naturalness', and 'engagement'. Physical space refers to an ability to feel located in the mediated environment, naturalness refers to the realism and believability of the experience, and engagement alludes to the ability of the environment's content to hold the participant's attention. In the present study, physical space is measured by the presence question "How strong is your sense of presence, 'being there', in the image right now?" Naturalness was expressed through the photo selection process, a previous phase of the

study, which only included realistic looking photographs (Vincent, Battiso, Grimes, 2009). Engagement was assessed by looking at the respondent's responses over time.

Measuring Presence

Presence theory (IJsselsteijn, 2004) and measurement tools are all in the developmental stage (de Kort et al., 2006). Physiological measures for presence have included heart rate, skin conductance, and postural responses (IJsselsteijn, 2004). Psychological measures for presence have included self-report surveys that often ask just one question, "To what extent did you experience a sense of being 'really there' inside the virtual environment?" (IJsselsteijn, 2004, p. 170). Due to its relative newness on the research stage, correlating the results from the objective measure with the subjective measure is recommended to ensure validity (IJsselsteijn, 2004). Virtual environments research is frequently concerned with the temporal responses of participants to the mediated environment and therefore IJsselsteijn (2004) recommends continuous assessment of data rather than retrospective reports.

Presence may also be difficult to measure if people don't understand the term. IJsselsteijn explains, "In everyday normal life we are seldom aware of our feeling of 'being there' in the world. It is not an experience we are used to reflecting upon" (IJsselsteijn, 2004, p. 138). There is some thought among presence researchers that the virtual environment is enhanced by increasing the size of the visual display, by enhancing screen resolution, and by high degrees of

realism (Grigorovici, 2003). The shape of the virtual window or screen is also a consideration. Viewers prefer wider rather than taller views (IJsselsteijn, Vogels, de Kort, & van Loenen, 2008). Accepting this, the present study utilized a large nine panel screen that was wider than tall (2.74 m wide by 1.6 m high), that was within the participants' field of view, maintained resolution and color by using computer projection, and used photographic projections rather than paintings due to their high realism potential. Research using photographs over the past 30 years suggests a high correlation between photographs and on site judgments (de Kort and IJsselsteijn, 2006; Laumann, Garling, & Stormark, 2001; Shang and Bishop, 2000; Stamps, 1990, 2007, 2008; Kaplan and Kaplan, 1989; Zube, Pitt, & Anderson, 1975). In 2007 and 2008 Stamps examined the perception of spaciousness using virtual environment simulations and still photographs. He concluded that for scientific purposes the two media were the same, though still photos were much less expensive.

Influence in Perception

Influence occurs when someone is affected or altered, swayed, changed, or persuaded (*New Merriam-Webster*, 1989; *Webster's New World Dictionary*, 2002). The word was chosen for inclusion in this study when, during the pilot study, ($n = 32$) a participant commented that rating levels of presence "was hard", while others looked puzzled. IJsselsteijn (2004) warned that presence may be a term that is difficult to understand while Lopez and Snyder (2004) and Gordon

(2004) commented that some aspects of emotional experience may not be available to subjective awareness.

Influence was chosen therefore to be a more relative experience for participants that used thoughts as the reference to measure rather than the physical experience associated with presence. Theories of visual perception, like presence theories, are interdisciplinary, are in the developmental stage, and may lack rigor (Gordon, 2004). The question, “How strong is the image at influencing your thoughts, either directly or indirectly, right now?” was administered at the same time as the presence visual analogue scale.

Evolutionary Theory

Evolutionary explanations for human environmental preferences basically agree that humans developed an innate predisposition for certain types of environments during the long developmental stage spent as hunters and gatherers. For foragers and hunters, habitat selection was linked to survival. Over time, this preference choice for habitat became neurologically “hardwired” and has contributed to our modern day landscape preferences (Edelman, 1987). In essence, these evolutionary theories and explanations agree that our modern day environmental preferences have biological roots in the long distance past (Ruso, Renninger, & Atzwanger, 2003).

Appleton’s prospect refuge theory is a widely accepted evolutionary theory that claims that humans, as hunter gatherers, developed an ability to assess the environment in order to select habitats that ensured survival (Appleton, 1975,

1996). “To see without being seen” is the viewer’s ideal objective in prospect refuge landscapes. Appleton’s extensive examination of landscape paintings led to major category titles and operational definitions for landscape features and content. Category titles included prospect, refuge, and hazard. A fourth category called ‘mixed prospect and refuge’ was included in this study due to its ability to act as a “compromise zone” (Appleton 1996, p. 191) and provide both prospect and refuge within one image.

According to Appleton’s definitions, prospect in the landscape present real or symbolic access to a view in landscape images, which can include clear skies, low ground cover vegetation, and ideal viewing advantages (from a high space for instance) that allow the viewer to survey their surrounding). Refuge in the landscape meanwhile presents real or symbolic situations for hiding or sheltering. Refuge characteristics include but are not limited to dim light and places to hide from inclement weather or threatening people. Hazard in the landscape presents incidents or conditions that pose real or symbolic threats to life and well-being. A fierce storm, a bramble field that impedes locomotion, and a forest fire all are characteristics hazard landscapes. Landscapes may contain multiple types of imagery and are named by the dominant feature (i.e. prospect-dominant and refuge-dominant). Landscapes with equal amounts of prospect, refuge, and hazard imagery are called balanced landscapes. A balanced prospect refuge landscape may occur when opportunities for both a view (prospect) and cover (refuge) are equally presented in the landscape. A bridge that provides a view

(prospect) and trees with low climbable branches (refuge) that are equally visible in one image represent a mixed or balanced landscape.

Methods

Research Design

The effect of perceived presence and perceived influence in a nature image was studied using a between-group research experiment where 109 participants were randomly assigned to one of four nature image categories classified by Appleton's prospect refuge theory. The image categories were prospect, refuge, hazard, or mixed prospect and refuge. There was also a control group that did not view a nature image; instead they looked at a black screen. Images were previously selected using multiple methods including focus groups, a controlled sorting task, and content validity analysis. One image was selected to represent each of the four categories in the experiment as shown in Figure 6.1. The type of view, one of four nature images or no image, was the independent variable.



Image #1 Prospect (Photo: Getty Image)



Image #2 Refuge (Photo: Getty Image)



Image #3 Hazard (Photo: Getty Image)



Image #4 Mixed Prospect and Refuge (Photo: Ellen Vincent)

Figure 6.1. Images representing prospect, refuge, hazard, and mixed prospect and refuge

Participants were randomly assigned to one of the image groups. The duration for each investigation was approximately 60 minutes and divided into five periods: pre-reporting, resting, pain stressor, recovery, and post-reporting. For each participant, one image was projected onto a large nine-panel screen that occupied the participant's field of view. A pain stressor was introduced after a 10 minute resting period. Physiological data were collected before, during, and after the pain stressor while psychological data was collected before and after the pain stressor. The pain stressor was an independent variable while the

cardiovascular or behavioral responses to the pain stressor task were dependent variables.

Participants were 109 healthy college students, including 56 females and 53 males. Eighty-six participants were undergraduate level and 23 were graduate level. The mean age of the sample was 21.50 (SD = 4.83). Racial representation included 85 White, 13 Asian, five African American or Black, three some other race (SOR), two American Indian or Alaskan native, and one Native Hawaiian. Participants represented all five colleges within the university which is preferable to one discipline convenience sampling. Seventy-seven participants had never stayed overnight as a patient in a hospital patient room while 32 participants had. The methodology, instruments, and protocol were approved by the Institutional Review board prior to starting the study. Participants were recruited through a universal e-mail to all Clemson University students. E-mails were also sent from the various college student services centers, and recruitment flyers were posted on bulletin boards in the college library, student union, and an assortment of classroom buildings. Fifteen dollars was offered as payment for up to 90 minutes of participation. Participants were randomly assigned to one of five treatment groups: prospect, refuge, hazard, mixed prospect and refuge, and no image (control). All recruitment materials contained exclusion criteria that excluded people with the following conditions from participation: chronic illness, past or present injury to their hand/arm, Raynaud's syndrome, arthritis, Lupus, skin disorders, open wounds, anemia, heart conditions, scleroderma, autoimmune

disorders, or visual acuity disorders (color deficiency). Participants provided informed consent before participating in the study.

The experiment was conducted in the School of Nursing's Clinical Learning and Resource Center at Clemson University in Clemson, South Carolina, U.S.A. More specifically, the study took place in a simulated hospital patient room. The room was approximately 4.57 m x 5.49 m. Participants lay in a hospital bed (Hill-Rom) that faced a nine-panel screen, with an overall size of 91.44 cm long and 53.34 cm high. The flat panel digital array was within the field of view, approximately 2.9 m away from the head of the bed. The bottom of the screen was 7.62 cm off the floor as shown in Figure 6.2. Apparatus for taking physiological recordings were placed to one side of the bed, slightly behind, with the machine's screen facing away from the participant. Wall paint was off-white, windows blinds were closed, and interior room lights were on. There was no art on the walls of the room.

This study used continuous assessment of vital signs (heart rate and blood pressures) as well as perceived influence and perceived presence in order to observe temporal shifts during the different stages of the treatment, Figure 6.3. The Profile of Mood Survey (POMS) was only administered once due to its length (65 items).



Photo: Ellen Vincent

Figure 6.2. Participant viewing image

Procedure

The duration for each investigation was approximately 60 minutes and divided into five periods: pre-reporting, resting, pain stressor, recovery, and post-reporting as shown in Figure 6.3. Readings were collected over time including a sense of presence and influence, and physiological health (vital signs). A psychological health (mood) measure was collected once during the post-reporting period.

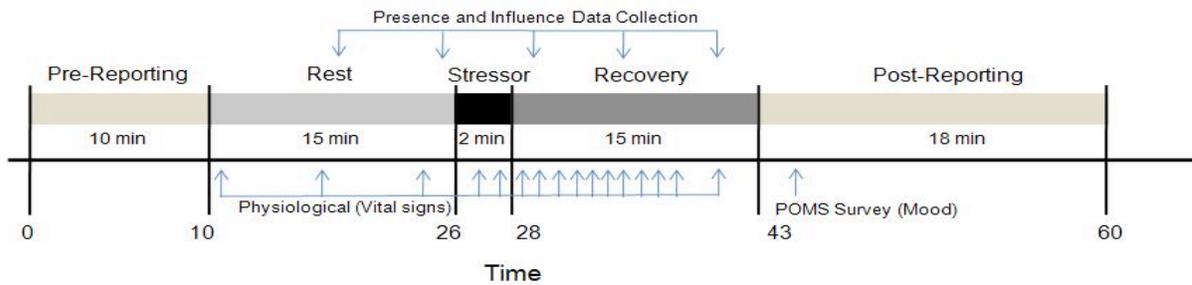


Figure 6.3. Timeline of events

When each of the participants arrived, they completed informed consent then lay down in a hospital patient bed where they received instructions and an orientation from a script read to them by the investigator. An appropriate sized arm cuff was attached to their dominant arm to collect blood pressure data. After completing a one page demographic survey one image was projected onto the screen located on the wall directly across from the bed within the field of view. One group, the control group, did not receive an image and were asked to view the screen (which was black) in front of them. During the resting period, physiological readings (heart rate and blood pressure readings) were collected three times (every five minutes) and presence and influence VAS were administered twice, immediately after a vital sign reading. After the approximate 10-15 minute rest period participants were asked to immerse their hand in ice water for up to two minutes while they viewed the screen (image or no image) in front of them. They were instructed to remove their hand if the pain became too terrible and say “done” if they did so. Physiological readings were taken every

minute during the cold pressor and for 10 minutes afterwards. Within two to four minutes of removing their hand from the iced water they completed the presence and influence visual analogue scales. Presence and influence VAS was administered twice more, during the recovery period, five minutes apart for a total of five times. The Profile of Mood States (POMS) questionnaire was administered immediately after the arm cuff was removed and image was no longer displayed, during the post treatment reporting time.

Presence (IJsselsteijn, 2004) was rated using a single question in a visual analogue scale (VAS). Participants were asked “How strong is your sense of presence, “being there”, in the image, right now?” Perceived influence was assessed with the question “How strong is the image at influencing your thoughts, either directly or indirectly, right now?” Both presence and influence VAS were administered at the same time for a total of five times (approx. min. 20, 25, 32, 35, 42). For both VAS surveys participants were instructed to make a vertical slash on a horizontal line between anchoring choices of “extremely weak” and “extremely strong”. Responses were measured with a ruler and assigned a number.

Physiological readings of systolic blood pressure, diastolic blood pressure, heart rate, and mean arterial pressure (MAP) were collected using the GE Dinamap Pro100 machine (Medical Solutions, Minneapolis, MN.) An appropriate sized arm cuff was attached to the participant’s dominant arm. Systolic pressure is the maximum arterial pressure during contraction of the left ventricle of the

heart and is represented as the first number in the blood pressure reading (Blakemore & Jennett, 2001). Diastolic blood pressure is the minimum arterial pressure during the relaxed state of the heart just before the next beat (Ibid). Measurements are in millimeters of mercury (mm Hg).

The Profile of Mood States (McNair et al., 2003) instrument was used to survey participants' present emotional state. The survey has strong internal consistency and high validity (Lopez & Snyder, 2004). The Profile of Mood States (POMS) survey contained 65 items, six subscales (one positive emotion subscale is Vigor) and required participants to rate their present mood condition by circling a number from 0 "not at all" to 4 "extremely". The POMS survey was administered when the image and arm cuff were removed (approx. 40 min.).

Results

Collected data were subjected to t-tests, repeated measures analysis of variance, and correlation analysis ($\alpha = 0.1$ to assess trends, SAS Institute Inc., Cary, NC). Perceived presence, perceived influence, and diastolic blood pressure data were analyzed using mixed model analysis of variance with a repeated measure design. No statistically significant differences were found in participants' perceived presence levels between the four image groups of prospect, refuge, hazard, and mixed prospect and refuge. However, statistical significance was found over time among responses to the influence visual analogue scale as shown in Figure 6.4 and Table 6.1. The hazard image was

higher in influence during the pain stressor (reading 3) then dropped during recovery (readings 4 and 5) while the other images all dropped in influence during the pain stressor. These results indicate that the hazard image was the only image to influence viewers during the pain episode, yet the influence effect plummeted shortly after the pain stressor was completed, during recovery.

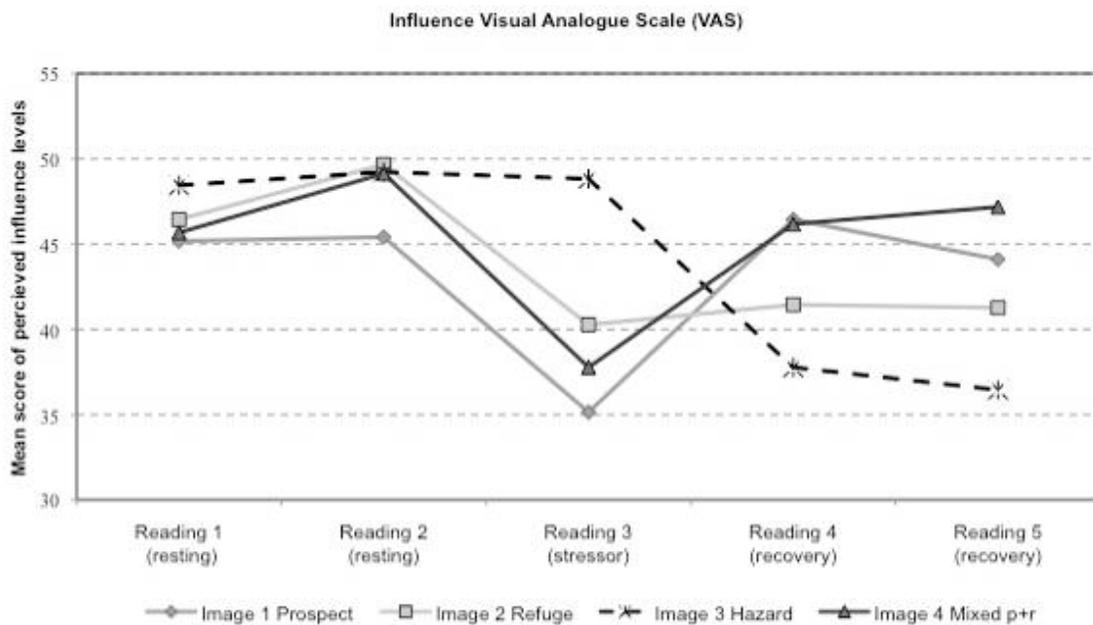


Figure 6.4. Influence visual analogue scale results

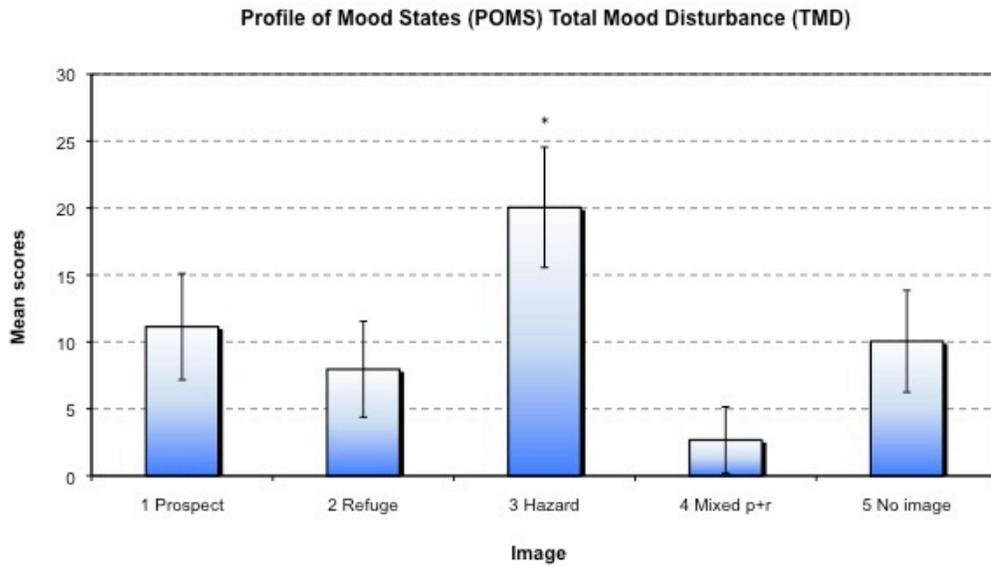
Table 6.1. Statistics of influence response for image and reading

Effect	Numerator DF	Denominator DF	F value	Probability F
Image	3	83.9	0.07	0.9745
Reading	4	332	4.29	0.0021 [†]
Image*Reading	12	332	1.95	0.0277 [†]

[†]Statistically significant $\alpha = 0.1$ for changes over time

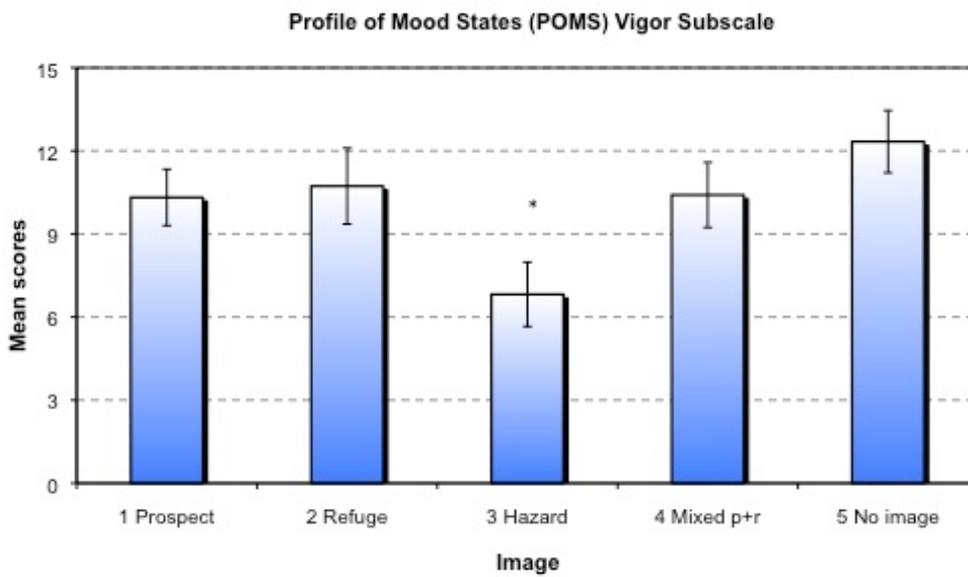
The correlation analysis between perceived presence and perceived influence showed a moderate to strong correlation ($r = 0.62$, $P < 0.0001$) in this study ($\alpha = 0.1$). Presence and influence rose and fell together a significant portion of the time.

The Profile of Mood States (POMS) survey was subjected to analysis of variance and means were separated using least significant difference ($\alpha = 0.1$). Results indicated significant difference in mean scores for Total Mood Disturbance and for the subscale Vigor. The hazard image was significantly greater for Total Mood Disturbance than the other images and no image (Figure 6.5, F Value = 2.90, df = 4, 104), Vigor, the only reverse scored, or positive emotion subscale showed responses to the hazard image were significantly low (Figure 6.6, F Value = 2.93, df = 4, 104). Participants that viewed the hazard image (#3 image in Figure 6.3), experienced lower emotional states (or mood) than those who viewed other images and no image.



*Statistically significant $\alpha = 0.1$

Figure 6.5. Profile of mood states total mood disturbance results



*Statistically significant $\alpha = 0.1$

Figure 6.6. Profile of mood states vigor subscale results

Diastolic blood pressure was the only physiological reading that showed statistical significance for changes over time, see Table 6.2. Data were analyzed using mixed model analysis of variance for a repeated measure design ($\alpha = 0.1$). The changes were most noticeable during the pain stressor when the hazard image responses did not rise while the other groups did. Image #3 hazard was the lowest diastolic reading, though image #1 prospect was not significantly different from any of the other images. This may indicate that viewer's of the hazard image were more distracted from pain than the other groups.

Table 6.2. Diastolic blood pressure statistical results

Effect	Numerator DF	Denominator DF	F value	Probability F
Image	4	104	0.57	0.6884
Reading	14	1245	118.88	<.0001 [†]
Image*Reading	56	1245	1.33	0.0561 [†]

[†]Statistically significant $\alpha = 0.1$ for changes over time

Discussion

There were no significant differences in the perception of presence among Appleton's image categories of prospect, refuge, hazard, and mixed prospect and refuge. This may be attributed to participants' lack of familiarity with the concept of presence (Ijsselsteijn, 2004) or that the images contained fairly equal amounts of presence. Presence equality among the images may be due to the rigorous image selection processes that were implemented in a previous phase

of the study. This phase employed focus groups, a controlled sorting task, and content validity analysis to select the most representative image for each image category (Vincent, Battisto, Grimes, 2009).

Participants' perception of influence in the present study did show statistical significance over time. The hazard image showed more influence during the pain stressor experience than the other images and then dropped to the lowest amount of influence during the recovery period. Diastolic blood pressure was also lowest for the hazard image during the pain stressor. Why would the hazard image (a forest fire) manage to influence peoples' thoughts during the pain treatment and have a more relaxed diastolic pressure than the other images? The hazard category does not have a history of use in experiments to our knowledge, so this is new information to process. One explanation may be found in the pain literature reports on the use of imagery. Turk (2002) claims imagery is a useful strategy for helping people to relax and feel distracted from pain. Syrjala and Abrams (2002) describe imagery as mentally picturing something/anything that makes you feel like you are there. 'Feeling like you are there' is also the definition of physical presence (IJsselsteijn, 2004). Several of the participants who viewed the hazard image stated during their debriefing session that they used the image of the fire to warm their hand that was painfully immersed in the iced water. It may be then that some participants in this study incorporated the qualities of the image (heat) into a sensory experience for themselves that resulted in lower diastolic blood

pressure. Researchers have described a reverse sensory situation with patients utilizing imagery who blew imaginary freezing arctic air onto and into body parts experiencing brief burning or hot pain (Syrjala & Abrams, 2002). While the existence of heat (the forest fire image) and cold (ice water pain stressor) is in fact an unexpected confounding variable in the research, it poses interesting hypotheses for future studies examining the use of specific images for distraction from different types of pain sensations. It would be incorrect however to describe the hazard image category as an effective distraction for pain over time. Not only did the effect of influence significantly drop in the recovery stage, its viewers reported the highest total mood disturbance and lowest emotional state in the Profile of Mood States. So while the hazard image appeared to be effective at distracting viewers during the pain treatment it did not result in positive emotions or feelings of well-being afterwards.

A methodology for the study of presence and influence was established through the research design, even though the study is preliminary and exploratory. Whereas most studies measure presence through post-test questionnaires, this study used a continuous assessment methodology (IJsselsteijn, 2004) to investigate the temporal variations in presence and influence. In pain studies retrospective self-reports were not as desirable as reports taken at the time of the event due to the variability of remembering (Stephenson & Herman, 2000).

Can and should presence be assessed in a still photograph that is being used in a therapeutic (hospital) setting? It should be, if the goal is for the photograph to function as a media source that creates a positive experience, virtual or imaginary, for the viewer. Is there a significant difference in the level of presence or the level of influence between the selected images? A difference was noted during the pain stressor. The hazard image showed greater levels of influence and lower levels of diastolic blood pressure than the other images. Is there a correlation between presence and influence? In this study there was, though whether it was coincidence or whether presence and influence regularly function together requires additional studies to discover. The hypothesis that higher degrees of presence and or influence in the still photograph make it more effective at holding the viewer's attention, which therefore may distract the viewer from pain, did appear to manifest in influence during the viewing of the hazard image, during the two minute pain stressor. It did not last however, and during recovery influence perception plummeted and the image caused significant mood disturbance, rendering it an ineffective therapeutic aid over time.

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CHAPTER SEVEN

THERAPEUTIC BENEFITS OF NATURE REVISITED

Introduction

Nature's use as a therapeutic agent was evident in ancient history and integral to concepts of health well into the 18th and 19th centuries. With the advent of germ theory a separation occurred between nature and health that no doubt began in the realm of medicine and trickled down to the general populace through doctor recommendations, publications, and pharmaceutical marketing campaigns. Now, due largely to our understanding of stress and its potential to undermine health outcomes, nature is once again being linked to health and well being. Interior and exterior garden installations in hospitals and long term care facilities are becoming more common, interior water features appear in hospital lobbies, and nature based wall art may be found in healthcare waiting areas and hallways. Some treatment rooms display nature scenes on digital ceiling panels.

While there is a movement to reintegrate nature as a therapeutic agent in the healthcare setting, there is also resistance due to lack of scientific evidence regarding specific therapeutic outcomes. Economic constraints force hospital administration and design professionals to invest in well-researched therapeutic interventions. This pressure requires researchers to improve the quality of research associated with nature and health. The first section of this chapter examines distinguishing features of *The Therapeutic Benefits of Nature Images*

on Health research design. The relationship of theory and methodology to research quality, validity, and reliability is emphasized.

Interdisciplinary fields of research, such as nature and health, are younger and still in the developmental stage of growth, and therefore are more exploratory. One area of concern for interdisciplinary studies is a lack of theory to philosophically ground the work. This was addressed in the present study with the selection of an evolutionary theory, specifically prospect refuge theory. This theory guided the selection of photographic images that were used as the independent variable in the experiment. What remains untested however, is the role of culture or environment in the selection of the most therapeutic image. The second section outlines suggestions for breaching the gap between evolutionary and environmental preferences in theory and methodology.

This study used one variable: visual assessment of one still image in order to collect psychological and physiological data for assessment. This was intentionally done to test the methodology and to be clear of the interaction between stimulus (image) and health outcomes (psychological and physiological data). Most people in this highly technological society however are accustomed to more sophisticated modes of communication and to multiple sensory stimulation. The last section discusses using research based therapeutic images in more contemporary formats.

Distinguishing Features of the Research

This present research distinguishes itself from prior work through its interdisciplinary application. This is most apparent in the theory and methods section. The interdisciplinary nature of the theory applied to this study hails mostly from the newer disciplines of study. These include environmental psychology, cultural geography, presence, healthcare and architecture, and environmental design and planning.

Each discipline mentioned is by and large multi-disciplinary in nature, frequently accessing other disciplines. Practice becomes interdisciplinary when individuals change the way they think or practice because of the new thoughts or practices offered by the different discipline. It is not a matter of discarding one way for another. Rather, it is a transformation, an altering of thought or process so that the new ideas or practices contain both former and new elements.

Theory

The Therapeutic Benefits of Nature Images on Health research draws from evolutionary theory (geography and biology) to explain landscape preference. Jay Appleton's prospect refuge theory (Appleton, 1996) is the primary application being implemented in this study. Biophilia, (Kellert & Wilson, 1993) and Savannah gestalt (Heerwagen & Orians, 1993) also inform and support the evolutionary theory of environmental preference.

Clearly stating and identifying the theory behind the study achieve focus and clarity. Opportunities for interdisciplinary results occur from using a social/biological theory in a true experiment.

Methodology

Methods selected for *The Therapeutic Benefits of Nature Images on Health* research came from restorative environments research (Kaplan & Kaplan, 1989); healthcare and architecture (Ulrich & Simons, 1986, Ulrich, Zimring, Quan, Joseph, Choudhary, 2004; Cooper Marcus & Barnes, 1999); and virtual environments presence research (IJsselstein, 2003, 2004; deKort & IJsselsteijn, 2006; deKort, Meijenders, Sponselee, & IJsselstein, 2006). Category titles and definitions for image selection were gleaned from Appleton (1996).

Environmental sampling criteria stemmed from Kaplan and Kaplan (1989).

Operational definitions for therapeutic aspects came from Cooper Marcus and Barnes (1999).

Methods were adapted to comply with suggestions from the literature. Stamps (2004) found that category language was non-reproducible, therefore not very valuable to other researchers seeking to replicate a study. In response, this study directly extracted category name and definitions from Appleton's 1996 edition of *The Experience of Landscape*. Few or no interpretative adjustments were made to the language in the sorting task chart, Table 4.2.

Stamps also noted that research images were not identified in ways that made them reproducible. In response, the present study is currently working with

the Graphics Communication Department to devise a way to document the images in descriptive ways, using color codes and a grid system to identify shapes within each frame. In addition, a color stabilization computer program was installed to lock in image color during the experimental treatment.

The selection of Images for preference studies should involve representatives of the experimental population, rather than experts (Stamps, 2004). This present study first used experts to gather images based on Appleton's prospect refuge theory, then used student populations and experts in the pre-sort focus groups; then used only students in the sorting task as they resembled the experimental college student population (Vincent, Battisto, & Grimes, 2009a). In the future phase, in the hospital setting, the image selection process and experiment will recruit hospital patient participants, not college students.

Research Quality

The Therapeutic Benefits of Nature Images on Health research is a true experiment. Quality was maintained by ensuring that random selections were made and the design is replicable. This research selected participants randomly, created a random order to the images used during the selection process, and randomly assigned participants to viewing categories in the experiment.

This study is replicable due to documentation regarding image selection, physiological and psychological data collection tools, and implementation techniques. Descriptions of the categories for image selection were placed in a

chart, Table 4.2, appeared in the sorting task instructions, Appendix D, and also appeared in brief on the bottom of the sorting task score sheet, Appendix E. These methods were designed to be consistent, reproducible, and as free as possible of researcher bias.

Reliability

Participant Instructions for the sorting task and the experiment were submitted to the Clemson University Internal Review Board (IRB) and to the Department of Defense for review. Instructions for the sorting task were piloted on a focus group of Landscape Architecture and Planning faculty in October 2007. Suggestions for clarity were solicited and received and the script was improved as a result. The script was then retested several more times on different focus group populations and continually improved as clear instructions improve reliability (Singleton & Straits, 2005).

Reactive measurement error was reduced in image selection phase by using audio taped introduction and instructions for the sorting task participants. (Singleton & Straits, 2005).

Vague or unclear terms are sometimes used in environmental preference studies. In the meta-analysis conducted by Stamps (2004) the majority of the 28 studies he examined used unclear terms that could not be generalized or replicated. In *What's Wrong With Virtual Trees? Restoring from Stress in a Mediated Environment* a nature film, (a soundless DVD), was used to create the immersion condition (de Kort, Meijenders, Sponselee, & IJsselstein, 2006). The

film was described as consisting of “numerous pieces of film some of them panning slowly across the landscape, others static, focusing on for instance waving sheer or nonthreatening animals (e.g. sheep, birds) and a few close-ups of plants or flowers. The landscape was semi-open, contained both open areas, bushes and shrubs, as well as trees, and water” (de Kort, Meijenders, Sponselee, & IJsselstein, 2006, p. 313). This description is an example of an extremely difficult variable to reproduce.

Learning from Stamp’s analysis and de Kort’s situation, still images (one per viewing group) were chosen for use. In addition, only royalty free images that were available for sale (Getty Images) and images belonging to the investigator (and available via email) were used in the Therapeutic Benefits of Nature Images on Health research to ensure reproduction.

Validity

Internal validity contains random assignment, manipulation of the independent variable, measurement of the dependent variable, and at least one control or comparison group; (at least two groups total), and constancy of conditions across groups (Singleton & Straits, 2005).

This study met all these criteria. In the experiment participants were randomly selected and assigned to treatment groups, there were five comparison groups (four received interventions and one, the control, did not), conditions across groups remained the same excluding the factor of time. The existence of

one simulated patient room and 109 participants, who received treatment one at a time, resulted in an eight-week time frame for the experiment.

Simulation studies using stress or pain inducers have frequently claimed the stressor was not strong enough to cause a condition that allowed for restoration or recovery. The stressor for the experiment was a pain stressor (cold pressor). The cold pressor treatment was chosen as a treatment that closely resembled postoperative pain, the condition likely to be experienced in a hospital room following surgery or treatment. The cold pressor task has a long history of use in cardiovascular research. The hand immersion is associated with heart rate acceleration (Saab, Labre, Hurwitz, Schneiderman, Wohlgemuth, Durel, et al., 1993). It has frequently been used in studies dealing with experimental pain and is routinely used in experimental psychology practice (McClelland & McCubbin, 2008). The results showed statistical significance and indicated stressor effectiveness for all the physiological readings.

External validity is generalizable and indicates that what is true in the study could hold true for other people at other times in other places (Singleton & Straits, 2005). External validity is a limitation of this research due to small sample size and use of college students. By increasing sample size, using a more diverse population, and increasing the number of locations in the future hospital study, this can be remedied.

Selection of the correct measurement scales for the experiment enhances validity. Scales were examined for appropriateness in the Therapeutic Benefits of Nature Images on Health research. Profile of Mood States (McNair, Lorr, Droppelman, & Heuchert, 2003) and Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985) were selected for their strong internal consistency and validity (Lopez & Syder, 2004) and the Hope Scale (Snyder, Harris, Anderson, Holleran, Irving, Sigmon, et al., 1991) was selected for high internal reliability and excellent construct validation.

Short-Form McGill Pain Questionnaire (Melzack, 1987) is commonly used in hospitals to assess pain and was reported to have high internal consistency (Wright, Asmundson, & McCreary, 2001).

Profile of Mood States measures short term or immediate mood states and Satisfaction with Life Scale measures cognitive well being. These specific tests/scales were also selected to correlate with the defined therapeutic aspects (operational definitions) of the study (Cooper Marcus & Barnes, 1999), Table 7.1. While the Profile of Mood States and the Short-Form McGill Pain Questionnaire yielded statistically significant data at $\alpha = 0.1$ to assess trends (Vincent, Battisto, Grimes, & McCubbin, 2009) neither the Satisfaction with Life Scale nor the Hope Scale did. The latter two instruments might be more effective when administered repeatedly over a longer time frame of study and changes within-subjects over

time can be detected. Repeated applications were not feasible in the one-hour experiment.

Table 7.1. Therapeutic Aspects and Data Collection Instruments

Therapeutic aspect	Data collection instrument
Relief from physical symptoms	Short-Form McGill Pain Questionnaire
Stress reduction	Blood pressures: systolic and diastolic Heart rate
Improvement in overall sense of well-being, hopefulness	Profile of Mood States Hope Scale Success with Life Scale

Sampling

In *Virtual Reality as a Distraction Intervention for Women Receiving Chemotherapy* the research design used a convenience sample of 20 women with breast cancer (Schneider, Prince-Paul, Allen, Silverman, & Talaba, 2004). The women served as their own control whereby they once received the virtual reality intervention and once did not. While the small sized convenience sample is to be expected with a vulnerable population such as cancer patients undergoing treatment, it does compromise validity.

The Therapeutic Benefits of Nature Images on Health research recruited from the entire student body to increase diversity within the convenience sample student population. Universal emails were sent to all enrolled students, and posters were displayed in the library, student union, and various classroom buildings, Appendix C and F.

Control

Familiarity, an alternative explanation for preference, is controlled for in this study through the exclusion of historic or well-known landmarks or identifiable people in the images selected for consideration in the study. Table 4.3 contains the criteria for photographic image selection. Though this study chose to control, at least partially for familiarity, not all research attempts to. In fact, some studies use familiar scenes intentionally. In *Consensus in Landscape Preference Judgments* Hagershall (2001) selected the farmland grassland, the traditional Swedish cultural landscape frequently found in literature and art to use with his Swedish participants (Ibid). In *Preference and Perceived Danger in Field/Forest Settings* Herzog and Kutzli (2002) selected Midwestern area color slides of field/forest environments for their Midwestern audience.

Levels of Measurement

In *What's Wrong With Virtual Trees? Restoring from Stress in a Mediated Environment* differences between immersion conditions disappeared over the full 10 minutes for both experimental conditions (de Kort, Meijenders, Sponselee, & IJsselstein, 2006). The researchers believe that reductions of heart rate to

baseline level had already been realized in the first phase of the nature film in both experimental conditions. They also suspect the stressor was not strong enough (Ibid.) In *Restorative Effects of Natural Environment Experiences*, Hartig, Mang, & Evans (1991) found no statistical difference among groups in blood pressure and heart rate and attributed the reason to a 50 minute delay between completion of the tasks and physiological assessment.

Lessons from the literature informed the timing of physiological data collection for the design of this study. Participants' vital sign data were collected every five minutes until the cold pressor treatment, then every minute during the two-minute pain treatment and for 10 minutes afterwards, then again every five minutes, Figure 5.4. This short time frame generated a great deal of data, but was useful for detecting trends in data analysis.

Evolutionary and Cultural Influences on Image Selection

Evolutionary theory describes our hereditary preferences, our need for vistas, shelter, and our attraction to water and flowering plants. These were features that helped us survive long ago. But, as scholars agree, "Even the most biologically oriented researchers do not suppose that we all have identical landscape preferences" (Bell Greene, Fisher, & Baum, 2001, p. 45). Appleton (1996) agreed that culture played a role in landscape preference, but also acknowledged that a sufficient theory to apply to that aspect of research was lacking. Suggestions for pursuing a comprehensive theory are mentioned below

followed by suggestions for including cultural influences at the design and methodology levels.

Toward Development of a Comprehensive Theory

Three points need to be considered in the pursuit of a theory of landscape preference that encompasses both evolution (biology) and culture (environment). First, perhaps it is not simply two dimensions, evolution and culture, that need to be accounted for by theory, but rather a search for three dimensions should be conducted. Bourassa (1990) suggested that a theory that accounts for biological, cultural, and personal landscape preferences is what is needed.

Secondly, the theory must be translatable into replicable design. The literature contains ample studies of unique situations, but includes few that are systematic and replicable. Replication of studies is necessary to build a convincing body of knowledge regarding nature and health. Lack of replication has been a problem associated with the Kaplan's environmental preferences and restorative environments concepts. The content and categories of the images used in research have been interpreted in very different ways, which means the studies on attention restoration do not necessarily build upon one another. Stamps (2004) noticed specific methodology characteristics that impeded replication in the meta-analysis of studies using Kaplan's environmental preference matrix categories of mystery, complexity, legibility, and coherence.

Lastly, the pursuit of a comprehensive theory of landscape preference must be done in an interdisciplinary environment. The complexity of the issues

requires input from the best minds from multiple disciplines who are willing to share knowledge and transform what is known within each field into a mutually insightful response that provides theory for biological, cultural, and personal landscape preferences. Obvious fields to contribute to this process include psychology, visual arts, neuroscience, and architecture.

Including Cultural and Personal Influences at the Research Design and Methodology Level

Evolutionary, cultural, and personal influences on image selection may also be represented at the research design and methodology level. First, it should be noted that preference and restoration might not correlate. It has yet to be consistently proven to hold true that viewing landscapes that one prefers will also provide restoration from pain or stress. What someone prefers when they are well may differ significantly from what may be preferred when they are tired, ill, or anxious. Heerwagen and Orians (1993) suggested that vulnerable people might prefer refuge rather than prospect dominated landscape scenes. Ulrich and Gilpin's (2003) concept of emotional congruence suggests that people's preferences hinge on their present emotional state.

Preference studies on therapeutic benefits of nature images therefore should be conducted on specific patient populations in specific settings using identical design and measures so that data can accumulate to inform the field. In simulated settings there must be an appropriate stress or pain treatment that provides the participant an opportunity to restore or recover.

In both real world and simulation studies data accumulation and data analysis must also occur to contribute to our understanding of culture. Data regarding ethnicity, urbanization, gender, age, and socioeconomic levels at a minimum should be collected and correlated with health responses. This will ensure that over time the many cultures that receive hospital treatment are noticed and acknowledged through data analysis. Additionally, replicated studies that occur in various parts of the world can contribute to the understanding of the role of culture in the selection of therapeutic images.

Once therapeutic images have been identified for particular patient populations within a specific environmental setting, it would be consistent with research findings pertaining to personal control in healthcare settings to add an option for personal choice into the selection of therapeutic nature images. There is much agreement in the literature that hospital patients benefit from being included in decision making, and experience a beneficial sense of control (Gerteis, Edgman-Levitan, Daley, & Delbanco, 1993; Frampton, Gilpin, Charmel, 2003). Allowing patients the option to choose from a menu of appropriate collections of images is a clear way to contribute opportunities for a sense of control. It is important however to first discover or uncover through research what the most therapeutic images are for a specific patient population, prior to creating image collections and offering choices.

Therapeutic Images in Contemporary Formats

Many people live in technically advanced societies or highly stimulated environments. Cell phones, computers, BlackBerrys and I-Pods have increased opportunities for multi tasking as well as the speed at which we process information. It may be then that added sensory stimulation could increase the distraction ability of the therapeutic intervention. This section will discuss the implications for using real time videos, prerecorded videos, and virtual reality manipulations as therapeutic interventions.

Videos

Videos are a common form of presenting nature in research studies. They hold the greatest possibility for meeting biological, cultural, and personal landscape preferences because they offer an array of scenes for the viewer to engage with. It is premature however to use videos at this time as a therapeutic intervention when it is not currently known which images are more therapeutic than others for a given patient population. Once the most therapeutic image is known however, it is the next logical application as a therapeutic intervention.

Real time video, which involves viewing images that are being recorded at a real setting with no time delay, has both benefits and deterrents. The benefits are that the viewer can experience the movement of day light in real time, provided the camera is located within the same time zone as the hospital. This connection with daylight can improve circadian rhythms, which has been identified as beneficial in the hospital setting. The harm that can occur with real

time video however is due to lack of control over the scene being recorded. If the area is wild, the opportunities for predator prey interactions between animals are highly probable. Also, storms could be considered counter therapeutic by some patients. Therefore, pre-recorded videos hold much greater promise for use as a therapeutic intervention due to the ability to control content.

Virtual environments

Virtual environment manipulations hold great promise as therapeutic interventions due to their ability to create realistic experiences in mediated environments for participants. The viewer in a successful virtual environment will feel more present in the virtual place than in the real environment. Virtual environments have traditionally been used for the treatment of phobias (IJsselsteijn, 2004) and a review of the literature supports the potential for virtual environments to have significant therapeutic psychological impact (Krijn, Emmelkamp, Olafsson, and Biemond, 2004).

Difficulties with implementing virtual environment technologies are related to lack of therapeutic research; equipment requirements that could be difficult to implement in a healthcare setting with ill patients, e.g. wearing a head tracking device; and costs associated with equipment.

Research within the field of virtual environments is developing, just as it is for nature and health. This means that it is largely exploratory and subject to lack of theory and lack of randomized methods that can be replicated. What is encouraging however is the practice of using natural environments as a

restorative agent among virtual environments researchers. The concept of presence, a sense of being there in the image, developed for use in virtual environments research contributed to the present study (Vincent, Battisto, & Grimes, 2009b).

Recent work by IJsselsteijn, Oosting, Vogels, de Kort, & van Loenen (2008) investigated components of a virtual window. They used projected photorealistic images and investigated the effects of movement parallax, occlusion, and blur to determine what created the most convincing see-through experience for the viewer. All three features are attributed with enhancing a sense of depth in the still image. Movement parallax, or visual depth had the greatest effect, while occlusion, a situation causing depth by including additional framing within the image, and blur to the boundaries of the frame showed significance by their interactions with each other and with movement parallax. Movement parallax or depth in a virtual window causes window-view relationship changes when the viewer moves their position. Present day limits in technology tracking and rendering speeds compromise the photorealism qualities of the real time projection. So for now, the realistic appearance of pre-recorded images is most appropriate for therapeutic use.

Toward the Development of Design Guidelines

The Therapeutic Benefits of Nature Images on Health research provides an empirical platform that will eventually lead to specific guidelines for the design of therapeutically supportive healing settings in hospitals and other healthcare

settings. View surrogates have a therapeutic function in healthcare settings due to windowless rooms, the inevitable absence of pleasing views, or patient immobility. Verderber, in *Innovations in Hospital Architecture*, envisions surrogate therapeutics being digitally generated to connect viewers to a worldwide selection of natural habitats, “such as rainforests, snow-covered mountain peaks, and remote undeveloped coastlines”. Architectural opportunities for digitally based person-nature transactions in hospitals “are wide open”, he claims (Verderber, forthcoming). As concerted, systematic, empirical research accumulates to identify the most therapeutic images for specific patient populations, and as available technologies improve to present realism at a reasonable cost, so will the therapeutic benefits of nature on health be realized through design.

Conclusion

While it has been suggested that images have both a positive and negative effect on healing, research to date has been unable to reliably say which images are more conducive or harmful to healing. The results of this study suggest that the hazard image was not therapeutic due to mood disturbance, but was capable of distracting people from strong pain. The mixed prospect and refuge image showed capacity to reduce perceptions of sensory pain and therefore shows potential as a therapeutic intervention. As suggested in chapter

five, further studies are needed, more specifically, we need to assess the reproducibility of the image category results with different representative images. We also recommend further study of these effects using different pain modalities and need to extend the research to clinical settings for assessment of therapeutic efficacy during painful medical procedures and pain-associated clinical conditions such as post operative recovery. The restorative impact of nature images may also provide longer term benefits for persons suffering chronic pain and discomfort. This study presents a methodology for testing the effects of nature images on physiological and psychological responses.

Overall, what this study indicates is that the interdisciplinary research methodology is rich and bears much further examination. Just as all the work of those before have lent credence to this, the journey is still to be undertaken.

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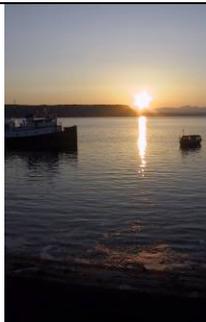
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APPENDICES

Appendix A

Categories for Restorative Environments

	Positive distraction	Being away	Other worlds & extent	Fascination	Action & compatibility
	Roger Ulrich (1999; 2004)	Kaplan & Kaplan (1989;1998)	Kaplan & Kaplan (1989;1998)	Kaplan & Kaplan (1989;1998)	Kaplan & Kaplan (1989;1998)
Definition (may be taken verbatim from the publication for clarity)	A small set of research supported environmental features to effectively reduce stress. Patients are diverted from focusing on their pain or distress (Ulrich et al., 2004, pp. 21-22).	Similar to “escape”; or “getting away” but occurs in three ways: distraction is minimal; familiar contents are absent; and one’s usual routine is altered (Kaplan 1989, p. 183).	Connectedness and scope create a feeling of being in a “whole other world.” Extent occurs when immediately perceived elements connect with a larger whole. (Kaplan 1989, p. 184).	A source of interest that keeps people from being bored and uses involuntary (effortless) attention. Includes an element of uncertainty or mystery; connecting the immediate fascination with something else, something larger (Kaplan, 1989, p. 185).	There is an alignment between environmental patterns and a person’s desired actions. Compatibility is high for example when a person’s desire to watch birds outdoors is supported by pleasant weather. (Kaplan 1989, p. 187).
Examples Photos by E. Vincent					
Caption	Unthreatening wildlife appears as a butterfly on lantana bloom	Seeing boats on the water at sunrise is conducive to “being away”	Privacy is provided for extent in a public garden by trellises, hedges, and spacing of benches	Sunflower with bees working offers soft fascination	Compatibility between desire (visiting the beech grove) and environment (bridge exists) is evident

APPENDIX A

Categories for Restorative Environments (continued)

	Positive distraction	Being away	Other worlds & extent	Fascination	Action & compatibility
	Ulrich (1999; 2004)	Kaplan, & Kaplan (1989; 1998)	Kaplan & Kaplan (1989; 1998)	Kaplan & Kaplan (1989; 1998)	Kaplan & Kaplan (1989; 1998)
Characteristics & symbols (may be taken verbatim from the publication for clarity)	Green growing plants; calm & slow moving water; some spatial openness; park-like or savanna-like properties; unthreatening wildlife; and a sense of security or low risk (Ulrich, p. 52, in Cooper Marcus, 1999)	Trips to natural setting i.e. camping; boat trips; parks. Noticing flower buds opening in nearby nature; the view of nature from a window; and looking at nature photographs can all cause a feeling of “being away”.	The depth, space, and mystery of a Japanese garden can create awe, wonder and “other world” (extent) sensations” (Kaplan, 1998, p.72). Viewing a mountain; or sitting in a park watching animals frolic or plants bloom; or watching a sunset often creates sensation of extent. Walls and hedges, can provide the visual privacy needed to experience extent Kaplan, 1998, p. 73). Running water can add noise privacy as well. A vista can create a feeling of extent.	Soft fascination: clouds; sunsets; scenery; leaves moving in the breeze; play of light on foliage; patterns cast by shadows; sunsets, waterfalls, caves, and fires. Quiet fascination: activities such as gardening and fishing; watching a tree through the window; watching birds and squirrels; seeing a fresh snow fall; looking at a coffee table book of nature photographs. Mystery: bend in the path; partial obstruction of view that triggers the imagination.	Wood, stone, and old materials that reflect or are compatible with the environment contribute to a sense of compatibility. A wood bench in the woods; a stonewall near a stone cottage; mature trees in a historic district of town.

Appendix A

Categories for Restorative Environments (continued)

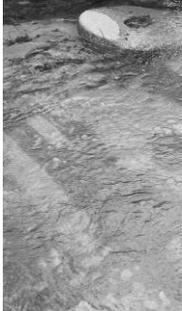
	Positive distraction		Fascination	
Primary author	Ulrich (1999; 2004)		Kaplan & Kaplan (1989; 1998)	
Types	Types of positive distractions include laughter, companion animals, art, music, and nature. Nature types include: ceiling mounted nature scenes; television nature scenes; nature view from the window; nature sounds; gardens		Soft fascination Quiet fascination Mystery	
Select types defined (may be taken verbatim from the publication for clarity)	The theory of supportive garden design believes that human health is improved through stress reduction and buffering. They do this by promoting sense of control, social support, opportunities for physical movement and exercise, and access to natural distractions (Ulrich, p. 72 in Cooper-Marcus, 1999). Supportive elements of design include easy way-finding; accessibility; access to privacy; seating for socialization; contact with nature (Ibid, p. 74).		Most of the fascinations offered by natural settings are “soft fascinations”. There is an involuntary aspect of modest strength that holds attention often in an undramatic way and there is an aesthetic component, usually of pleasure. Mystery is the promise that one can learn more. Contains partially hidden information; something in the scene tempts one to explore further (Kaplan, 1989, p. 55). Quiet fascination is free from noise and chaos-it permits reflection (Kaplan, 1998, p. 69).	

Appendix A

Categories for Restorative Environments (continued)

	Positive distraction	Being away	Other worlds & extent	Fascination	Action & compatibility
Primary author	Ulrich (1999; 2004)	Kaplan, & Kaplan (1989; 1998)	Kaplan & Kaplan (1989; 1998)	Kaplan & Kaplan (1989; 1998)	Kaplan & Kaplan (1989; 1998)
Importance	Relevant to stress reduction.	Being away is a component of a restorative environment that helps people recover from mental fatigue.	Extent is a component of a restorative environment that helps people recover from mental fatigue.	Fascination is a component of a restorative environment that helps people recover from mental fatigue. Mystery is highly preferred in landscape preference studies (Kaplan, 1989, p. 57-58).	Compatibility is a component of a restorative environment that helps people recover from mental fatigue.
Effect on health	Improved emotional state in the perceiver, may block worrisome thoughts, and results in beneficial physiological systems such as lowered blood pressure, and stress hormones. (Ulrich, p. 49 in Cooper-Marcus 1999).	When present along with extent, fascination, and compatibility, helps recovery from mental fatigue. (Kaplan, 1989, p. 180).	When present along with being away, fascination, and compatibility, helps recovery from mental fatigue. (Kaplan, 1989, p. 180).	When present along with being away, extent, and compatibility, helps recovery from mental fatigue. Allows the mind to wander, in order to experience "being away" (Kaplan, 1989, p. 193). (Kaplan, 1998, p. 69).	When present along with being away, extent, and fascination, helps recovery from mental fatigue. (Kaplan, 1989, p. 180).

Appendix A: Categories for Restorative Environments (continued)

	Positive distraction	Being away	Other worlds & extent	Fascination	Action & compatibilit
Similar to	Appleton's prospect/refuge (Appleton, 1996)	Ulrich's positive distraction; Ulrich's restorative environments	Privacy is similar to Appleton's refuge (Appleton, 1996)	Ulrich's positive distraction	Appleton's successful prospect/refuge (Appleton, 1996); Heerwagen and Orian's (1993) ideal habitat full of resources that sustain life
Examples Photographs by Ellen Vincent					
Caption	Park-like or savanna setting is open with trees and flowers	A view from the window can create a sensation of "being away"	A garden with still water, a waterfall, conifers, and rocks may seem other worldly	Soft fascination & mystery: What lies around the bend is a mystery to the viewer	Compatibility and action are high if the person wishes to rest or sit for awhile in the woods
Examples Photographs by Ellen Vincent					
Caption	Shallow water fosters sensation of safety	Tree canopy in botanical garden	Running water fosters extent	White daisies peeking through a fence	Wood, stone, and old materials

Appendix A

Categories for Restorative Environments

REFERENCES

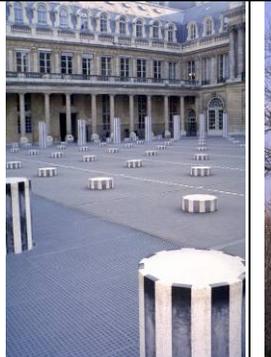
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APPENDIX B

Appendix B

Prospect Refuge Theory Category Classifications

	Prospect	Refuge	Hazard	Combination
Definition (may be taken verbatim from literature for clarity)	Any situation, feature, or object that directly improves visibility or that indirectly suggests an opportunity to extend the field of vision or improve visibility.	Any object, feature, or situation that provides shelter from 'hazards'.	Incidents or objects that are threats to life and well-being.	The relationship or proportion of prospect, refuge and hazard symbolism in a landscape scene determines its 'balance'. When each type of image is represented equally the scene is considered 'balanced'. When one type dominates, the scene is labeled that way. 'Reduplication" occurs when multiple symbols for one characteristic appear in the image. This repetition creates a stronger effect upon the viewer for prospect, refuge, or hazard.

	Prospect	Refuge	Hazard	Combination
Example				
Caption	Low groundcover, reflective water, and mountains are all prospect symbols	Mist, trees, sunset, and glimpse of a house are all refuge symbols	The exposed feeling of being seen without being able to see who is watching creates a feeling of vulnerability or hazard	Refuge is symbolized by trees, prospect by the road and field and blue sky, hazard by the dense impenetrable hedge along the road

Photographs by Ellen Vincent

Appendix B

Prospect Refuge Theory Category Classifications (continued)

	Prospect	Refuge	Hazard	Combination
Characteristics & symbols (may be taken verbatim from literature for clarity)	Light or bright illumination, sun, clear skies, long views, meadows, raised elevation and 'falling ground', lakes, hills, mountain tops, turrets, towers, roads, bridges, obelisks, temples, sundials, flowerbeds, naked and carpeted surfaces, bare rock, gravel, sand, concrete, turfgrass, heather, groundcover ivy, oceans, lakes, rivers, pools, patterns of light reflected in water, snow surfaces, bits of blue sky in an overcast sky, and other reflective surfaces, color blue, sunrise and sunset colors rich in yellow-orange-red (Appleton, 1996). Evidence of resources: large animals, birds, flowering and fruiting plants, water (Heerwagen & Orians, 1993).	Trees, house, caves, forests, ravines, buildings, boats, dens and nests, rough rocks, hollows, forests, woody reeds tall grasses, bamboo, mist, smoke, vapor, low clouds on mountain tops, windows in a wall, stairs and steps into a structure, or a forest opening to an adjacent glen, darkness, color shades of gray, brown, or dull purple.	Animate incident: fights, wars, robberies. wild animals. Inanimate incident: weather and its affect on body, temperature, rock slides, earthquakes, floods and rapids, fire, falling and fear of falling, Symbols: dense vegetation, cliffs and water bodies prison walls, planted hedges, navigation channels, fences	A scene with long views and water is 'prospect-dominant' while a scene of a ship-wreck is 'hazard- dominant.' Some buildings symbolize both prospect and refuge. A castle turret, a church steeple, and a watermill symbolize both. Each structure soars high in the air, signaling prospect, yet each also suggests potential shelter or refuge. The image canvas or picture is typically divided into two zones. The upper part of the landscape is associated with prospect and the lower section with refuge.

Appendix B

Prospect Refuge Theory Category Classifications (continued)

	Prospect	Refuge	Hazard	Combination
Types	<ul style="list-style-type: none"> -Panoramas and vistas simple -Interrupted Panoramas and vistas -Multiple vistas -Horizontal vistas -Peepholes -Primary vantage points -Secondary vantage points 	<ul style="list-style-type: none"> -Function -Origin -Composition -Accessibility, -Effectiveness 	<ul style="list-style-type: none"> Incident hazards, Impediment hazards, and Deficiency hazards 	<ul style="list-style-type: none"> -Balanced -Prospect-dominant -Refuge-dominant -Hazard dominant -Reduplication
Select types defined (may be taken verbatim from literature for clarity)	<p>Primary vantage points indicate the placement of the viewer. Secondary vantage points are indirect 'prospect' symbols. They allow the viewer to suspect that other, perhaps better viewing areas exist (Appleton 1996; Heerwagen and Orians 1993, p. 146). Secondary vantage point symbols include the horizon; tall vertical trees; peaks of hills & mountains; towers, lookouts, or clearings on forested hills.</p>	<p>Accessibility; Effectiveness: Anything that eases access to a refuge aids in the symbolism of safety and respite. Windows in a wall, stairs and steps into a structure, or a forest opening to an adjacent glen accentuate refuge. Whether the refuge can practically be entered is not as important as whether the viewer of the image thinks the refuge is penetrable or easily accessed.</p>	<p>Incident hazards: are caused by external incidents, and they may be animate (imply pursuit and escape from threatening people or wild animals) or inanimate (storms, severe temperatures, fire, fear of falling). Impediment hazards: are indirect hazards that thwart movement (brambles; fences) Deficiency hazards: imply conditions such as hunger or thirst rather than hostile events (photographs of the depression are good examples).</p>	<p>Balanced: An equal amount of prospect, refuge, and hazard exists in the image. Prospect-dominant: Prospect symbolism dominates Refuge-dominant: Refuge symbolism dominates the image. Hazard-dominant: Hazard symbolism dominates the image. Reduplication: Multiple symbols for one characteristic appear in the image. This repetition creates a stronger effect upon the viewer for prospect, refuge, or hazard.</p>

Appendix B

Prospect Refuge Theory Category Classifications (continued)

	Prospect	Refuge	Hazard	Combination
Importance	Hunters could see potential prey and predators.	Protection of all people at night; protection of more vulnerable children and women at all times.	Detection and avoidance could save lives.	Allows for realistic both/and experiences rather than either/or.
Effect on health	Possible distraction from pain.	The elderly, children, and ill people should prefer refuge spaces rather than prospect-dominant spaces where they can be easily seen by others (Heerwagen & Orians 1993, p. 165).	Possibly alarming and cause stress.	Prospect/refuge balanced images could provide the highest sense of well-being, when both (clear views) and refuge (safety) are present.
Similar to	Kaplan's 'Being away'; Ulrich's positive distraction. Being away: can occur in three ways: distraction is minimal; familiar contents are absent; and one's customary purposes are not pursued (Kaplan, 1989). Positive distraction: is an environmental feature or situation that promotes an improved emotional state in the perceiver, may block worrisome thoughts, and results in beneficial physiological systems such as lowered blood pressure, and stress hormones. Types of positive distractions include laughter, companion animals, art, music, and nature (Ulrich, p. 49 in Cooper-Marcus, 1999).	Kaplan's soft fascination; Ulrich's restorative environments. Soft fascination: Feelings of safety and ease. One's involuntary attention is caught and held. A reflective quiet mode that is conducive to healing may occur (Kaplan, 1989). Ulrich's restorative environment: Hereditary reasons for humans to seek restoration through exposure to green plants, unthreatening wildlife, and a sense of security or low risk (Ulrich, 1999).	Ulrich's abstract art survey in Swedish psychiatric hospital. The patients felt troubled by the abstract art and attacked the paintings on the wall (Ulrich, 1991).	Kaplan's "mystery" and "compatibility". Mystery: Arouses curiosity-what's around the corner of the curved path or road? Compatibility: The environment supports the person's actions or desires (Kaplan, 1989).

Appendix B

Prospect Refuge Theory Category Classifications (continued)

	Prospect	Refuge	Hazard	Combination
<p>Example</p> <p>Photographs by Ellen Vincent</p> 				
<p>Caption</p>	<p>Peephole through tree branches to blue sky.</p>	<p>SC live oak resembles the Acacia tree found in the Savanna with its stout trunk and low climbable horizontal branches</p>	<p>A snowstorm may symbolize a meteorological hazard or impede movement</p>	<p>Prospect dominant: The low vegetation and clear view symbolize prospect and the clumps of trees symbolize refuge</p>
<p>Example</p> <p>Photographs by Ellen Vincent</p> 				
<p>Caption</p>	<p>Sunrise, water & reflection are all prospect symbols</p>	<p>Shelter can be found by ducking down in the foliage</p>	<p>Steep stairs may trigger fear of falling</p>	<p>Refuge dominant: Foliage frame symbolizes refuge and the turret both prospect and refuge</p>

APPENDIX B

Prospect Refuge Theory Category Classifications (continued)

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APPENDIX C

Appendix C

Recruitment Flyer for Image Selection Process

**\$10.00 for students to participate
in a one hour sorting task of nature
images**

Who: Clemson University students 18 years of age or older
Place: Poole (P&A) Room E-145
Time: One hour on April 7, 9, 11 or 14, 2008

Description: Participants will attend a short orientation session that describes the specified image categories and then complete a sorting task. First, you will sort provided nature photographs into each category. Then, you will rate the images for each category using an ordinal scale of "most" to "least" fit. Lastly, you will record your findings on a score sheet.

Participants will complete a pre-test questionnaire that asks you questions about who you are and where you grew up.

**Please Respond ASAP or by April 2, 2008 to
Ellen Vincent**

E-mail: ellenav@clemson.edu or Phone: 864.656.1342
You will be contacted and sent an application form

Dr. Dina Battisto, Principal Investigator
Architecture + Health, School of Architecture,
dbattis@clemson.edu

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Environmental Planning and Design PhD program in the College of Architecture, Arts and
Humanities

Grant funding from
U.S. Dept. of Defense, NXT & SC Forestry Commission

APPENDIX D

Appendix D

Image Selection Sorting Task Script

THE THERAPEUTIC BENEFITS OF NATURE IMAGES ON HEALTH SORTING TASK SCRIPT

INTRODUCTION

Thank you for agreeing to participate in this sorting task for the Therapeutic Benefits of Nature Images on Health study.

Please fill out the questionnaire that asks you questions about yourself now.

Now, please remove the documents from your transparent pocket at this time. There is a sorting task script, a summary chart, and a score sheet. I am now reading from page one from the sorting task script.

Here is an overview of your activities today. First I will give you some background and define the image categories for you and show you sample images for the categories.

You will then participate in a three-step process.

Step 1 asks you to sort the images into categories.

Step 2 asks you to rank the images within each category from "most" to "least" representative of that category.

Step 3 asks you to record your images on a score sheet.

When the hour is up I will hand you an envelope containing \$10.00 as you leave.

PROSPECT, REFUGE, HAZARD THEORY OVERVIEW

I will briefly describe the theory that is driving this sorting task and then define the four categories for you. Prospect refuge theory was developed to explain why we like certain types of landscapes more than others. This theory believes that humans' chances for survival historically were linked to their ability to see without being seen. Landscapes that supported human survival would be rich with opportunities that allowed people to see what was around them and to hide or seek shelter from conditions or incidents that could cause them harm. Now I will define the four categories that are part of the Prospect-Refuge Theory. You will be sorting 20 images into these four categories today.

Appendix D

Image Selection Sorting Task Script (Continued)

CATEGORY 1: PROSPECT

The first category is called 'prospect' and includes anything that either symbolically or actually extends your field of view. Long views and short views are 'prospects'. Sometimes, a feature in the landscape will cause you to suspect or feel that if you were to go there, your field of vision would again be extended. This is still 'prospect', even though it may be imaginary and speculative. Look now at the first column on your chart for a summary of other features typical in prospect-rich landscapes. Prospect skies are usually clear blue, patches of blue in an overcast sky, and sunrise and sunset colors rich in yellow-orange-red. Surface features that help enhance viewing include ground that slopes down and away, mountains and hill tops, vertical trees, off-shore islands, turrets, towers, and clearings. Surface groundcovers are very low and include smooth earth, rock, and carpet type vegetation. Reflective surfaces such as the moon, stars, water and ice are also prospect features.

Here is a sample of a prospect landscape. The sky is relatively clear and blue, the sand ground surface is smooth, there is water, and there is an easily accessible strip of land in the distance which could provide additional viewing opportunities. Do you feel as though you might have a good clear view in this landscape? If so, it is high in prospect.



Prospect landscape sample #1

Here is yet another possible prospect landscape. There is low ground cover of grass, low hills in the distance, and a mountain capped by snow. The fence is see through and has a gate to pass through. Can you imagine seeing and moving easily through this landscape? If so, then this image has high prospect potential for you.



Prospect landscape sample #2

Appendix D

Image Selection Sorting Task Script (Continued)

CATEGORY 2: REFUGE

You second category, 'refuge', exists in landscapes that present real or symbolic situations that provide cover for hiding or sheltering. 'Refuges' may be natural or artificial; permanent or temporary. Each refuge feature provides cover from a specific type of hazard. Cover from inclement weather and spaces that promise an opportunity to hide from potentially harmful people are all refuges.

Look at the second column in your chart for refuge characteristics and symbols. Refuge may be found in dim or dark light, thin mist or haze often found with the colors of dull purple, gray and brown. Features that provide shelter may include caves, rocks, hollows, tall reeds and tall grasses as well as houses and ships. Entry or access to hiding spaces also symbolizes refuge. This includes doors, steps, windows, and bridges. Low hanging branches in trees make them climbable shelters and clusters of trees scattered throughout an open space suggest potential shelter or hiding places as well.

See a sample refuge image below. There is a tree with a hollow trunk. Does this look a good place to shelter from a storm? The brown and gray color of the tree trunk symbolize refuge.



Refuge sample #1

In this second refuge example you are looking through a frame of tree foliage. The color is darker in the foreground. Do you feel safe and sure that no one can see you from your position? If so, this image has high refuge potential for you.



Refuge sample #2

Appendix D

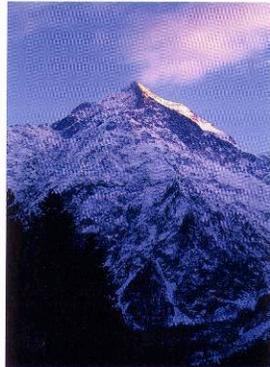
Image Selection Sorting Task Script (Continued)

CATEGORY 3: HAZARD

'Hazards' are a third category and exist in the landscape as incidents or conditions that present real or symbolic threats to life and well-being.

'Hazards' may be animate or inanimate. Banks and rocky mountain sides that are too steep to safely scale; storm clouds; storm waves; signs of extended drought that threaten food and water sources; and threatening people or animals are all symbols of hazards. Hazard features may also block your way. Brambles and briars or a steep ravine are examples of movement hazards.

In the first sample image can you imagine feeling fear of falling on this steep hill? Do you feel exposed and vulnerable in this landscape? If so, it has high hazard qualities.



Hazard image #1

In sample image two, does this fence appear to restrict your movements? Does it keep you from crossing the field? If so, it contains hazard features just like a raging river or a bramble field.



Hazard image #2

Appendix D

Image Selection Sorting Task Script (Continued)

CATEGORY 4: MIXED PROSPECT AND REFUGE (EQUAL AMOUNTS)

Your fourth category is called prospect and refuge mixed and is created for images that do not easily fall into one of the other categories because they appear to contain an equal amount of prospect and of refuge. If the image provides a good view (prospect of seeing more) and also contains shelter of some sort (refuge) it belongs in this category.

In this first sample image can you see any prospect symbols? The low turf ground cover and mountains and blue sky are all prospect symbols that promote a good clear view. Now can you imagine hiding or finding shelter in this landscape? The solid rock wall, dark shadows, cloud cover, and the climbable tree in the distance are all refuge symbols.



Prospect and refuge mixed sample #1

In sample #2 do you see the prospect symbol of the sun? It provides a clear short view instead of a long view. Do you see the vertical tree trunks? They allow us to easily see around them and are another prospect symbol. Now let's look for refuge symbols. Perhaps the high groundcover, shrubs, and dark spaces caused by dense tree foliage provide places to hide or shelter?



Prospect and refuge mixed sample #2

Appendix D

Image Selection Sorting Task Script (Continued)

SORTING PROCEDURE INSTRUCTIONS

Please help us determine which images best describe each category to you. Please feel free to use your imagination in this process as much of this theory involves symbolism. There are no 'right' or 'wrong' answers. Don't be concerned if you hear the directions for the next step being read while you are still working. People work at varying speeds so take the time you need to complete each step.

Please refer back to your chart or these directions as often as you like. A quick view of the categories and their brief definitions are also printed on the bottom of your score sheet for you to refer to as you work through the sorting task.

STEP 1: SORTING IMAGES INTO CATEGORIES

Now you are ready to sort the images into four distinct categories. Place each image in the category pile that best describes your reaction to and interpretation of the image. Do not be concerned if some categories contain more, less, or the same number of images than another. Sort every image, do not leave any out. Please now handle your stack of images. You all have the same images which were randomly numbered. There is also a set of category label cards for you to use. Complete this sorting task now.

STEP 2: RANKING SORTED IMAGES

Now you will sort within each of the four categories, ranking the images from 'most' to 'least' representative of that category. Place the 'most' on top of the pile and 'least' on the bottom of the pile.

STEP 3: RECORDING RANKED IMAGES ONTO SCORESHEET

Now you will record your ranked images, by the image number which is located on the back of the photograph, on the sorting task record sheet starting with the 'most' representative of the category and finishing with the 'least'. Record every image, do not leave any out. When you are finished recording please flip the score sheet over so I will know you are done.

THANK YOU

Thank you for your time and valuable assistance with this sorting-task phase of the research project.

APPENDIX E

Appendix E

Sorting Task Score Sheet

1. Please sort the images into four categories: 1.) prospect, 2.) refuge, 3.) hazard, 4.) prospect and refuge mixed.
2. Please reorder the images within each category pile into the 'most' descriptive of the category to the 'least' descriptive.
3. Please record the image numbers on the record scoring sheet, starting with the most and ending with the least.

	Prospect		Refuge		Hazard		Prospect & Refuge mixed	
Most								Most
Least								Least

- Prospect: The landscape that presents real or symbolic access to a view.
- Refuge: The landscape that presents real or symbolic situations for hiding or sheltering, for cover.
- Hazard: The landscape that presents incidents or conditions that present real or symbolic threats to life and well-being.
- Prospect & Refuge Mixed: Opportunities for both a view (prospect) and cover (refuge) are equally presented in the landscape.

APPENDIX F

Appendix F

Recruitment Flyer for Experiment

Participate in a 1.5 hour study identifying

Effects of Nature Images

Who: Clemson University students 18 years of age or older
Place: Clinical Learning and Research Center (CLRC),
Edwards Hall on 2nd floor, on campus
Time: Sept-Oct, 2008

**Participants receive \$15.00
for their involvement.**

Description: Participants will lie down in bed (alone) in a mock-hospital room and watch a nature image on a digital television set for one hour after immersing their hand in ice water for up to 2 min. Participants will complete a set of pre and post treatment self-report questionnaires and wear an arm cuff that transmits their vital signs to a continuous automatic vital sign tracker. No blood will be drawn.

People with chronic illness, past or present injury to their hand/arm, Reynaud's syndrome, arthritis, Lupus, skin disorders, open wounds, anemia, heart conditions, scleroderma, autoimmune disorders, visual acuity disorders (color deficiency), should not apply.

**Respond by Wednesday, Sept. 3, 2008
To Ellen Vincent**

**Via e-mail: ellenav@clemson.edu
with your name and contact phone numbers**

For more information contact:
Ellen Vincent, Ph.D. candidate EDP
ellenav@clemson.edu
864.656.1342
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School of Architecture
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APPENDIX G

Appendix G

30+ Year Timeline of Key Contributions for Nature and Health

Key: *Concepts and Theories noted in italics*
 Research contributions are not italicized

Year	Contribution	Author
1975	<i>Prospect refuge theory of landscape preference</i>	<i>Appleton</i>
1976	<i>General adaptation syndrome to stress</i>	<i>Selye</i>
1979	<i>Hospitals are stressful places</i>	<i>Cousins</i>
1981	Nature views in prisons may result in reduced health complaints	Moore
1982	<i>Environmental preference matrix</i>	<i>Kaplan & Kaplan</i>
1984	In-hospital research: nature views from hospital windows are more therapeutic than views of a brick wall, published in <i>Science</i>	Ulrich
1985	Nature views in prison may reduce health complaints	West
1986	In-hospital research: person-window transactions in the hospital environment	Verderber
1987	In-hospital research: window views enhance health in hospitals	Verderber & Reuman
1988	<i>Surgery is stressful</i>	<i>Johnston</i>
1989	<i>Restorative environments</i>	<i>Kaplan & Kaplan</i>
1989	<i>Preference matrix advanced</i>	<i>Kaplan & Kaplan</i>
1990	<i>Stress effects medical outcomes</i>	<i>Johnston & Wallace</i>
1990	<i>Theory of positive distraction</i>	<i>Ulrich</i>
1990	Nature art reduces anxiety in dentist waiting room	Heerwagen
1990	Meta-analysis of photographs in simulated environments	Stamps
1991	Field study of restoration using multiple methods	Hartig, Mang, & Evans
1991b	Nature art is preferred by psychiatric patients over abstract art	Ulrich
1993	Meta-analysis of simulation effects	Stamps
1993	Nature art preferred by open heart surgery patients	Ulrich, Lunden, & Eltinge
1993	Field study of restorative environments using multiple methods	Hartig
1993	<i>Biophilia</i>	<i>Kellert & Wilson</i>
1995	Hospital gardens reduce stress	Cooper Marcus & Barnes
1995	<i>Attention restoration theory (ART)</i>	<i>Kaplan</i>
1996	<i>Prospect refuge theory revisited</i>	<i>Appleton</i>

1997	<i>Psychoneuroimmunology</i>	<i>Ader, Felten, & Cohen</i>
1998	<i>5 preference patterns to restorative environments</i>	<i>Kaplan, Kaplan & Ryan</i>
1999	<i>Healing gardens for healthcare settings</i>	<i>Cooper Marcus & Barnes</i>
1999	Hospital gardens case studies	Cooper Marcus & Barnes
2002	Gardens in residential care facility study	Rodiek
2002	Indoor plants effect on pain in simulated hospital patient room	Park, Mattson, & Kim
2003	Restoration of blood donors using nature videos and multiple methods	Ulrich, et al.
2003	Restoration in natural and urban field settings using multiple methods	Hartig, et al.
2003	<i>Reasonable person model (RPM)</i>	<i>Kaplan</i>
2003	<i>Planetree model developed in Putting patients first</i>	<i>Frampton, Gilpin, & Charmel</i>
2003	<i>Hospitals are stressful places</i>	<i>Frampton, Gilpin, & Charmel</i>
2003	<i>Emotional congruence theory</i>	<i>Ulrich & Gilpin</i>
2004	Literature review on nature and health	RMNO
2004	Meta-analysis of mystery, complexity, legibility, and coherence	Stamps
2004	Literature review of physical environments effects on health outcomes	Ulrich, et al.
2004	Presence research in virtual environments	IJsselsteijn
2004	Role of presence in stress restoration	Sponselee, et al.
2004	Nature based wall art preferred over abstract art	Ulrich, et al.
2005	Garden access for elderly in assisted living facilities	Rodiek
2005	<i>Evidence based design scorecard includes points for positive distractions in hospitals</i>	<i>Center for Health Design</i>
2006	Stress restoration in a mediated environment	de Kort, et al.
2006	Literature review of effects of environmental stimuli on psychological health	Dijkstra, Pieterse, and Pruyn
2008	Effects of indoor plants in hospital patient room	Park & Mattson
2008	Literature review of evidence based healthcare design	Ulrich, et al.
2009	Literature review of psychological benefits of indoor plants	Bringslimark, Hartig, & Patil

Key: *Concepts and Theories noted in italics*
 Research contributions are not italicized

See chapter three for complete reference citations