THE EFFECT OF MYSTERY, MEDIATED BY FASCINATION, ON RECOGNITION MEMORY AMONG COLLEGE STUDENTS VIEWING SCENES OF NATURE

by

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ABSTRACT

Today’s college students face a number of new and demanding situations that often leave them feeling mentally fatigued. Recovery from this type of fatigue is contingent upon a person being able to rest directed attention, a capacity that requires effort. One approach to resting directed attention is to interact with settings that minimize the demands on that capacity. A natural setting that a person perceives as fascinating could be a critical resource in resting attention as these types of settings presumably evoke a form of attention that is undemanding or effortless. With the prospect of acquiring new information, settings that contain patterns of mystery may offer a means by which to elicit a person’s fascination.

Using a 2 x 4 within-subjects experimental design, participants took part in a recognition memory task (RMT) that examined the effect that scene type and presentation duration had on a student’s capacity to direct attention. The use of presentation duration as an independent variable helped to determine whether or not the processing of certain images was more automatic (effortless) or controlled (effortful). Data garnered from the RMT revealed a significant interaction effect, F(3, 288) = 5.34, p < .05. A closer examination of participants’ recognition memory performance within in each duration indicated that when given more time to study an image (5 seconds and 10 seconds), images perceived high in mystery offered the greatest advantages with regard to recognition performance.
Test for mediation provided a means by which to examine the role measured fascination played in mediating the effects between scene type and recognition performance. The results indicated that fascination was an effective mediator both at the 5 sec ($B = .205, p < .001$) and 10 sec ($B = .215, p < .01$) durations. The findings from the study not only affirmed the importance of fascination as a mediating variable, but also demonstrated that perceptions of fascination evoked a form of attention that involved both top-down (effortful) and bottom-up (effortless) processing. That experience of fascination as attentional resonance, although not completely effortless, may in fact, more appropriately characterize the quality of rest that is so central to Attention Restoration Theory.
I dedicate this dissertation to my wife, Beth, whose love, support, and never-ending faith provided me with the inspiration I needed to succeed.
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CHAPTER I

INTRODUCTION

Directed attention fatigue can significantly impair a person’s capacity to function; resulting in a lowered ability to concentrate, heightened irritability, and a greater likelihood of making mistakes (Herzog, Black, Fountaine, & Knotts, 1997). According to Tennessen and Cimprich (1995), college students are at an increased risk for directed attention fatigue. While striving to meet a higher academic standard, most college students are for the first time in their lives adjusting to a new environment and living independently (Aycock, 1989). At the same time, students are learning how to cope with a more demanding course load, making important scheduling decisions, and weighing career options (Kanters, Bristol, & Attarian, 2002; Sell & Robson, 1998). Each of these activities requires the effortful and often prolonged use of a limited resource: directed attention.

The capacity to direct attention allows a person to focus on weak or ambiguous stimuli by blocking out competing distractions (S. Kaplan, 2001; Posner & Snyder, 1975). That capacity plays a significant role in recognition memory, increasing the likelihood that information a person attends to will be remembered, and information ignored will be forgotten (Sternberg, 2003). After periods of prolonged use or under conditions of cognitive load, a person’s directed attention capacity will become fatigued, making it difficult to ward off distraction (S. Kaplan, 1995a). A decline in the capacity to
direct attention could undermine a student’s potential to succeed in school (Diamond, Barnett, Thomas, & Munro, 2007). In response, most major colleges have incorporated student development programs and services as one way to help students cope with the attentional demands and stresses of a college setting (Todaro, 1993). Given the critical role that directed attention has in the learning process and in supporting effective mental functioning in daily life, approaches that allow students to rest their directed attention capacity would be of value.

One way to rest a student’s directed attention capacity may exist in the person-environment transaction, in which a person finds certain settings to be more restorative than other settings. When the demands of a particular environment become too taxing, a person will often express the need to “escape” or to “get away from it all.” Many people find relief in a recreational setting, such as an urban park or wilderness area (Knopf, 1987; Hartig, 1993). Research suggests that a person can obtain a number of restorative benefits from spending time in a natural setting (Hartig, Mang, & Evans, 1991; S. Kaplan & Talbot, 1983; Ulrich, 1981). Some of the most compelling work in this area has been to identify and confirm the effects that natural settings have on a person’s capacity to direct attention (Taylor, Kuo, & Sullivan, 2001; Wells, 2000). According to R. Kaplan and S. Kaplan (1989), person-environment transactions that allow a person to feel a sense of being away, fascination, extent, and compatibility can provide the rest needed to restore attention when fatigued. While each of the four co-acting factors may exist in a variety of settings, Attention Restoration Theory (ART) suggests that natural settings commonly hold all four factors at high levels (S. Kaplan, 1995a). With a better understanding of the environmental patterns that enhance each of these factors, a college
could more effectively design its campus and promote experiences that would enable students to rest their directed attention capacity.

A natural setting that a person perceives as fascinating could be a critical resource for resting directed attention (Cimprich, 1992; S. Kaplan, 1978). Fascination presumably involves a form of attention that is undemanding and effortless (Hartig et al., 1991; R. Kaplan & S. Kaplan, 1989). By avoiding circumstances that require mental effort, a person is able to rest their overworked directed attention capacity. Having recognized that possibility, many people seek out a setting that is inherently fascinating when they are in need of a mental break. Certain kinds of cognitive contents and processes can contribute to a person’s fascination (S. Kaplan & Talbot, 1983). Contents that tend to affect people in this way include things of great value or great danger, as well as objects that have evolutionary significance such as water, fire, and greenery (S. Kaplan, 1978). The cognitive processes that are able to effortlessly hold a person’s attention are those that promote understanding and involvement (S. Kaplan & R. Kaplan, 1982). As people interact with a setting that offers both fascinating contents and processes, there are presumably fewer demands placed on their processing capacity. Thus, one crucial facet of any restorative experience is the need to elicit a person’s fascination.

One way to elicit a person’s fascination could be to have a person interact with environmental patterns that contain mystery. Mystery refers to those features of a setting where a portion of the visual landscape is obstructed, enticing a person to explore that area further (Hammitt, 1980; S. Kaplan & R. Kaplan, 1982). Natural settings commonly contain the hidden views that compel a person to delve deeper into a setting. A bend in the trail, a view partially concealed by foliage, or a stream that meanders out of sight all
possess a pattern of mystery (Gimblett, Itami, & Fitzgibbon, 1985). With the prospect of acquiring new information, mystery can engage people’s interest and enhance their sense of involvement with a setting. Consequently, these types of settings tend to not only have the capacity to fascinate, but also are generally preferred over settings that do not possess those features (Herzog, 1984; S. Kaplan, 1978). From an evolutionary perspective, humans are apt to prefer settings that will allow their capacities to function effectively, as well as meet certain basic human needs. While the relationship between mystery and preference is well established, researchers have yet to investigate the influence that mystery may have on allowing a person to rest his or her directed attention capacity (S. Kaplan, 1995b).

Although fascination is a critical component of the restorative process, a natural setting that a person perceives as fascinating could still fail to provide the rest needed to restore that person’s capacity to direct attention. Some settings contain contents and processes that a person may perceive as fascinating but are unrelated or inconsistent with that person’s goals. In such cases, the content and process fascinations have such a high degree of salience that considerable mental effort is required to ignore them (S. Kaplan & Talbot, 1983). A similar expenditure of effort is also required when a person confronts a series of unrelated fascinations. Sources of fascination that fall outside a larger framework often compete for a person’s attention and can become a source of confusion (Cimprich, 1992). On other occasions, a person may perceive an event as fascinating that could negatively affect his or her emotional and mental state. For instance, a situation that involves great danger can capture a person’s attention but fail to restore that person’s directed attention capacity. Thus, even though people may perceive a variety of settings
as fascinating, those settings might still be unable to provide the rest needed to restore their directed attention capacity.

The influence that mystery may have on fascination makes both theoretical and intuitive sense, but a person’s perception of fascination is not completely a function of the visual patterns in a setting (S. Kaplan, 1978). A person’s prior experiences, culture, and innate tendencies will shape the types of settings that person perceives as fascinating (S. Kaplan & Talbot, 1983). For fascination to occur, a setting should not only demand a person’s involvement, but also make sense to that person (S. Kaplan, 1978). “Making sense” is contingent on a person’s knowledge and expectations of a setting. Natural settings that contain mystery provide a person with only part of the information about what might lie ahead. Without the knowledge to recognize, predict, or act in a setting that contains mystery, a person may feel uncomfortable or anxious. That state of mind is likely to preclude a person from experiencing fascination, and subsequently prevent a person from being able to rest their directed attention capacity (S. Kaplan, 1995b). Therefore, the purpose of this study is to examine the effect of mystery, mediated by the perception of fascination, on college students’ capacity to direct attention.
CHAPTER II

LITERATURE REVIEW

The constant barrage of stimuli from heavy traffic, cell phones, work pressures, complex decisions, and a myriad of other sources can cause a person to feel worn out and in need of a break. That state of exhaustion is usually not physical, but rather, one in which a person is mentally drained. A variety of costs are associated with a fatigued mind. Most people who suffer from mental fatigue become increasingly impatient and are more prone to distraction (S. Kaplan, 1995a; Parasuraman, 1998). Others find themselves irritable and less social (Kuo & Sullivan, 2001). Those consequences can significantly detract from a person’s ability to function at their highest level. When the demands of an environment become mentally draining, people often look for ways to restore their competence. For many people, interacting with nature provides a much-needed respite from the demands of the modern world. To best understand the restorative role that nature can serve for a mentally fatigued person, one must first identify what constitutes the “mental fatigue” that nature is asked to help heal.

Mental Fatigue

All of us have felt the effects of a long day’s work, an intense period of studying, or trying to accomplish too much at once. These types of situations can cause a person to
feel mentally exhausted. In a state of mental fatigue, a person’s capacity to consistently put forth the same effort and produce the same result diminishes (Parasuraman, 1998). Tasks that a person could once perform easily become much more difficult. For example, a simple trip to the grocery store can turn out to be a daunting task for a person who is mentally fatigued. Selecting items to purchase, deciding on a particular brand, or even waiting in the checkout line could cause a mentally fatigued person to become confused, frustrated, or irritated. Under normal conditions, that same person could complete those tasks without difficulty. As a person becomes mentally fatigued, the ability to function effectively can quickly decline.

People often inaccurately attribute the effects of a fatigued mind to stress. Stress is different from mental fatigue. Cohen (1978) defines stress as a physiological reaction to harm or the threat of harm. Some of the more common symptoms that can occur due to stress include a rapid heartbeat, increased skin conductance, and greater muscle tension (Ulrich & Simmons, 1986). Many of the situations that people describe as stressful possess none of the usual symptoms for that condition. Instead, much of what people experience and refer to as “stress” is more aptly attributable to mental fatigue. While stress can certainly lead to feelings of mental fatigue, stress does not necessarily always cause mental fatigue. Mental fatigue can occur even when a person is doing something that he or she enjoys but has done for too long without a rest (S. Kaplan, 1995b). A term that more appropriately describes the psychological symptoms caused by mental fatigue is beneficial to understanding the condition.

Although the term “mental fatigue” provides a useful label for the set of symptoms that a person may experience after a period of sustained effort or under
conditions of cognitive load, that phrase is to some extent a misnomer. In contrast to what the name suggests, mental fatigue does not affect the mind as a whole (S. Kaplan, 1995b; S. Kaplan & Talbot, 1983). In fact, there are certain situations in which the consequences of a fatigued mind have no effect at all on a person’s ability to function. Yet, in other circumstances, mental fatigue can completely incapacitate and prevent a person from carrying out many of his or her ordinary, daily tasks. To report that a person is not genuinely fatigued just because he or she is able to function in certain situations is inaccurate. Likewise, to claim that the whole mind is fatigued when a person can clearly function effectively in certain situations is also inaccurate. Thus, the phrase “mental fatigue” can be misleading because it does not denote exactly what aspects of a person’s mental capacity are wearing down or becoming fatigued.

Most people who experience mental fatigue have a difficult time focusing (Parasuraman, 1998). That recurrent characteristic provides a clue to understanding the nature of this human condition. In a state of mental fatigue, paying attention to something that is uninteresting can overburden the mind’s ability to effectively process information. As a result, a person’s focus will often wander to stimuli that require less mental effort. A decline in the capacity to put forth mental effort can also be the result of too many distractions (Posner & Snyder, 1975). When confronted with a myriad of distractions, a person must decide which stimuli to attend to, and which to ignore. Blocking out distractions in order to sustain focus on a particular purpose requires mental effort (Schwartz, Ivancich, & Kaplan, 1997). Unfortunately, the effort required to block out those distractions is limited (Posner & Snyder, 1975). Ultimately, after a period of prolonged demand or under a condition of cognitive load, a person may be unable to
inhibit surrounding distractions. At that level of fatigue, a person will often begin to notice just how much effort is required to attend to even the simplest of tasks.

A common misconception that people have about attention is to assume that all attention is effortful. That misconception likely came about because some of the earlier definitions of mental fatigue tended to treat attention and mental effort as one and the same (Cohen, 1978; Kahneman, 1973). If all attention were indeed effortful, then the rate at which a person becomes fatigued would be a function of the amount of attention a person allocates to a given situation and the duration of that situation (Cimprich, 1992). The logic of that argument however, does not hold. There are a number of situations that exist in which the amount of attention a person allocates and the duration of a situation have no ill effects on a person’s attentional capacity. Thus, a definition of mental fatigue that treats attention and mental effort as synonymous would appear to have limited explanatory value for these types of situations.

Although many of the situations that demand a person’s attention require mental effort, other instances exist in which the use of attention is relatively effortless. For example, most people can effortlessly direct their attention when they are watching television or a film. In addition, people rarely describe activities like walking through a park or riding a bike as mentally demanding. Those types of situations undermine the belief that attention is a single or unitary process that always involves mental effort. Empirical evidence suggests that there are various forms of attention, including a form of attention that is effortless (Muller & Rabbit, 1989; Yantis & Jonides, 1990). One of the first researchers to make the distinction between effortful and effortless attention was
William James. Reviewing the varieties of attention as described by James (1890) provides additional insight into the issue of mental fatigue.

The Varieties of Attention

As a psychological construct, a person can more readily identify the phenomena of attention through his or her intuitions, than a specific definition. William James alluded to that obvious point when he wrote:

Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others… (James, 1890, pp. 403-404)

In the common usage of the word, a person will often apply the concept of attention to a number of situations and experiences. For example, a person could use the concept to describe a situation in which someone directs mental effort to something that was not necessarily interesting, yet requires sustained focus to achieve a specific goal. Attention could also refer to a circumstance in which an unexpected event automatically captures a person’s focused effort, causing that person to re-engage their focus in order to mitigate the distraction. Each of these examples characterizes a different type of attention explored by James (1890) within his book, The Principles of Psychology. In his analysis of the varieties of attention, James divided attention into different types and identified the various ways in which those forms of attention functioned.

The processes of attention, as indicated by James (1890), are a function of those things that arouse our interest. Implied within this proposition, is a component of selectivity. Without selective interest, individuals would be unable to protect themselves from the utter chaos created by the constant barrage of ever changing outside stimuli.
(Cimprich, 1992; Johnson & Proctor, 2004). James noted that a person could divide his or her attention between either sensorial objects (stimuli in the external environment) or intellectual objects (internal stimuli; ideas or memories). A person’s thoughts are just as likely to compete for attention, as are the patterns of stimulation in an external environment. The ability to be selective enables a person to focus on a single neural activity in a given environment by ignoring other stimuli. The initial selection of a stimulus depends largely on the type of interest produced by that stimulus (James, 1892).

James (1890) purported that the interest produced by a stimulus could be either Immediate or Derived. An Immediate stimulus is one that is inherently interesting to a person. For example, the sudden sound of an automobile horn can command a person’s interest while being unrelated to anything else. In contrast, a Derived stimulus is one in which the interest produced is the result of another immediately interesting thing. For example, a person’s previous experience reading a novel can influence that person to read future novels by the same author if their impressions of that author and his or her written work are positive. In this case, the person’s interest stems from the impressions they have drawn from their experiences reading novels by the same author. James (1890) explored not only the extent to which interest caused attention, but also the role that effort had in the processes of attention.

Involuntary attention. James distinguished between his final two varieties of attention based on the amount of mental effort he believed each required. James referred to the first type as being passive, reflexive, or involuntary. According to James (1890), involuntary attention is an effortless response to sensorial or intellectual stimuli of interest. The types of stimuli that elicit a person’s involuntary attention are often difficult
for a person to ignore (Muller & Rabbit, 1989). James described the stimuli that triggered involuntary attention as being instinctively dangerous, novel, or fascinating. Sources of involuntary attention that James (1890) identified included: “strange things, wild animals, bright things, pretty things, metallic things, words, blows, blood, etc.” (p. 417). Support for James’ early descriptions of these types of stimuli have occurred in both laboratory and field studies (McArthur, 1981; Taylor & Fiske, 1978).

As a person whose work had a great deal of influence on the functional school of psychology, James viewed all psychological phenomena from an “organic” evolutionary perspective. For early humans, the ability to focus on one particular stimulus for an extended period would likely have made that human vulnerable to potentially life threatening surprises (S. Kaplan, 1995b; Kellert, 1993). As hunter/gatherers, early humans had to remain alert and vigilant to their surroundings in order to survive. That need was likely far more important than the need for sustained periods of intense concentration. Thus, an attentional mechanism that could be voluntarily controlled, and yet at the same time readily interfered with by a reflexive orienting mechanism served a very important role in humans’ ability to adapt and survive.

Early human survival would have also benefited from the proclivity that patterns and events could capture and hold interest. For example, it would have been adaptive for situations that involve danger to be perceived as inherently interesting. If early humans had perceived these types of situations as purely bad or painful, then their reaction would have likely been to immediately flee, instead of carefully scrutinizing the situation (S. Kaplan, 1978). The opportunity to examine a potentially dangerous situation with minimal mental effort would have allowed early humans to gain a better understanding of
themselves, as well as their surroundings. Even today, people gravitate toward those things that possess an element of danger (Zuckerman, Ulrich, & McLaughlin, 1993). While certain types of environmental hazards can evoke a sense of fear and avoidance, mild hazards often attract and sustain a person’s interest (Appleton, 1976, 1984; Herzog, 1984). The fascination with these types of hazards can ultimately keep a person safe. For a species as cognitive as humans, survival has depended more on knowledge than on physical prowess. As a result, situations that could summon a human’s interest offered certain advantages with regard to survival.

According to James (1890), the best form of attention is effortless. On occasion, a person may be lucky enough that the patterns of stimulation in the environment are not only compatible with one’s objectives, but also attractive in their own right. Under those types of circumstances, attention is more likely to occur effortlessly. More often than not though, a person will face a far less congenial situation. If the stimuli in an environment do not coincide with a particular objective, then more effort is required to ignore irrelevant stimuli in order to attend to relevant ones. In such cases, there are likely too many sources of interest competing for a person’s attention. People face these types of distractions daily when they travel to work, perform various tasks, or carry on a conversation in a crowded room. James (1890) referred to the mechanism that allowed a person to function successfully in the face of competing distractions as active or voluntary attention.

**Voluntary attention.** Voluntary attention is the willful act of directing one’s mental effort in order to “resist the attractions of more potent stimuli,” “discriminate a sensation amidst a mass of other sensations,” or “detect an impression of extreme
faintness” (James, 1890, p. 420). When the stimulus patterns from an environment are essential to achieving a specific purpose, but otherwise fail to hold interest; a person may have to apply mental effort to ignore irrelevant stimuli and attend to relevant ones. Expenditures of mental effort are also required when a person confronts interesting patterns of stimulation that are irrelevant to that person’s goals (Theeuwes, 1991). As an attentional mechanism that is content-free, voluntary attention allows a person to purposefully direct attention. In contrast, involuntary attention is largely a function of the interest or attraction that is present within an environment and can occur automatically (Posner, Snyder, & Davidson, 1980). A person who is incapable of directing his or her attention is likely to be bombarded by competing distractions and unable to meet predetermined goals (Lezak, 1982).

In today’s modern world there is often a lack of harmony between what a person deems important and what a person finds interesting or fascinating (R. Kaplan & S. Kaplan, 1989). In fact, many of the stimuli that are important to achieving certain goals fail to hold a person’s interest without considerable mental effort. Meanwhile, modern life contains a number of stimulus patterns that are not only capable of attracting a person’s interest, but also are specifically designed to capture attention even though those stimuli are wholly unrelated to a person’s set of goals. For example, advertisements often attract a person’s interest for the purpose of the advertiser, and not necessarily for the purpose of the individual. The growing disparity between a person’s natural interest and their self-directed purposes has placed greater demands on a person’s attentional resources (R. Kaplan & S. Kaplan, 1989). Thus, an increasing number of the situations that people confront today require the use of their voluntary attention. The constant
exertion of mental effort by a person can eventually reduce that person’s ability to successfully engage in sustained voluntary attention (Cohen, 1978; Hancock & Warm, 1989).

There are certain costs that are associated with the prolonged use of voluntary attention. The most obvious cost is mental fatigue, manifested by a decline in a person’s capacity to direct attention (S. Kaplan & R. Kaplan, 1982; Parasuraman, 1986). The decline in a person’s capacity to direct attention is most likely due to the fatiguing of the inhibitory mechanism that presumably underlies the use of that capacity (S. Kaplan, 1995a; Posner, 1990). According to James (1890), a person cannot strengthen a weak intention. Instead, the only hope a person has of maintaining focus is to block out or protect that intention from competing distractions. On an average day, a person can effectively block out many of the usual distractions. If the number of distractions increases, however, a person would have to expend more inhibitory effort to suppress those distractions (Schwartz et al., 1997). The inhibitory mechanism that allows a person to focus can easily become fatigued through overuse. Once fatigued, even the weakest of distractions can interfere with a person’s objectives. As a result, a person can become more easily distracted, impatient, or even irritable.

**Directed attention.** Although the central tenets of involuntary and voluntary attention have remained resolute, the language used to describe those concepts has evolved. Inspired by James’ notion of voluntary attention, R. Kaplan and S. Kaplan (1989) adopted the phrase “directed attention” in order to minimize the confusion brought about by previous terminology. Directed attention is defined as the capacity to inhibit competing distractions in order to sustain focus during purposeful activity (Cimprich,
Three basic distinctions exist between this form of attention and the variety that occurs involuntarily. Directed attention requires mental effort, occurs under a person’s own volition, and is vulnerable to fatigue. Involuntary attention or fascination as termed by S. Kaplan (1995a) is at the opposite side of the spectrum in all regards. It occurs regardless of mental effort, regardless of a person’s volition, and is tireless. Each of these forms of attention is vital to the performance of a number of other cognitive processes, including the processes of human memory.

**Memory and Attention**

Psychologists have long viewed attention as having a critical role in the formation of a durable memory (Broadbent, 1958; Cherry, 1953; James, 1890; Norman, 1969). Memory is the means by which a person stores and retrieves information from past experiences. More specifically, that process can be broken down into three common operations: encoding, storage, and retrieval. Each operation represents a different stage in a person’s memory processing. Encoding refers to how a person converts physical sensory input into a kind of cognitive representation. Once a person has constructed that representation, it is then stored in a memory system. Retrieval of a particular representation refers to how a person gains access to information stored in his or her memory. Without the allocation of attention, a person would be unable to carry out any of the described memory operations. In essence, memory is a byproduct of attention. Examining each stage of memory processing in more detail can further demonstrate the intimate role that attention has in the formation and preservation of human memory.
**Encoding.** The process of encoding stimuli that a person experiences through sight, sound, and touch can at times be quite demanding. For example, most college students will often spend hours reviewing course material prior to being tested on that material. In their preparation, students might utilize different strategies in order to ensure that they can remember the required information at the time of the test. The strategies that enable a student to convert information into memory necessitate the use of that student’s attentional resources (Norman & Shallice, 1986; Posner & Peterson, 1990). Without attention, students would be unable to carry out the type of elaborative rehearsal processes that are necessary to commit information to long-term memory. A number of studies have documented the importance of attention in memory encoding (Baddeley, Lewis, Eldridge, & Thomson, 1984; Mulligan, 1998; Murdock, 1965). The evidence provided from that research reinforces what many had already believed; attention plays an integral part in all aspects of human memory, especially for encoding.

In a study conducted by Craik, Govoni, Naveh-Benjamin, and Anderson (1996), the researchers asked participants to study lists of words in order to assess the role that attention had on memory encoding. The participants studied the lists of words either under full attention or while performing a concurrent reaction-time task. The results from that manipulation clearly showed that when participants divided their attention between a secondary task and the encoding phase of a memory task, memory performance would decline relative to the full attention condition. Declines in memory performance would often occur steadily as the complexity of the secondary task increased. In a much earlier study, Murdock (1965) implemented a secondary task that required participants to sort cards while studying a set of words. The results from that study are consistent with
contemporary findings. Participants’ free-recall performance was higher when the researchers emphasized the memory task to participants, rather than the speed of the card sorting. Collectively, the results produced from each of these research studies suggest that the memory encoding process requires attention, and is to some extent, under a person’s own volition.

While the capacity to direct attention can certainly affect the memory encoding process, there are a number of situations in which a person can encode information with minimal attentional effort. For example, most people if asked are able to recall where they ate lunch the previous day. People will frequently encode information that they are not consciously aware of encoding. Psychologists attribute that occurrence to the level of mental effort or demand that certain situations place on a person’s cognitive resources. Previous research has shown that under conditions of cognitive load, the attentional resources that a person needs to process and store information may no longer be available or can dissipate, causing a decline in memory accuracy (Baddeley & Hitch, 1974; Barrouillet, Bernardin & Camos, 2004). Although the use of a dual-task paradigm has allowed researchers to simulate conditions of cognitive load, introducing time constraints into the design of a study can have a similar effect (Towse & Hitch, 1995). A brief explanation for each memory system can better illustrate the correlation between time and a person’s memory.

Storage. Most theoretical models of human memory suggest that there are three main types or systems of memory: sensory, short-term (working), and long-term. Each type of memory store differs in the duration of memory retention (Atkinson & Shiffrin, 1968; Sternberg, 2003). A person’s sensory store serves as the initial repository for
information perceived in an environment. That system of memory is capable of holding a limited amount of information for a very brief time (usually less than 2 seconds). Short-term memory, sometimes referred to as “working” or “active” memory, enables a person to store information that he or she is actively processing or maintaining. The level of processing that takes place in short-term memory often determines whether a person is able to move that information into long-term memory. Long-term memory is the permanent storehouse for information that a person retains and may later retrieve when needed. The performance of each memory system is contingent on a person’s attentional resources and the demands imposed on those resources (Turner & Engle, 1989).

Models of human memory often include a component that describes the role that attention has in the various memory systems. Baddeley and Hitch (1974) integrated the central executive process into their model as a way to explain the function of attention in memory. Other researchers have used terms such as “controlled attention” and “supervisory attentional system” to achieve the same purpose (Norman & Shallice, 1986; Shiffrin & Schneider, 1977). Despite the differences in terminology, there are a number of conceptual similarities. Researchers tend to agree that the capacity to process and maintain information in memory requires attention. Because attention is a resource of limited capacity, people must often divide their attention between processing and maintenance tasks. When attention switches away from a particular memory trace, that memory will often begin to decay. In order to refresh a decaying memory trace, attention must focus on the retrieval of that memory. As the interval of time between storage and recall increases, the strength of a memory trace tends to weaken (Towse & Hitch, 1995).
Those memory traces that required the least amount of mental effort during the encoding stage of memory processing are more likely to be accessible for retrieval.

**Retrieval.** Retrieval is the process by which a person gains access to previously stored information (Sternberg, 2003). Gaining access to information stored in short- or long-term memory requires attention. Although some researchers (Baddeley et al., 1984) have argued that retrieval processes are wholly automatic, a few recent studies have demonstrated otherwise. For example, Hicks and Marsh (2000) found that when they divided a person’s attention during retrieval, there was a significant drop off in a person’s memory accuracy. In a similar study, Fernandes and Moscovitch (2002) asked participants to engage in two concurrent memory retrieval tasks. Participants had to manually indicate on a keyboard whether a word had appeared previously, while simultaneously recalling words from an earlier study list. The results from that study showed a significant decrease in memory accuracy among participants. In each case, the division of a person’s attention restricted the attentional resources that person had available to carry out the recognition test. Examining the process of recognition can provide even more insight into the role that attention has on retrieval.

Some researchers view recognition memory from a dual process perspective. Under that view, the process of recognition is a reflection of two distinct retrieval processes: recollection and familiarity. Recollection is the process of actively remembering both the specific test item and the context in which that item took place. Familiarity is the undifferentiated feeling that a person experiences when he or she believes that they have encountered an item, but are unable to retrieve any contextual details about that item. Various methods have been used to tease apart each of these
processes. One of the more common procedures employed includes asking a participant to make a remember/know judgment about a test item (Eldridge, Sarfatti, Knowlton, 2002; Gardiner & Richardson-Klavehn, 2000; Jacoby, 1991). Donaldson (1996) has argued that the “remember-know” distinction might not necessarily indicate two separate forms of recognition memory, but rather the strength of a particular memory trace.

Hicks and Marsh (1999) obtained results that were in support of a strength-trace model. In their study, participants performed a recognition memory test designed either as a one-step or two-step process. For the one-step process, participants would make a “remember-know” judgment at the same time they would make a recognition decision. In the two-step process, participants would first make a recognition decision, and then make a “remember-know” decision only for a recognized item. The results showed that when participants made the “remember-know” decision in conjunction with the recognition decision, there were more false alarms than there were in the two-step process. The increase in false alarms for the one-step process suggests that participants used a more liberal criterion in making a “remember-know” judgment. For the two-step process, participants were more deliberate in their responses for recognition and remember-know judgments (Hicks & March, 1999). The results from this study not only corroborate the idea that “remember-know” judgments reflect the strength of a memory, but also demonstrate the role attention has in the process of recognition.

The role of attention in human memory is pervasive. By using techniques that either restrict people’s attention or require people to divide their attention, researchers have been able to observe the relationship between attention and the different memorial processes. People often experience situations that place a high demand on their
attentional resources. In a typical day, a person will likely have to divide his or her attention between a number of different tasks, responsibilities, and outside distractions that are present within their environment. As a result, a person’s attentional resources can become fatigued, making it difficult to carry out basic memory processing. Although memory is not the only process affected by a decline in attention, it is often one of the more observable processes. The fatiguing of attention can affect a person in variety of ways. Thus, as opposed to “mental fatigue” the phrase “directed attention fatigue” better describes the condition of the mind that results from situations of prolonged mental effort.

**Directed Attention Fatigue**

Although a decline in the capacity to direct attention may appear to be unfortunate, but hardly catastrophic, there is significant evidence to suggest that the role of directed attention is more pervasive in human functioning than once thought (Lezak, 1982; Cimprich, 1992). As a result, directed attention fatigue can significantly influence various aspects of a person’s life. One area of human functioning that is commonly affected by directed attention fatigue is the process of selection (S. Kaplan, 1995a). The ability to be selective is of vital importance in performing a variety of tasks. In fact, without the process of selection a person would have a difficult time with most tasks that require problem-solving skills. Directed attention allows a person to be selective in the types of stimuli to which he or she believes are relevant to the problem at hand (S. Kaplan, 2001; Lyon & Krasnegor, 1996). When fatigued, a person will likely be unable to select the appropriate resources that are necessary for finding the solution.
Consider a person who is attempting to solve a particular problem. A person often has a variety of resources to use at his or her disposal. Some of those resources may include a person’s collection of capabilities, an extensive amount of stored knowledge, as well as an assortment of potential actions (S. Kaplan, 1995a; Lyon & Krasnegor, 1996). Although each of those resources could be powerful in their own right, most of them are likely irrelevant to the solution that a person is seeking. Directed attention allows a person to focus solely on the resources that are most pertinent to solving the problem. Selecting appropriately can help ensure that a person efficiently finds the most effective solution. For a person who is suffering from directed attention fatigue, the multitude of possibilities from which to choose from can become overwhelming, making even the simplest of problems difficult to solve.

In certain situations, a person can determine the solution of a problem despite having a fatigued directed attention capacity. For instance, routine tasks in a person’s life generally require less selectivity (Schneider & Shiffrin, 1977; Sternberg, 2003). The need for less selectivity occurs because a person has developed a set of associative connections. Those connections function in such a way that when a person perceives the critical stimulus, the appropriate response is immediately registered (Sloman, 1996). In essence, the solution to the problem has become habitual. However, in circumstances that require new problem solving, a person has yet to develop the associative connections to make the solution a well-learned response. As a result, a person must consider a larger range of capabilities or resources, and from that larger grouping select the most effective means. Directed attention provides the means to not only be selective, but also to apply that means to solve problems.
A person’s ability to inhibit certain impulses or feelings can also decline because of directed attention fatigue (S. Kaplan, 1995b). The capacity to direct attention depends on an inhibitory mechanism in order to block out competing distractions (Schwartz et al., 1997). When that mechanism becomes fatigued, a person is more likely to act on his or her inclinations. These types of situations can potentially be maladaptive. For example, most people have been in a circumstance in which restraining their thoughts or actions was more beneficial than the alternative. In view of that need, Pennebaker (1991) refers to inhibition as the ‘linchpin of health.’ Much in the same way that a linchpin on a wagon wheel holds the wheel together, inhibition does the same for human behavior. Inhibition prevents a person from acting out without first thinking about the consequences of an action. A moment of reflection allows a person to determine whether a particular behavior is socially acceptable. Without directed attention, a person is likely to be impulsive, impatient, and make poor decisions (S. Kaplan, 1995b). Thus, an inhibitory mechanism that a person can control voluntarily plays an essential role in a person’s ability to function effectively.

Two other areas that are critical to the success of human functioning are perception and thought. Perception allows a person to distinguish, classify, and make sense of the sensations that exist in an environment (Sternberg, 2003). A person employs perception in a variety of situations. For example, anytime a person catches a proofreading mistake in a document, that person is making use of his or her ability to perceive. The ability to perceive can become impaired due to directed attention fatigue. People prone to distraction are more likely to act hastily when they are assessing or analyzing a situation, especially if that situation is not inherently engrossing. The impact
that directed attention fatigue has on perception may subsequently affect a person’s ability for thought (S. Kaplan, 1995a; Lezak, 1982). Many circumstances that involve planning or implementing a plan necessitate that a person take a step back in order to look at a situation from a broader perspective. Without the support of directed attention a person would be unable to see past the immediate pressures and temptations of a situation, making that person’s behavior aimed more at the short term (S. Kaplan, 1995a).

Perhaps the most significant impact that directed attention fatigue can have on human functioning relates to how a person’s mood may change when experiencing that condition. People who suffer from directed attention fatigue tend to show signs of irritability (Warm & Dember, 1986). After a period of sustained effort, a person’s capacity to direct attention can decline (Glosser & Goodglass, 1990). When that occurs, a person will often become increasingly aware that the level of directed attention required for a situation is insufficient for his or her desired purposes. Consistently failing to meet one’s short-term goals can bring about a rising level of frustration. That level of frustration is further intensified due to a person’s inability to block out distractions that he or she could normally deflect. Circumstances that would generally not bother a person can suddenly become a major nuisance. As a result, a person whose capacity to direct attention is fatigued is more prone to overreact. The tendency to overreact can in turn cause a person to become less social and more confrontational (Pennebaker, 1991).

Of all the costs that are associated with directed attention fatigue, irritability is the most hidden in that its effects are more gradual (S. Kaplan & R. Kaplan, 1982). For example, on an average day a person will confront a variety of situations that are demanding on that person’s attention. In most cases, a person possesses a level of
directed attention that is sufficient to function successfully. That capacity enables a person to perform difficult tasks and endure the consequences of those tasks later on. For example, many people are able to incessantly rise to the occasion when faced with successive demands. After a long day, however, the irritability that a person has built up can become too much for that person to endure any longer. As a result, a person may become increasingly aloof with family, relatives, or friends at the end of a day.

A seminal study conducted by Sherrod and Downs (1974) examined the delayed costs that were associated with the use of effortful attention. In the study, participants performed a series of attentionally demanding tasks. Although some of the participants performed tasks in a condition that was relatively quiet and peaceful, others carried out tasks in the presence of loud, uncontrollable, and random noise. Despite the distraction, many of the participants could perform the tasks rather effectively. Upon the conclusion of the experiment, the researchers noticed a number of subsequent effects. When a participant had completed the required tasks and begun to gather their things to leave, a researcher would pose as another participant, and approach the participant to ask for assistance. The participants who had performed tasks under a condition of high distraction were less likely to offer any assistance and were more callous than those participants who performed tasks in the condition with no distraction (Sherrod & Downs, 1974). The evidence obtained from that study supported the notion that the sustained use of effortful attention could potentially cause a person to become irritable and less likely to interact positively with others.

A decline in the capacity to direct attention, even temporarily, could have dire consequences if the effects of that decline exhibit themselves at a particularly
inopportune time. For example, consider the level of focus a pilot must have to fly an airplane. The tasks that are required of a pilot commonly involve monitoring numerous visual displays within the cockpit, monitoring the visual environment outside of the aircraft, and listening and responding to the auditory messages coming in over the radio (Styles, 1997). Managing each of those tasks is critical both to the successful operation of the airplane and the safety of the people on board. Without sufficient capacity to direct attention, a pilot may potentially make a mistake that could result in a tragic outcome. In a careful review of the causes of airplane crashes, Wolfe (1992) concluded that all of the incidents that were not due to equipment failure resulted from interruptions in the sleep patterns of pilots or other important personnel. The capacity to direct attention is thus a key factor in a person’s ability to function effectively.

Directed attention fatigue is a significant problem because it occurs regularly, the costs can be very high, and it affects a large segment of the population. Regrettably, directed attention fatigue is hardly what one would consider a rare phenomenon. There are a number of situations that can lead to the fatigue of a person’s directed attention capacity. Some of the more common causes attributed to attentional deficits include overwork, lack of sleep, and situations that involve prolonged mental effort (S. Kaplan, 1995a). As a result, directed attention fatigue is an extremely widespread problem that can affect a range of populations. The research evidence that has been garnered thus far shows that directed attention fatigue is prevalent among a diverse group of people, including, AIDS caregivers (Canin, 1991), cancer patients (Cimprich, 1990; Cimprich & Ronis, 2003), corporate employees (Lohr, Pearson-Mims, & Goodwin, 1996), students (Tennessee & Cimprich, 1995), and even children (Taylor, Kuo, & Sullivan, 2001; Wells,
2000). A more detailed examination of the attentional demands of one of those population segments, college students, brings into better focus how directed attention fatigue has become a significant problem.

**Directed Attention Fatigue among College Students**

The psychological well-being of college students is a growing concern for many administrators in higher education (Sell & Robson, 1998). Students who are working toward a college degree often face a number of new and demanding situations. Many of those situations require the prolonged use of a student’s directed attention capacity. For that reason, college students as a population are likely to be at an increased risk for directed attention fatigue (Tennessen & Cimprich, 1995). A decline in the capacity to direct attention could undermine a student’s success in higher education. In response, most major colleges have incorporated student development programs and services as one way to help students cope with the attentional demands and stresses of a college setting (Hensley, 1997; Todaro, 1993). Examining the conditions that can cause directed attention fatigue among college students could help to determine the most effective ways to restore that important capacity.

The transition from high school to college is a major adjustment for most students (Bray & Born, 2004). In that initial year, students are often for the first time in their lives living independently from their parents (Aycock, 1989). The separation from parents and other relatives, home, friends, and community can be a fatiguing experience. Students must adjust to new friendships, people of varied backgrounds, as well as a communal living environment. Those types of adjustments can disrupt the routines and habits that students established while in high school and living at home. Consequently, students
may feel that their new environment lacks a sense of security and predictability. When a person can no longer make sense of their surroundings or anticipate what might happen next, more attentional effort is required in order to process what is happening (S. Kaplan & R. Kaplan, 1982). As one might expect, the adjustment to an unfamiliar college setting can be an overwhelming experience for a new student.

A student’s first year in college can present a number of challenges. One of the many challenges that new college students cope with is an increased level of responsibility. Living away from home without the supervision of a parent or guardian often provides students with their first opportunity to make important life decisions (Aycock, 1989). Some of the more important decisions that students will make in college may deal with the temptations and expectations of sexual behavior and drug and alcohol use (Kanters et al., 2002). The mental effort that students allocate to those types of decisions can be significant. Directed attention enables a person to step back from a situation in order to make a judgment based on rational thought, rather than on quick impulses (S. Kaplan, 1995a; Lezak, 1982). Without the support of directed attention, a person is more likely to make a decision that is devoid of careful thought. A decision that is lacking in such conscientious reflection could potentially have severe, immediate, and long-term consequences for a student.

In a study that explored the perceptions of college life, Sell and Robson (1998) reported that 62% of the students surveyed acknowledged that their level of alcohol consumption had increased since coming to college. A third of the students had indicated that they had consumed more than the recommended limit for safe drinking. Many of the students commonly cited social and academic pressure as reasons for their increase in
alcohol consumption (Sell & Robson, 1998). While the data obtained from that study is for the most part descriptive, student responses point to the potential impact that social and academic demands could have on student behavior. A person who perceives the social and academic demands as high would presumably be at a greater risk for directed attention fatigue. A person who suffers from directed attention fatigue is more likely to make poor and irrational decisions (S. Kaplan, 1995a). Thus, one might reasonably suspect that directed attention fatigue could be a factor in unsafe student behavior.

The demands of an environment can largely dictate the behavior of the person in that environment. The college environment exposes students to a variety of demands, including the demand to meet a higher academic standard. That adjustment often requires that students devote a considerable amount of time and effort to each of their academic courses. The time and effort that a student allocates to working on a project or studying for an exam could affect that student’s capacity to direct attention. In an earlier study, Cimprich (1989) showed that college students’ capacity to direct attention declined after taking a difficult examination. During the course of a semester, students are coping with a variety of academic demands, many of which necessitate the prolonged use of directed attention. The constant exertion of mental effort can take a toll on a student, making studying for exams, writing a research paper, working on a project, or even attending class difficult. Unfortunately, many of the tasks that are so integral to a student’s academic success are the very same tasks that make a student prone to experience directed attention fatigue.

While undergraduate students clearly go through a transitional period during their first year, Grayson (1985) suggests that there are a series of adjustments that students
must make each year in order to achieve success in higher education. A student’s second year in college introduces a new set of conditions. Most students by that time have adjusted to being away from their family as well as to the academic and social demands of college life. Students are now beginning to make more of a concerted effort to sort out their potential career options. Choosing an academic major requires students to establish a set of long-term goals. To formulate those goals, students must carefully assess their strengths and weaknesses. The self-awareness that enables a person to conceptualize his or her objectives requires sustained focus (Cimprich, 1992). The mental effort needed to sustain that level of focus is however, limited (Posner & Snyder, 1975). As a result, situations that involve making major life decisions, such as selecting a particular career path, can be mentally draining for a student, particularly when coupled with the academic rigors of college life.

Many of the issues that students cope with in their second year of college still apply during their junior year. Students are still making important life decisions, exploring career options, and establishing long-term goals. Unlike the preceding year however, students now have less time at college. With less time, students must focus on setting realistic goals and demonstrate more of a commitment to achieving those goals. In fact, most students are no longer satisfied with simply developing a specific goal set; students increasingly judge themselves based on how well they accomplish their ambitions (Grayson, 1985). Those ambitions are often diverse and can be academic, social, physical, and even cultural in nature. In most cases, students are tackling more than just one goal at a time. The mental effort that is required to initiate and maintain each intended activity can place more of a demand on a person’s directed attention
capacity (Cimprich, 1989). That increasing demand can lead to the rapid decline and fatigue of a directed attention.

A student’s final year in college ushers in yet another series of adjustments as the process of graduation begins (Grayson, 1985). While students are focusing on completing their undergraduate commitments, they must also prepare for the next transition, life after college. Transitioning from college to the “real world” can involve quite extensive planning on the part of a student. Students must address issues related to their employment, finances, and residence. Dealing with these matters requires that a student explore his or her alternatives, select from those alternatives, and create an abstract framework that can function as a guide for action. Directed attention is intimately involved in each of those operations. By suppressing competing distractions, directed attention allows a person to maintain an ongoing train of thought (Schwartz et al., 1997). Depending on the circumstances, the amount of mental effort needed to block out distractions from both the external and internal environment could exceed a student’s directed attention capacity. With all of the changes and adjustments that students must make during their undergraduate college experience, many of which require the prolonged use of directed attention, students are likely to find themselves in situations in which they feel worn out and in need of a break.

When the demands of college life become overwhelming, students intuitively seek out experiences and settings that place less strain on their mental capacities. For many students, recreational settings such as urban parks and wilderness areas offer a much-needed respite from those demands (Francis & Cooper-Marcus, 1991). Numerous studies have documented the beneficial effects that contact with nature can have on a
person’s psychological well being (Hartig et al., 1991; Ulrich, 1979). In her doctoral dissertation, Canin (1991) examined the effects that certain activities had on AIDS caregivers, a population that is also prone to fatigue and burnout. In that study, Canin (1991) discovered that locomotion in nature, regardless of the activity, was the most effective remedy for a person experiencing fatigue. By contrast, Canin’s study showed that sport-related activities and watching television were less effective in helping a person recover from fatigue. An explanation of the restorative effects that nature could have on a student requires a more thorough analysis of the human-nature relationship.

Understanding the Human-Nature Relationship

The idea that contact with nature can provide a person with a number of benefits is by no means a recent revelation. In fact, many of the cultures throughout recorded history have felt that nature played a unique restorative role in healing a person’s mind (Kluckhohn, 1953; Knopf, 1987). A large body of anecdotal literature has further advanced that notion. For example, Thoreau’s (1854) account at Walden Pond provided readers with an intimate view of the influence that nature experiences could have on human well being. Other literary works have followed a similar theme and have described how nature can rejuvenate a person’s mind, body, and soul (Eiseley, 1957; Leopold, 1949). Those early writings, as well as people’s personal experiences have contributed to the persistent notion that contact with the natural world can be both physically and psychologically healthful.

Fredrick Law Olmsted, a prominent figure in American history, was sensitive to the impact that natural settings could have on restoring a person’s mental capacities. As an eminent landscape architect, Olmsted (1865) strongly believed that fatigued urban
dwellers could recover their capacity to focus in the context of nature. In reference to natural scenery, Olmsted (1865) wrote, ‘it employs the mind without fatigue and yet exercises it; tranquilizes it and yet enlivens it: and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration to the whole system’ (p. 22). Olmsted’s astute observation of the human-nature relationship served as his guide in designing one of America’s most famous recreational areas, Central Park. In designing Central Park, Olmsted wanted to provide people with a pleasant contrast from the chaotic conditions of New York City. Olmsted (1865) felt that Central Park would offer the people of that city a haven for escape, and a place where they could rest their mind.

Nature is certainly a treasured aspect of human life. There are an infinite number of examples. People find pleasure in planting flowers and watching them grow (R. Kaplan, 1973). Some people travel great distances in order to experience pristine nature. Cities devote a considerable amount of their resources to planting trees, establishing parks, and protecting urban fringe nature areas (Ulrich, Dimberg, & Driver, 1991). Despite substantial economic costs, nations set aside large segments of land to preserve that land’s aesthetic and recreational appeal. Behaviors such as these indicate the significance that nature has in people’s lives. Although a humanistic approach to understanding the character of people’s relations with nature is insightful, for some, a theoretical perspective is more compelling. One approach to understanding the human-nature relationship explores the role that evolution may have in people’s predilection for nature.
Nature’s Appeal: An Evolutionary Perspective

As a species, humans tend to gravitate toward places they find intriguing and that support certain basic needs (S. Kaplan, 1978). Of course, humans are not the only species to exhibit those types of proclivities. Many animals demonstrate a preference for environments that are more apt to meet the needs of their species (Partridge, 1978; Woodcock, 1982). In fact, animals held in captivity or raised in a laboratory setting are just as likely to select an environment that is conducive to their species’ needs (S. Kaplan, 1983b; Wecker, 1964). The selection of a particular habitat, as the previous example indicates, is not solely an expression of preferring what is known. Rather, a species’ inclination for particular types of settings may very well be a product of that species’ evolutionary past.

For millions of years humans have endured the dangers and difficulties of evolving in the natural environment (Knopf, 1987). As one would expect, humans have not emerged unscathed from those experiences. Some of the more widely recognized impacts of human evolution highlight the changes in the human species’ gross physical structure. Although those changes are significant, many researchers view the impact that evolution had on human’s psychological makeup as equally profound (S. Kaplan, 1972; Kellert, 1993). From this perspective, the patterns of thought and behavior of today’s humans reflects a sequence of evolutionary experiences. In terms of human evolution, experience was largely a product of the physical environment and the requirements of that environment. Examining the requirements that have influenced the evolutionary path of humans could provide a better understanding for why humans prefer certain types of settings to others.
Researchers have traced the roots of our human ancestry back millions of years to a time when early humans lived amidst the trees (Berrill, 1955; S. Kaplan & R. Kaplan, 1982). As tree dwellers, early humans were visually oriented animals that used their hands to interact with the environment (Berrill, 1955). For reasons that are not entirely evident, humans came down from the trees and began to inhabit the open African savanna (S. Kaplan, 1972). Having become well adapted to an arboreal setting, early humans faced a number of difficult challenges in their new environment. Unlike the habitat that humans previously occupied, the savanna included a variety of species that probably viewed early humans as prey. Since humans did not possess any of the traditional defenses of great size, speed, or claw, they likely needed to rely on other methods for survival (S. Kaplan & R. Kaplan, 1982).

To survive in such unfavorable conditions, early humans would have benefited from knowing a great deal about their environment (Appleton, 1976; S. Kaplan & R. Kaplan, 1982). The ground was a dangerous place filled with a number of uncertainties. Being able to recognize terrain or know the nuances of certain predators would seem to be critical to achieving even the smallest amount of safety. Acquiring that type of knowledge meant that early humans not only had to be able to assimilate information about their environment, but also have an inclination to do so (Knopf, 1987). In essence, humans needed to be builders and users of cognitive maps (S. Kaplan, 1983a). With a cognitive map, or mental model of one’s environment, early humans could proceed through an environment as if the essentials of that environment were already stored (S. Kaplan & R. Kaplan, 1982). Using information stored from previous experiences allows
a person to predict, anticipate, and plan for future events. In an uncertain world, those capacities would have been extremely beneficial to the survival of early humans. There is no doubt that knowledge has played an integral role in human evolution. To underline the significance of that point, Laughlin (1968) discussed the niche that early humans had as hunter/gatherers. While early humans were home-based animals, the need for sustenance necessitated that humans range over large territories. To find their way back home, humans needed to be able to identify landmarks and make judgments about distance. The failure to recognize one’s environment or make accurate predictions about that environment would have likely been disturbing, if not painful or life threatening (Laughlin, 1968). To avoid those types of situations, early humans would have likely preferred environments that were able to facilitate comprehension, as well as sustain their interest. Based on that view, S. Kaplan and R. Kaplan (1982) developed a theoretical framework for landscape preference that focused on the kinds of cognitive contents and processes that would have assisted early humans in their struggle to survive.

Cognitive Contents and Processes: An Informational Approach

S. Kaplan and R. Kaplan (1982) have suggested that humans evolved during a time in which visual information was critical for survival. Given that assertion, there is good reason to suspect that humans would have acquired strong biases for certain types of information in their environment. For example, early humans would have likely reacted favorably to settings that were comprised of elements needed for their survival, such as water or greenery (Orians, 1986). At the same time, humans would have also found certain visual patterns to be adaptive, such as those that fostered understanding and exploration (S. Kaplan, 1987). The tendency to make choices based on one’s evaluation
of the visual information in an environment is essential for effective functioning. Therefore, in studying environmental preference one should focus on the kinds of cognitive contents and processes that would have been important to early human survival. Possessing a thorough understanding of each of those factors can provide further insight into why people prefer certain settings.

**The power of content.** In every environment there are qualities or objects that make-up the content, or subject matter of that environment. Research has shown that nature provides one of the most powerful types of content, as demonstrated by people’s overwhelming preference for natural settings (S. Kaplan, R. Kaplan, & Wendt, 1972; Ulrich, 1983; Zube, 1976). For example, the very presence of certain natural elements, such as vegetation or water, can enhance a person’s preference for a landscape (S. Kaplan, 1983a). In fact, people’s inclination for nature is so strong that they are often willing to pay higher prices for real estate located in a more natural surrounding (Luttik, 2000). The appeal that natural contents have on humans is best understood from an evolutionary context.

According to Herzog (1989), the contents that tend to influence a person’s environmental preferences are of two types: general and specific. General contents refer to those features or arrangements that establish what a person can do in an environment. That concept is similar to what Gibson (1979) has called affordances. The affordances of a particular object are essentially the potential uses that object can offer a person. With respect to space, the affordance is not so much what a person can do with that space, but what a person can do in that space. For example, an environment comprised of terrain that was smooth in texture would have offered early humans greater locomotion. The
ability to move through an environment with ease, and without obstacle, likely had a certain adaptive advantage. As a result, early humans would have been more inclined to prefer those types of settings.

A preferred environment is one in which a person’s abilities are more likely to be effective, and that will allow a person to thrive (S. Kaplan, 1972; R. Kaplan & S. Kaplan, 1989). According to Appleton (1976), environments that afforded early humans prospect and refuge would have gone a long way in meeting those needs. For the evolving human, the world was a dangerous place filled with predators that were constantly lurking. Settings that offered opportunities for unhindered seeing (prospect) would have allowed humans to easily survey their surroundings for potential threats. At the same time, humans would have likely found solace in settings that offered refuge or protection from those threats. Of course, under a climate of suspicion, a place of refuge could very easily evoke feelings of fear or distress (Appleton, 1976; Nasar & Jones, 1997). Therefore, a person’s preference for a particular setting depends on his or her evaluation of the affordances offered by that setting.

In addition to the affordances that generally comprise a setting, a setting may also contain specific contents that can influence a person’s preference. For example, research has shown that the presence of water, trees, or foliage can substantially affect whether or not a setting is preferred (Choker & Mene, 1992; Zube, Pitt, & Evans, 1983). Each of those properties is an indication that an environment can support human life. For early humans, developing a bias toward settings that contained such properties would have enhanced their likelihood for survival. The impact that the content of nature has on a person’s environmental preference is undeniable. Nature, even in its unspectacular form,
is preferred over settings that are lacking in such content (S. Kaplan et. al, 1972). A careful analysis of environmental preference shows that while content is an important factor in determining one’s preference for a setting; content is not the only factor.

Cognitive Processes: Making Sense and Involvement

Countless studies have shown that natural settings, as a group, are among the most preferred types of settings (S. Kaplan et al., 1972; Stamps, 1996; Zube et al., 1983). In fact, self-reported preference ratings for scenes containing nature are so much higher than scenes lacking that type of content that the distribution of preference ratings for scene type rarely overlaps (Van den Berg, Koole, & Van der Wulp, 2003). In studying people’s preferences for nature, researchers have identified that within the nature category there were certain types of settings that were distinctly more preferred than other settings. One such example is of natural settings that through their layout seemingly invite the person to explore the setting further. The most preferred natural settings were often comprised of trails that disappeared around a bend or that included partially obscured views (Gimblett, Itami, & Fitzgibbon, 1985; S. Kaplan, 1987). Each of those settings suggests that a person could acquire more information if they were to go deeper into the setting. Although content can influence a person’s preference for a setting, the spatial configuration of that setting seems to also have an effect.

A human’s desire for information should hardly come as a surprise. After all, the survival of the human species has depended on the propensity of humans to construct and use cognitive maps (S. Kaplan, 1987). If such a propensity were in fact critical to survival, then craving that information would seem only natural. For that very reason, humans should also view opportunities to acquire new information as enticing. The
prospect of extending one’s cognitive map would have been thoroughly adaptive for early humans (Barkow, 1983; S. Kaplan & R. Kaplan, 1982). At the same time, however, early humans wanted to avoid situations that were too far from their own understanding. From an evolutionary perspective, early humans would have likely felt powerless in situations or settings for which they lacked their most potent weapon, knowledge. Based on that assumption, S. Kaplan and R. Kaplan (1982) have suggested that two cognitive processes would have been especially important to the evolving human: making sense and involvement.

**Making sense.** The process of making sense out of one’s environment is perhaps the single most important and pervasive of human needs (S. Kaplan, 1987). Humans find a great deal of satisfaction in those things that they are able to recognize and understand. Consider a person who is well versed in mathematics; being able to complete a complicated mathematical problem can be a gratifying experience. On the other hand, a person who lacks the necessary knowledge to solve such a problem is liable to feel lost, confused or even frustrated. If a person experiences those types of feelings repeatedly, they would more than likely develop a strong aversion for math. Similar aversions can develop for environments when a person experiences an environment that is so unfamiliar that they have no relevant knowledge to draw on. In such circumstances, a person is likely to feel extremely uncomfortable and could even become panicked (Lynch, 1960). As a result, people tend to prefer environments that are able to facilitate comprehension.

Making sense of one’s surroundings is in part contingent on the presence of certain environmental factors. The environmental factors that are of particular importance to the making-sense-process deal with space. As S. Kaplan and R. Kaplan
(1982) so duly noted, “A scene or setting or landscape is not something merely to perceive, but something to enter into” (p. 82). When a person evaluates a setting, they often consider how they would function in that setting. Two environmental factors believed to be important to the process of making sense are coherence and legibility (R. Kaplan & S. Kaplan, 1989). Coherence refers to the ease with which information in a setting can be organized and identified (Herzog, 1989; S. Kaplan, 1987). The recurrence of certain elements, textures, and other features can permit the cognitive organization of a setting, which can subsequently aid in the process of making sense. Legibility refers to the ease with which a person could travel through a setting and not get lost (Herzog, 1989; S. Kaplan, 1987). A setting perceived as legible suggests that the organization or “order” of that setting would remain constant if one were to wander further into the setting. The presence of each of those environmental factors is important to the process of making sense, and in determining people's environmental preference.

Although people tend to prefer settings that are familiar, the relationship between familiarity and preference is not exactly clear-cut. Familiarity often provides a person with a sense of confidence and feeling of security. With extensive knowledge a person can more readily call on previously stored information when there is a need to make sense of an environment. Too much familiarity, however, can cause a person to become tired or bored. As a person becomes more familiar with an environment, less of that person’s cognitive capacity is required (S. Kaplan & R. Kaplan, 1982). In essence, certain elements that at one time occupied a person’s mind are now no longer involving. Although people tend to avoid situations that are overwhelming, they often desire
opportunities that will challenge and utilize their capacity fully. Therefore, simply making sense of one’s environment is not enough to satisfy humans’ informational needs.

**Involvement.** As a species that was dependent on knowledge for survival, humans would have benefited from an environment that not only offered them the capacity to make sense, but also that engaged and sustained their interest. An environment that was “involving” would have provided early humans with an opportunity to use and extend their cognitive maps. An extensive supply of cognitive maps as well as the ability to call on that information quickly would have been helpful in keeping early humans prepared for the dangers in their environment. For example, early humans who were motivated by opportunities for involvement would have been more inclined to explore, and enter into a new setting (S. Kaplan & R. Kaplan, 1982). The exploration of an unfamiliar setting would have allowed humans to gradually make more of their environment familiar. Increasing ones’ familiarity with a setting would have enabled humans to cope better with uncertainty, and improved their chance of survival by providing them with the knowledge that may be needed to survive. As a result, people tend to prefer environments that not only facilitate comprehension, but also that promote involvement.

The process of involvement, much like the process of making sense, is in part subject to the presence of certain environmental factors. The factors that are likely to promote a person’s involvement in a setting are those that can arouse and hold a person’s interest. According to S. Kaplan and R. Kaplan (1982), settings that contain a degree of complexity and mystery are likely to enhance a person’s involvement. Complexity refers to the amount and variety of information that is present within a particular setting.
At first glance, a person will often assess a setting based on whether that setting has enough information to occupy his or her mind. Mystery refers to the degree to which a person could obtain additional information if that person were to go deeper into the setting (Herzog, 1989). With the promise of additional information, mystery offers a person more to think about and suggests that there is more to learn through locomotion and exploration. Each of these environmental factors can enhance the process of involvement, and substantially affect a person’s preference for a setting (Herzog, 1984, 1987, 1989; R. Kaplan, 1975).

Both the need to make sense and the need for involvement are intimately intertwined in people’s preferences for certain types of settings. In fact, each of those needs appears to be less paradoxical than one might initially think. The need to make sense out of the environment allows people to determine which of their cognitive maps fits within a particular situation (S. Kaplan & R. Kaplan, 1982). People often find satisfaction in those things that they can comprehend. At the same time, however, in an environment that lacks variety or challenge, the process of making sense is likely to become monotonous, leaving people feeling restless or bored. As a result, people tend to also seek out environments that offer an opportunity for involvement. Environments that are capable of engaging and sustaining people’s interest will allow those people to continue to use and extend their cognitive maps. Of course, people driven solely by opportunities for involvement are likely to find themselves in situations that are beyond their capabilities. Thus, the process of making sense and the process of involvement emerge as simultaneous needs, each of which can influence a person’s environmental preference and a person’s ability to function effectively.
Environmental Preference: Empirical Findings

The systematic and scientific study of people’s preferences for certain types of settings began in the early 1970s. Researchers from the social science and design disciplines were largely responsible for initiating those efforts. The common view held by many of the researchers at that time was that culture and learning, rather than genetics, was the preeminent factor in human behavior, thought, and preference (Ulrich, 1993). From this perspective, a person’s response to a setting was a function of that person’s previous experiences, and the accumulated emotions and meanings garnered from those experiences (Knopf, 1987). In light of that belief, researchers carried out a number of studies expecting to find results that would indicate that people held widely different preferences for certain types of settings.

Although some studies showed that people’s preferences for a setting significantly varied based on ethnicity (Yang, 1988), age (Zube et al., 1983), and occupation (Yi, 1992); those differences were relatively minor when compared to the percentage of variance explained by group similarities. Within-group variance indicated that people had very similar preferences for certain kinds of settings, which researchers largely attributed to the physical properties of those settings. In view of that research, the results seem to suggest that there is an alternative cause, other than learning and culture, for human preference patterns. Drawing on the evolutionary approach developed thus far, humans are more likely to prefer those settings that have attributes similar to the settings from which they have evolved. Given that assertion, a person should have a strong inclination for natural settings that possess savanna or park-like characteristics.
Settings that are characterized as savanna or park-like are often visually open, flat or uniform in texture, and include trees that are scattered or in small groups (Orians, 1986). According to most evolutionists, those types of settings offered humans a number of advantages in terms of their primary necessities: water, food, and security. Certain studies have examined the degree to which people prefer a diverse sampling of natural settings (Ulrich, 1983; Yi, 1992). The results from those studies consistently showed that American, European, and Asian adults preferred settings that were savanna or park-like in appearance the most. A person can readily find these types of views in rural areas, urban fringe locations, and even in the middle of cities (i.e., Central Park). In order to gain a better understanding of the effect or role that evolution has on people’s preferences, researchers studied the preferences of persons of different ages.

Balling and Falk (1982) examined the preferences of individuals of different ages for various types of settings. For the purpose of their study, they exposed participants to slides of five different types of natural landscapes. The five landscapes used for the study included settings from desert, rain forest, deciduous, coniferous, and savanna biomes. Under the assumption that familiarity was an important factor in preference, Balling and Falk (1982) suspected that the influence of evolution on preference would be most evident in a younger age group. Participants in this category would likely have the least amount of experience with any of the biomes presented. Thus, the familiarity effect would be less prevalent. The results obtained from the study were consistent with the researchers’ expectations. Participants between the ages of 8 and 11 significantly preferred the savanna biome to all of the other landscapes presented. Although Balling
and Falk (1982) interpreted their results with caution, they suggested that such findings point to the potential role that evolution may have on people’s preferences for a setting.

Numerous studies that have provided support for the possible roles those evolutionary factors may play in influencing people’s preferences for settings. For example, certain studies have shown that settings comprised of water features will often elicit strong and positive responses from people (Choker & Mene, 1992; Herzog, 1984). From a functional perspective, early humans would have likely viewed settings that contained elements necessary for their survival as attractive. In fact, excavations in East Africa have revealed that many early humans established their camps along the edges of water sources (Brown, Harris, Leakey, & Walker, 1985). To this day, humans still exhibit many of the same behaviors. Contemporary humans, when they can, will often opt for homes that have a view of an ocean, lake, or river (Kellert, 1997). About the only time that water does not enhance a person’s preference for a setting is when there is increased risk (Ulrich, 1983). Aside from that circumstance, humans frequently prefer scenes comprised of some water element.

Some of the more persuasive studies to support the role of evolution on people’s preferences are those that examine people’s aesthetic reactions to natural and urban scenes. In such studies, people will often view a series of visual slides and rate each scene to the degree that they liked or preferred that scene. The results obtained from examining people’s preferences for natural and urban scenes clearly show that samples of American, European, and Asian adults strongly prefer natural scenes to urban scenes (Hull & Revell, 1989; Stamps, 1996). That pattern of human preference will often take place even when researchers present people with scenes of unspectacular natural settings.
For example, in a study that compared people’s preferences for unspectacular nature scenes to scenes from a relatively attractive townscape, Ulrich (1981) found that people still perceived the nature scenes as more desirable. The evidence garnered from that study, and others like it, clearly demonstrates that people respond in fundamentally different ways to natural and urban settings.

Although many people contend that humans’ preferences for nature are a function of their evolutionary past, there are others who have been less convinced of that approach (Hebb, 1972). The discomforts that some have with the notion that people’s preferences for nature are innate center on issues related to universality (S. Kaplan, 1983a). The widespread misconception that surrounds the evolutionary approach is the idea that all people must share those things influenced by genetics. In fact, this is not the case. Genetic transmission for any species has involved variability. S. Kaplan (1983a) is quick to note that even within the human species variability exists in speed, strength, and size. Certainly if there is variation for those types of human characteristics that a person inherits, one could reasonably expect to find variation in people’s preferences. As a result, an approach that stresses the role of evolution on human preference patterns does not at the same time discount the role that experience, learning, and culture may have on preference.

The influence of “learned” knowledge on preference is hardly debatable. People will often develop a set of evaluative codes based on previous experiences. In essence, those codes that a person develops serve as a guide for action and allow a person to have feelings about things that have yet to occur, or that may never occur (S. Kaplan & R. Kaplan, 1982). Researchers who adhere to the evolutionary approach believe that the
evaluative codes that people form because of experience or learning are to some extent inherited. To clarify, humans inherit preferences for certain situations or settings to the degree that their experience in those circumstances affects the structure of the mind. People’s experiences often have an immediate impact on behavior, thought, and preference. For a prior experience to influence current behavior or preference would mean that some residue of that experience must remain. Thus, what a person inherits is not preference, but presumably a structure that predisposes that person to a specific preference (S. Kaplan, 1987; S. Kaplan & R. Kaplan, 1982).

There has been a cascade of studies examining the role that genetic and experiential factors have on numerous aspects of human behavior and response (Ulrich, 1993). Researchers have suggested a more integrative approach that views both learning and genetics as having a crucial role in forming people’s preferences for settings (Knopf, 1987). The idea that in only a few thousand years the perceptual and informational capabilities that humans developed in response to the natural world would cease to exist seems unlikely. At the same time, to ignore the role that people’s immediate experiences have on their preferences for settings would be a mistake. Therefore, an approach that considers both the role of evolution and the role of experience would provide a more complete way of looking at the human-nature relationship. Regardless of the position one takes to understand the human-nature relationship, researchers agree that people prefer nature because of the potential benefits it offers as a resource.

The Benefits of Human-Nature Interactions

In America and other urbanized countries there is a strong prevailing sentiment that contact with the natural world can offer a person a wide range of benefits. Perhaps
the most resounding declaration made about human-nature interactions is that they can provide people with a respite from the demands of everyday life (Knopf, 1983; Olmsted, 1865; Schreyer, 1989). People often describe the reprieve that they get from interacting with nature as restorative. An important question to ask is, “What exactly is being restored?” Research and theory in this area have primarily focused on two positions, one highlighting stress reduction, and the other addressing the recovery of attention (R. Kaplan & S. Kaplan, 1989; Ulrich, 1983). Each of those areas of research has documented substantial evidence to support the restorative influence that natural settings can have on a person (Hartig, et al., 1991; Sheets & Manzer, 1991). Examining the results from some of those studies can provide a clearer understanding of the potential benefits derived from human-nature interactions.

**Nature’s Effect on a Person’s Affective Well-Being**

One of the more prominent researchers to investigate the benefits of human-nature interactions has been Roger Ulrich. His area of research has focused on how nature can influence a person’s affective well-being. In one of Ulrich’s (1979) earlier studies, he examined the impact that viewing natural scenes had on a group of students who were experiencing mild stress due to an upcoming exam. In order to determine the effect that visual scenes would have on a student’s psychological state of mind, Ulrich utilized a self-report questionnaire. The questionnaire encompassed a number of items designed to assess the stress reduction associated with viewing certain types of scenes. Ulrich presented students with a series of slides from one of two categories: either scenes of undistinguished natural settings or scenes of urban settings that lacked natural contents. Findings from that study showed that natural views were more effective at
reducing students’ stress levels than urban views (Ulrich, 1979). Students exposed to natural views had a greater reduction in negative feelings and a more pronounced increase in positive affect.

In a later study, Ulrich (1981) made use of an additional measure in order to provide even more support for the notion that natural settings could affect a person’s psychological state of mind. The sample for that study involved a population of unstressed college students. Ulrich once again exposed students to a series of slides from one of two categories: either scenes of everyday natural settings or scenes from an attractive townscape that lacked nature contents. In addition to collecting self-report data, Ulrich recorded the brain electrical activity of students by using an electroencephalograph (EEG) device. The data collected from the EEG was largely convergent with data from the self-reported measures of stress reduction. Students exposed to natural settings were more wakefully relaxed than they were when viewing urban settings (Ulrich, 1981). The combined use of both psychological and physiological measures provided a deeper understanding of the restorative effects that natural settings could have on a person.

Sheets and Manzer (1991) obtained results that were comparable to Ulrich’s in a study that examined people’s emotional responses for American urban street scenes. In that study, the researchers exposed people to urban street scenes with and without prominent trees and/or landscaping. The results obtained from that study showed that people had higher levels of positive toned feelings for scenes containing vegetation than they did for scenes lacking that type of content. Honeyman (1992) found similar results in her study, which examined the effects that three different types of landscapes had on
people’s emotional state of mind. She exposed people to scenes that were either completely natural, completely urban, or urban scenes that contained natural elements. Although scenes that were completely natural had the greatest effect on enhancing mood, urban scenes that contained prominent vegetation were more effective at enhancing a person’s mood than those scenes that altogether lacked natural content (Honeyman, 1992).

Many researchers contend that the physiological and emotional changes that can occur from interacting with nature have close ties to humans’ evolutionary past. In fact, Ulrich (1983) views humans as a species that is biologically prepared to respond positively to certain qualities and contents of a setting. During evolutionary times, humans would have likely related some settings with security or low-risk. Having the capacity to respond restoratively to certain properties within a setting would have been advantageous for early humans. For example, settings comprised of an abundant food supply and that were also accessible to a water source would have likely fostered emotional restoration. For an early human, knowing that a setting was able to meet basic human needs would have likely quelled any anxieties that he or she might have had about how to find food and water. Logic would seem to suggest that natural settings of that type would also have certain advantages on a person’s cognitive capacity.

**Nature’s Effect on a Person’s Cognitive Capacity**

Stephen and Rachel Kaplan have had a profound influence on the development of a theoretical framework that addresses the effect that certain settings can have on a person’s cognitive capacity. The evolution of that framework is the culmination of a number of studies that have examined the benefits people can derive from interacting
with nature. Nature experiences tend to encompass a variety of conditions. For example, people may experience nature while watching a sunset on a street corner, hiking in the wilderness, looking through the glass of an aquarium, or even admiring a picture. Each of those circumstances could potentially offer a person an array of benefits. The Kaplans have focused their research efforts on understanding how certain settings can benefit a person’s cognitive capacity; more specifically, how certain settings can restore a person’s capacity to direct attention when that capacity has become fatigued (S. Kaplan, 1995a; R. Kaplan & S. Kaplan, 1989). Reviewing some of the Kaplans’ earlier studies can better demonstrate how the theoretical basis for that research originated.

One of the first studies the Kaplans conducted involved gardening. As an activity, gardening can provide a person with a variety of benefits. For some people, their participation in gardening is solely consumptive. For others, participation is a reflection of their desire to experience benefits that are more internal. Those benefits have often revolved around themes of fascination and rest (R. Kaplan, 1973a). For example, people tend to describe their fascination for things that grow, that are wild, and that contain an element of uncertainty. Other people focus on the respite that nature experiences can afford. A closer examination of each of those themes demonstrates the symmetry of their relationship and calls to mind William James’ description of involuntary attention.

In describing the varieties of attention, James (1890) distinguished between two types of attention based on the amount of mental effort each required. The first type, voluntary attention, is a form of attention that requires mental effort and is difficult to sustain over a prolonged period of time or under conditions of cognitive load. The second type, involuntary attention, is effortless and can place less demand on a person’s
cognitive capacity. The types of stimuli that can elicit involuntary attention are those that are instinctively dangerous, novel, or fascinating (James, 1892). Immediately one is able to see a parallel in the way that James described involuntary attention and the way in which people describe their experiences gardening. If gardening is able to elicit a form of attention that is less demanding, allowing a person to rest his or her voluntary attention, then there is good reason to believe that these types of experiences could offer certain cognitive benefits.

In order to investigate the psychological effects of gardening, R. Kaplan (1973a) administered a questionnaire to two different groups of gardeners: community gardeners and home gardeners. The questionnaire asked participants to respond to a series of items in terms of the value each item had as a source of satisfaction. The items in the questionnaire belonged to one of three benefit categories: 1) tangible benefits, 2) primary garden experiences, and 3) sustained interest. The items grouped within the “sustained interest” category addressed benefits tied to fascination. For example, a participant would identify the degree to which gardening provided a diversion from the routine, acted as a source of relaxation, or was able to maintain his or her interest (R. Kaplan & S. Kaplan, 1990). The results from the study showed that both community and home gardeners perceived nature fascination as among the more important sources of satisfaction in gardening. Although this study did not provide evidence to confirm a cause and effect relationship, it did serve as the starting point in long line of restorative research.

Soon after the Kaplans initiated their study on the psychological effects of gardening, they began to research the effects of wilderness settings (R. Kaplan, 1974). At
that time, there was a strong prevailing sentiment that extended wilderness experiences could offer a number of benefits to a variety of populations. Those claims, however, lacked empirical evidence to support them (Gibson, 1979). As a result, the Kaplans and their associates designed the Outdoor Challenge Research Program, a program sponsored by the U.S. Forest Service. Participants in the program spent approximately two weeks backpacking in the wilderness while learning various outdoor survival skills. During that time, participants maintained a journal and responded to different topic questions each day. One of the main research objectives was to find convincing evidence demonstrating that wilderness experiences could offer people a wide range of lasting benefits. After achieving that objective, the program would then turn its focus to understanding the nature of the benefits that participants experienced.

During the span of 10 years, the Outdoor Challenge Research Program collected data that measured emotional and cognitive changes in participants. The analysis of that data involved making pre and post trip comparisons, as well as comparisons with a control group of subjects. Results showed that participants after the trip had made gains in self-confidence, self-sufficiency, and were making more realistic self-evaluations than those participants in the control group (R. Kaplan, 1974). In addition, participants had also developed a level of competency in outdoor survival skills. Follow-up evaluations showed that the emotional and cognitive changes persisted even 5 months after the treatment (R. Kaplan, 1974). The qualitative analysis of participants’ journal entries provided a deeper understanding of the types of experiences participants valued most during their trip.
Although there was a range of responses in participants’ journals, a number of common themes emerged. Participants often commented on how their level of engagement remained high due to the many sights, sounds, and smells (S. Kaplan & Talbot, 1983). In addition, participants tended to remember the wilderness positively, and were appreciative of the opportunity they had to get away from the demands of their everyday lives. Other participants reflected on their growing sense of wonder for elements that they had previously allowed to go unnoticed. People had come to perceive nature in a very different and profound way. The silence of nature was no longer uncomfortable, but rather was something to cherish. Using these and other participant reflections, R. Kaplan and S. Kaplan (1989) identified four factors that they felt had a critical role in the restorative experience. Examining how each of the proposed factors facilitates attention restoration is important to understanding the types of person/environment interactions that may offer that particular benefit.

Attention Restoration Theory: Restorative Environments

Attention Restoration Theory (ART) posits that prolonged periods of mental effort can lead to the fatigue of a person’s capacity to direct attention. When that capacity becomes fatigued, a person is more likely to be impatient, irritable, and is prone to make mistakes (Herzog, Maguire, & Nebel, 2003). According to ART, a fatigued person can benefit from interacting with a setting that does not require reliance on his or her capacity to direct attention. Under such conditions, a person would presumably be able to rest the inhibitory mechanism that underlies the use of that capacity. ART suggests that the rest and recovery of directed attention will occur to the degree that the person-environment interaction allows a person to feel a sense of being away, fascination,
extent, and compatibility (S. Kaplan, 2001). Exploring each of those factors in more
detail provides a better understanding of the requirements needed for a restorative
environment.

**Being away.** People who need rest will often express their desire to “escape” or
to “get away from it all.” Although for some people this may require a change of venue,
for others it may indicate the need to avoid certain cognitive contents that involve mental
effort. In essence, “being away” refers to feeling a sense of distance from those aspects
that are routinely present in one’s life, but are generally not preferred. R. Kaplan and S.
Kaplan (1989) identified three ways that a person could achieve a sense of being away.
One way of experiencing such a sensation is to escape from unwanted distractions.
Another is to avoid specific types of mental content that have become routine or mentally
taxing. The third and final method that the Kaplans address deals with suspending one’s
pursuit of certain purposes. Each of these methods stresses the importance of creating
physical or psychological distance from those things that impose a demand on a person’s
capacity to direct attention. In doing so, a person can presumably rest his or her directed
attention capacity, allowing that capacity to recover when fatigued.

For many people, natural settings provide a type of cognitive content that is very
different from what they typically experience. In fact, the contents of nature are often in
stark contrast to the urban contents and concerns that most people cope with in modern
societies (Knopf, 1987). With that said, natural settings tend to offer people relief from
those demands that normally occupy the mind, thus enhancing their sense of being away.
Natural settings are frequently the preferred destinations for people planning a vacation.
At the same time, however, a vacation-like setting is not required for a person to
experience a sense of being away. A person can just as easily experience being away in the context of a nearby natural setting. For example, a neighborhood park can provide a person with the same kind of uniqueness that allows the pressures and obligations of the world to seem distant (R. Kaplan & S. Kaplan, 1990). Although the conditions that enhance a person’s sense of being away are an essential part of the restorative experience, by themselves they are hardly sufficient.

**Fascination.** Many situations and settings in modern society require the use of a person’s directed attention. As a result, the constant exertion of mental effort can cause a person’s directed attention capacity to become fatigued. Recovery from fatigue is contingent on a person being able to rest that attentional capacity. While sleep provides a person with one means of resting directed attention, that approach is not always effective or pragmatic when demands are intense and prolonged (Cimprich, 1992). An approach that allows a person to maintain focus without depleting that person’s attentional resources would be of value. S. Kaplan (2001) suggests that the rest and restoration of directed attention lies in the use of involuntary attention, a form of attention that is undemanding and effortless. For a person to shift from a voluntary (effortful) to an involuntary (effortless) mode of attention, there often needs to be some source of interest or fascination (Cimprich, 1992).

In the context of ART, fascination is the perception of stimuli that are capable of attracting a person’s attention effortlessly. Natural settings tend to have a wealth of contents and processes that people perceive as fascinating. For example, many people have acknowledged gardening as an activity that can evoke fascination (R. Kaplan, 1973a; R. Kaplan & S. Kaplan, 1990). People often describe the fascination that they
experience from gardening as relaxing and aesthetically pleasing. Sunsets, lakes, mountains, and other natural elements tend to have a similar effect on people. In fact, most of the contents and processes found in nature have the propensity to effortlessly hold a person’s attention, rather than drain it. The interest inherent within those environments allows a person to maintain focus without calling on that person’s effortful attention. At the same time, the soft fascination produced from these types of setting can provide opportunities for reflection. Although the potential to elicit a person’s fascination is a key aspect of a restorative setting, without some sense of structure, a setting perceived as fascinating might simply serve as a source of confusion or distraction.

**Extent.** Environments that possess “extent” often suggest that the immediate setting is part of a larger whole. R. Kaplan and S. Kaplan (1989) have proposed that there are two properties that contribute to a setting’s sense of extent; those properties are connectedness and scope. Connectedness refers to the order and structure of the elements perceived in a given setting (S. Kaplan & R. Kaplan, 1982). For example, a setting that allows a person to readily organize what he or she perceives is more likely to possess enough continuity so that building a cognitive map of that setting is possible. From a more abstract perspective, connectedness can also refer to the relationship that a person may develop with a given setting. For instance, a person hiking in the middle of Yellowstone could form a historical connection with that area as he or she walks alongside the various geothermal features or interacts with the wildlife in the park. These types of interactions have a way of redefining people’s relationships with nature, reminding them of their origins. Although a feeling of connectedness is important to
achieving a sense of extent, the scope of a setting can be equally important to that objective (R. Kaplan & S. Kaplan, 1989).

Scope refers to the scale of the area in which the perceptual and organizational activity takes place (Hartig, Kaiser, & Bowler, 1997). Areas that are vast in size can create the sensation of being in a whole other world (S. Kaplan & Talbot, 1983). Yosemite Valley will often have that effect on people as they overlook giant monoliths and hear the sound of the many waterfalls cascading down the Sierra Mountains. These types of settings tend to be visually captivating, thus contributing to that setting’s sense of extent. Scope, however, is not limited to areas of sheer physical size, but also can occur on a more conceptual level. An environment that caters to a person’s imagination and suggests the continuation of a world that is not immediately apparent can enhance the scope of a setting. For example, the structure of a Japanese garden will often maximize the illusion of depth, thus creating the impression that an area of limited space is actually much more spacious (Eliovson, 1971). Settings such as these are not only coherent and rich enough to make building a cognitive map possible, but also worthwhile.

Compatibility. Environments that provide people with distance from their everyday demands, elicit fascination, and that offer a sense of extent can still fail to provide the rest needed to recover a person’s attentional resources. For a setting to be truly restorative, a person’s inclinations and purposes need to be congruent with the requirements or demands imposed by that setting (R. Kaplan & S. Kaplan, 1989). The correspondence between what an individual wants to do, must do, and is able to do in a setting will determine if that setting is compatible. The degree to which a setting is compatible has a direct effect on human functioning. Settings that do not support a
person’s intentions tend to require a considerable amount of mental effort. Consider a person who is trying to study for an exam in an area surrounded by people who are socializing. The mental effort needed to block out those types of distractions often requires a substantial portion of one’s limited cognitive capacity. The struggle to remain effective in such a setting can significantly reduce a person’s capacity to direct attention.

Natural settings provide a striking contrast to many settings in their ability to foster a high degree of compatibility (S. Kaplan & Talbot, 1983). These types of settings are distinctive, in that they tend to support a wide range of activities that coincide with people’s various inclinations. In fact, the elements that a person perceives as interesting in nature are often the same elements that a person requires for action in those settings. Furthermore, people often seek out natural settings to achieve the purposes that those types of areas can readily fulfill. For instance, a person who desires a break from their workday may retreat to a nearby park for lunch. The repetition of such behavior, day in and day out, would likely not occur if the effects of those experiences did not have a lasting impact. Thus, a compatible environment is more likely to enable a person to carry out his or her intentions smoothly, and without struggle.

The Development of the Perceived Restorativeness Scale

Although S. Kaplan (1983b) first proposed each of the four restorative factors almost three decades ago, researchers have only just begun to develop measures to assess those constructs. In 1991, Hartig et al. carried out a study that compared certain restoration outcomes under natural, urban, and passive relaxation conditions. As part of that study, the researchers constructed a measure of perceived restorative quality. The scale that they had developed comprised a series of items designed to measure individual
perceptions of fascination, being away, coherence (extent), and compatibility. By including that assessment into the design of their study, the research team was able to examine the theoretical constructs that S. Kaplan and Talbot (1983) believed to be operating within a restorative setting. A closer examination of the study conducted by Hartig and his associates can further demonstrate the importance of the proposed restorative factors.

Having established a set of items that they felt best represented each restorative factor, Hartig et al. (1991) carried out a study in which they divided participants into one of three treatment sessions; a nature walk, a walk through an urban setting, or a passive relaxation condition that involved participants reading magazines while listening to music. Prior to treatment, the research team collected physiological measures (i.e., blood pressure, heart rate) of the participants at rest. In addition, participants filled out a brief questionnaire in order to assess their mood. After collecting baseline data, participants performed a series of tasks designed to induce cognitive fatigue. Immediately following those tasks, participants experienced one of the three treatment sessions. Treatment sessions lasted approximately 40 minutes. When a treatment session had concluded, the researchers administered the Perceived Restorativeness scale (PRS) and reevaluated participants’ mental and physiological states.

The results obtained from that study provided substantial evidence to support the notion that experiences in natural settings can have certain restorative outcomes. Most notably, the study was able to demonstrate the impact that natural settings have on a person’s cognitive capacity. The researchers found there to be significant differences across treatment conditions for participants’ proofreading performance (number of errors
detected). For example, post treatment analysis showed that participants who were involved in the nature walk session could detect more proofreading errors than those participants who were in the other two conditions (Hartig et al., 1991). To better assess the role that the restorative factors may have had on certain outcome measures, the research team examined participants’ responses on the PRS.

Initially, the research team looked at participant responses on the PRS for each of the three treatment sessions. Results from that analysis showed that participants who were in the nature walk condition experienced being away, fascination, extent, and compatibility to a greater degree than those participants in the urban and laboratory settings. Following that review of the data, the researchers ran correlations between the different outcome measures and the summary score derived from participant responses on the PRS (Hartig et al., 1991). The researchers found a moderate but reliable relationship for those outcome measures significantly affected by treatment. One finding was of particular interest to the research team. The data garnered from the study had indicated a moderate relationship between the summary score of the PRS and the proofreading performance measure. Results of this sort seem to suggest that natural settings can have a positive effect on a person’s cognitive capacity, and that the proposed restorative factors could play a significant role in that effect.

Further Development of the PRS

Preliminary work on the PRS provided a foundation upon which more recent studies have continued to develop a measure of perceived restorative quality. The results obtained from those studies (Hartig, et al., 1997; Hartig, Korpela, Evans, & Garling, 1996) have shown the PRS to be a reliable and valid instrument for assessing restorative
qualities. In fact, the pattern of results across each study have shown strong internal consistencies for the subscales of items intended to represent each of the four restorative factors proposed by S. Kaplan and Talbot (1983). Questions surrounding the PRS have largely focused on the factor structure of the scale. Studies consistently align the items for being away, fascination, and compatibility in one factor, and the items for the extent construct in another factor. Upon further investigation, one is able to see that certain items have particularly strong factor loadings. For example, the items intended to represent the construct fascination are of interest. Fascination, which presumably involves a form of effortless attention, provides the basis for resting a person’s attentional resources. The utility of the fascination subscale lies in outlining the distinction between effortful and effortless attention.

**Fascination: Attention without Effort**

While typical models of attention do not address the notion of fascination, other aspects of that concept have appeared in cognitive-based research. Fascination, as described by S. Kaplan (1995a), presumably involves a form of attention that is effortless. In studying people’s cognitive capacities, researchers have been able to distinguish between forms of attention that require mental effort, and those that are seemingly effortless. One of the first researchers to make that distinction was William James. James (1890) used the terms voluntary and involuntary attention to distinguish between effortful and effortless attention. Many of the terms used by researchers today, such as endogenous versus exogenous attention or controlled versus automatic attention, correspond nicely with the language first employed by James, and that S. Kaplan (1995a)
now espouses. A review of some of the more prominent studies on attention can further
demonstrate the distinction between effortful and effortless attention.

The attentional spotlight. Psychologists have often described attention as akin to
a mental spotlight that allows a person to selectively attend to certain parts of the visual
environment (Posner et al., 1980). According to the attentional spotlight perspective, a
person will fully process stimuli that fall under the spotlight, leaving information that is
outside the spotlight’s focus unprocessed and in the dark (Johnson & Proctor, 2004).
Although intuitively appealing, the use of this metaphor is somewhat confounded.
Earlier research demonstrated that while a person can voluntarily direct their attention to
a given area, that same person could find their attention automatically drawn to a
completely different area (Moray, 1959; Treisman, 1960). The attentional spotlight
metaphor not only stirred debate, but also inspired a number of researchers to investigate
more closely the focus and movement of a person’s visual attention.

In a very simple and elegant experiment, Posner et al. (1980) examined the effect
that spatial cueing had on directing a person’s attention to a visual target. Posner asked
subjects participating in his experiment to fixate on the center of a display and respond as
quickly as possible when they had detected the onset of a light in their visual field. Prior
to presenting the target stimulus, he presented subjects with either a central or a
peripheral cue. Central cues appeared as an arrow, indicating the direction (either right or
left) that the target would appear relative to fixation. Central cues, although usually
presented centrally within a display, are termed as such because they are symbolic of
direction, which requires central processing by a person’s cognitive system in order to
interpret the meaning of that symbol (Styles, 1997). Unlike central cues, peripheral cues
appear outside fixation and are not symbolic of a particular direction. In fact, peripheral cues do not require interpretation because the cue itself indicates position directly. Posner presented a peripheral cue by illuminating the outline of one of a number of boxes that marked the possible location for the target.

In order to determine the extent to which visual cues could summon or direct a person’s attention, Posner manipulated the validity of the cues. For example, during certain trials Posner presented a cue that correctly indicated where the target would appear. In other trials, Posner presented subjects with an invalid cue that indicated a location different from the one where the target would appear. To assess the costs and benefits associated with valid and invalid cues, Posner included a control condition. During the control condition, Posner presented a cross in the center of the display that informed subjects the target was about to appear. Based on the data he collected, subjects reacted faster when presented with a valid cue than they did during the control condition. Posner et al. (1980) interpreted these results to suggest that subjects were able to use the cue to direct, or orient their attention. In contrast, when presented with an invalid cue, subjects reacted much slower than they did during the control condition, suggesting that a subject’s attention had moved in the wrong direction (Posner et al., 1980). By manipulating the validity of the cues, Posner established that valid cues could assist a person in directing their attention, regardless of whether that cue was central or peripheral.

S. Kaplan’s construal of attention falls right in line with the results obtained from the Posner et al. (1980) spatial cueing experiment. According to S. Kaplan (1995a), directed attention is a capacity that requires effort and that is subject to voluntary control.
In presenting subjects with both valid and invalid cues, Posner et al. (1980) was able to observe the effects those cues had on a person’s attentional resources. Valid cues elicited a very deliberate response from subjects. Subjects made a distinct decision about where to focus their attention in order to respond quickly to the presented target stimulus. For invalid cues, however, subjects reacted more slowly to the presented target. In such instances, the invalid cue acted as a source of distraction, placing more demand on that person’s attentional resources. In turn, a person would respond more slowly. S. Kaplan (1995a) suggested that a similar effect could occur when a person interacts with a setting that lacks extent, or a sense of connectedness. For these types of settings, stimuli perceived as fascinating are likely to serve as distractions. As a result, a person would have to exert more effort to block the distractions present in a setting.

For many studies, including those conducted by Posner, reaction time has served as an index for the amount of attentional resources and mental effort a person required or devoted to a particular task (Prinzmetal, McCool, & Park, 2005). From this perspective, people regularly distribute their attentional resources across different channels of input. The more attention allocated to one channel, the less of that resource remains available for an alternative channel. Consequently, with less attentional resources available, a person will most likely need more time to accomplish a set of alternative activities (Klimmt, Hartmann, Gysbers, & Vorderer, 2005). Although not always the case, slower reaction times are usually indicative of increased demand placed on a person’s attentional resources. Further review of the studies carried out by Posner et al. (1980) can provide additional insight on this issue.
In subsequent trials, Posner et al. (1980) demonstrated that there are in fact differences in the cueing effects for a central cue, and a cue that occurs within a subject’s periphery. In principle, ignoring a cue that is repeatedly invalid would be advantageous for a subject, as attending to that cue would likely be misleading and cause a person to react more slowly. Posner established that while a subject could ignore a central cue, a subject could not ignore a peripheral cue. By presenting subjects with cues that were only valid a small proportion of the time, Posner discovered that if a subject believed a central cue was invalid, they could ignore that cue without incurring a response time cost (Johnson & Proctor, 2004). Yet, if presented with an invalid peripheral cue and a subject had grounds to think the peripheral cue was invalid; a response time cost would still be incurred. Posner had shown that despite a subject’s intention to ignore peripheral cues, their attention would involuntarily shift toward the cued location. Understanding why certain types of cues lead to different forms of attention shifts lies in the nature of the cue itself.

Orienting studies, such as Posner’s, often used two distinct types of cues: central or peripheral cues. As mentioned, central cues appear at the point of fixation, and often indicate symbolically where the target is likely to appear. The presentation of a central cue (i.e. an arrow) required subjects to process and intentionally act upon that cue in order to have an effect. The arrow would inform a subject where to look for the target; however, that subject still had to consciously direct their attention toward the indicated location for an effect to take place. On the other hand, when presented with a peripheral cue, a subject’s attention shifted automatically because the cue provided no information for the subject to interpret. In this case, the stimulus, rather than the subject, drives
attentional orienting. Drawing on the data obtained from his study, Posner et al. (1980) proposed that there were two modes of controlling the same attentional orienting system: either through exogenous or endogenous control.

**Exogenous and endogenous control.** Research has shown that the allocation of attention is largely contingent upon two sources of control: exogenous and endogenous control (Jonides, 1981; Posner, et al., 1980). Attentional allocation occurring through exogenous control is stimulus-driven and based entirely on the salience of the features in a display. In this case, the specific intentions and task demands of the subject are irrelevant. This variety of attention is said to be involuntary and not under the control of the subject (Posner et al., 1980; Yantis & Jonides, 1984). Alternatively, endogenous control occurs when the deployment of attention is the direct result of the goals of the subject. Under endogenous control, a subject will allocate attention to stimuli that are task-relevant or important to that subject’s goals (Posner, 1980; Yantis & Egeth, 1999). Thus, psychologists have often thought that spatial and auditory shifts in attention can occur in one of two ways: either as an automatic and reflexive response to a salient stimulus or as voluntary process determined by factors from within the subject (Posner et al., 1980).

According to Posner (1980), these two varieties of attentional orienting reflected two modes of controlling the same attentional orienting system. Other psychologists however, have argued that instead of a single attentional orienting system controlled in different ways; there might in fact be two distinct control mechanisms (Muller & Findlay, 1988; Muller and Rabbit, 1989). Numerous studies have garnered a considerable amount of evidence in support of this position (Bacon & Egeth, 1994; Muller & Rabbit, 1989;
Yantis & Jonides, 1990). In a series of experiments conducted by Muller and Findlay (1988), they determined that there were different time courses for shifts in attention produced by peripheral and central cues. Attentional shifts produced by peripheral cues tended to be transient in nature, in that facilitation of processing at the cued location occurred almost immediately, but the effectiveness of the cue diminished rapidly (Muller & Findlay, 1988). For example, peripheral cues produced a fast and automatic response, with orienting to the cued location most effective when the cue preceded the target by 50-250 milliseconds (ms). When a peripheral cue preceded the target by more than 250 ms, a shift in attention could still occur, however facilitation at the cued location would diminish as inhibitory processes took effect.

Although the facilitatory effects for peripheral cues are generally automatic, there are situations in which this effect can reverse and become inhibitory (Muller & Findlay, 1989; Posner & Cohen, 1984). Psychologists often refer to this effect as inhibition of return (Johnson & Proctor, 2004; Styles, 1997). In trials where there is a delay of more than 250 ms between the presentation of the cue and the target, detection of the target by subjects slows down (Muller & Findlay, 1989). One possible explanation for why a person’s visual attention necessitates this kind of inhibition is that it allows for a person to efficiently scan the environment. That is, after directing attention toward the cued location, that location is mentally marked so that there is no need to return and search the location again. In the absence of such a record, a person’s search processes would continually be in danger of revisiting the same location repeatedly.

Although peripheral cues produced a relatively reflexive shift in attention, Muller and Findlay (1988) identified that a different type of attention shift occurred among
subjects when presented with a central cue. Attentional shifts produced from central cues tended to reach maximum facilitation only after 300 ms from cue onset. Despite this delayed shift in attention, processing at the cued location could persist for an extended period of time. Shifts in attention produced by central cues could survive even a substantial delay between the presentation of the cue and the target (Muller & Findlay, 1988). Unlike peripheral cues, central cues produced a more sustained shift in attention. As a result, psychologists considered sustained shifts in attention to be associated with voluntary control (Most & Simons, 2001; Muller & Findlay, 1989; Muller & Rabbit, 1989). Drawing from their results, Muller and Findlay (1988) contended that because peripheral and central cue effects had different time courses for shifts in attention, there were likely two separate orienting mechanisms at work.

In an attempt to further clarify and refine whether there was one attentional orienting system governed in different ways or two distinct attention mechanisms, Muller and Rabbit (1989) carried out a series of experiments that pitted central cues against peripheral cues. They designed an experiment in which they simultaneously presented subjects with both a central and peripheral cue (i.e., an arrow and a flash). Muller and Rabbit (1989) discovered that when they presented cues that would elicit both exogenous and endogenous orienting in the same display, the effects were additive if the cues were compatible and subtractive when cues were incompatible. That is, when the arrow and flash cued the same location, facilitation of processing was greater than if they had cued conflicting locations. Muller and Rabbit (1989) noticed that when the arrow and flash cued different locations, the peripheral cue interfered with the voluntary shift in attention more strongly than the central cue interfered with the reflexive shift in attention. Results
from their study are consistent with the notion of two independent attention mechanisms: one mechanism that is reflexive and resistant to competing stimuli (involuntary attention) and another that is voluntarily controlled and susceptible to interruption and fatigue (voluntary attention).

The study conducted by Muller and Rabbit (1989) serves as an excellent example for when involuntary shifts in attention can enhance a person’s ability to function effectively. Previous studies have primarily shown how involuntary shifts in attention can place increased demand on a person’s attentional resources. This however, is not always the case. As S. Kaplan (2001) so noted, settings that offer a person a sense of fascination, being away, extent, and compatibility can provide a person with the rest needed to recover from directed attention fatigue. Under those conditions, a person can function while using an alternative mode of attending; a mode of attending that will render the use of directed attention, a capacity that requires effort, temporarily unnecessary. Such was the case when Muller and Rabbit (1989) simultaneously presented subjects with central and peripheral cues that were compatible with each other. Identifying the types of stimuli that can elicit a person’s fascination, prompting a person to shift into an involuntary mode of attention is critical to the restoration process.

**Mystery**

The suggestion that there is more to see can be quite compelling for a person. In fact, many people find enjoyment in discovering what lies beyond the realm of their immediate perception. Intuitively, this makes good sense. Humans have a strong desire to know their environment (S. Kaplan & R. Kaplan, 1982). Thus, anything not yet known is likely of significant interest. Consider a partially obstructed view, a view typical of many
natural settings. These types of scenes give the impression that there is more to gain by going deeper into the setting. The possibility of acquiring new information captures a person’s interest, prompting that person to look more carefully through the leafy branches and slim tree trunks of the forest. The fact that the view is vaguely seen makes it all the more elusive, distant, and intriguing.

S. Kaplan (1987) initiated the use of the term “mystery” to define those settings that promised a person additional information. Under this interpretation, there is an element of prediction; a person has an expectation for the information he or she will acquire when venturing further into a setting. That capacity to predict, to anticipate what might come next, enables a person to cope with the uncertainty present within a setting. On occasion, a person may confront a circumstance in which one’s preconceived notion of what follows does not coincide with his or her immediate perception. In such instances, a setting more accurately embodies what some researchers call “surprise”, rather than mystery. The distinction between these two concepts is important to understand.

Surprise, consistent with some of the early conceptions of mystery, denotes a situation in which a person finds some aspect of a setting to be unexpected (Hubbard & Kimball, 1917). Although subtle, that distinction has a clear impact on the very essence of the term. Situations that present a person with information suddenly, and without warning can be potentially overwhelming. Without some sense of continuity, a person will likely have to pay attention more closely, and constantly evaluate their surroundings for potential threats. Settings that produce this sort of state of mind are likely to preclude a person from experiencing the type of fascination needed to rest his or her attentional
resources (S. Kaplan, 1987). A more detailed examination of the Kaplan’s use of mystery can bring further clarity to that concept.

Mystery indicates that additional information can be gained if a person goes deeper into a setting. Although the promise of additional information is a key component of Kaplan’s notion of mystery, the continuity between what a person sees and anticipates is equally important. When assessing a particular setting, a person will often consider what would happen if they were to proceed further into that setting (S. Kaplan & R. Kaplan, 1982). For a setting that is high in mystery, a person expects that the suggested new information, the character of that information, and the information immediately available are similar. In this way, the novelty of a setting is limited, which in turn provides a person with more control. That control allows a person to determine the rate at which he or she wants to experience and deal with new information. For a species that can easily become bored with the familiar and apprehensive with the strange, humans are likely to find settings that possess patterns of mystery to be close to their ideal.

Although the presence of mystery implies that there is uncertainty, the existence of that uncertainty is by no means beyond a person’s comprehension. In fact, the degree of uncertainty present in mystery is quite manageable, allowing a person to explore a range of possibilities. The curiosity evoked from these types of settings is often what makes mystery so fascinating and mind-filling. Authors achieve a similar effect when they incorporate elements of mystery into their fictional works. By presenting critical elements of story at particular points, an author makes it possible for a reader to develop various hypotheses about what might come next. If used effectively, the story compels a person to read page after page. In much the same way, a setting that is high in mystery
can provide the temptation needed to entice a person “a little farther” down the pathway. Achieving that effect in the context of a natural setting requires one to identify the critical physical properties that can enhance mystery.

**Attributes of Mystery**

In a study carried out by Gimblett et al. (1985), researchers desired to know whether people could perceive mystery in accordance with the Kaplans’ definition of the term. To the extent that goal was met, the researchers also aimed to identify the physical attributes that contributed to peoples’ perception of mystery in a given setting. The research design involved participants rating a series of photos on a five-point scale for the presence of mystery. Gimblett and his associates analyzed the results of the perception test through the use of arithmetic means, standard deviations, and a technique called multidimensional scaling. Each technique allowed the researchers to determine the agreement among participants’ ratings of mystery, as well as identify the physical attributes that contributed to their perceptions of mystery. The study revealed five physical attributes associated with mystery. A review of each attribute can better illustrate the relationship those attributes have with the Kaplans’ notion of mystery.

One of the more prominent attributes found in settings rated high for mystery was *screening*. Gimblett et al. (1985) defined screening as the degree to which a view of a larger setting is visually blocked. Key elements contributing to a setting’s screening of view include heavy shading and vegetation. In fact, vegetative screening consistently appeared in photos rated high for mystery (Gimblett et al., 1985). A view partially concealed by foliage entices a person to go deeper into a setting in order to explore the hidden, yet promised information. Conversely, photos in the study for which the
screening composition was less defined received lower mystery ratings. With less information hidden from view, opportunities for discovery and involvement declined.

The second attribute found to be associated with mystery was distance of view. According to Gimblett et al. (1985), distance of view refers to the amount of space between the viewer and the nearest forest stand. In the study, photos with an increased distance of view received lower ratings for mystery than their counterparts. Distance, as a physical attribute, involves both the involvement and promised information components of the mystery definition. A setting with an increased distance of view is likely to reduce a person’s opportunities for involvement. With a greater degree of openness there is often simplicity in the character of the land that fails to occupy a person’s mind. At the same time, increases in distance will often reduce the potential of screening. An unobstructed view offers little in the way of promised information. Although distance alone does not define mystery, the amount of space between a viewer and a particular area can strongly affect the strength or weakness of those attributes that enhance a setting’s mystery.

Another key attribute contributing to a setting’s perception of mystery is what Gimblett et al. (1985) called spatial definition. Spatial definition is the degree to which certain natural elements surround the viewer. Vertical elements, such as trees, can help define an area’s limits, providing a sense of enclosure. Wooded scenes that possess this quality often receive higher ratings for mystery. That sense of enclosure creates more opportunities for a person to be involved in a setting. Consider a setting in which there is a dense forest. With a decrease in distance of view and an increase in vegetative screening, an enclosed setting can offer a person additional information if simply by
changing his or her vantage point. That same effect is difficult to achieve in an ‘open’ setting which often presents a person with all of the information, leaving very little for that person to marvel.

In addition to screening, distance of view, and spatial definition, Gimblett et al. (1985) identified two other attributes associated with settings rated high in mystery. The first attribute, radiant forest, occurred only for special cases in which the immediate foreground of an area was shaded, while the background of that area appeared brightly lit. Settings possessing that characteristic often suggest there is more information to be gained, if only a person were to move closer to the nonshaded area. In these instances, the lighting of an area partially obstructed by foliage can capture a person’s interest, and compel that person to see what lies beyond the shaded confines of their immediate location. The second attribute, physical accessibility, refers to the apparent means of moving through or into a setting (Gimblett et al., 1985). The inclusion of a pathway or trail, especially those that bend or vanish in the distance, provides a person with a way to explore and acquire more information about that landscape. Each of the five attributes identified in the presented study plays an important role in enhancing the mystery of a setting.

The research conducted by Gimblett et al. (1985), provided support for the notion that mystery is a landscape quality that a person is capable of perceiving in natural settings. With that in mind, could a setting that possesses attributes associated with mystery provide certain cognitive benefits for a person? Current research has shown that people have a strong preference for settings that contain patterns of mystery (Herzog, 1984, 1987, 1989, 2007). In general, a preferred environment is one in which a person’s
abilities are more likely to function effectively, and that will also meet certain basic human needs. The literature suggests that mystery not only engages a person’s interest, but also can help satisfy a person’s need for involvement, a component presumed to elicit fascination. Although the relationship between mystery and landscape preference is well established, researchers have yet to investigate the influence that mystery may have on a person’s capacity to direct attention.

Conclusion

Recovery from fatigue is contingent on a person being able to rest his or her attentional resources (Cimprich, 1992; S. Kaplan, 2001). When the demands of a particular environment become too taxing, people intuitively seek out experiences and settings that place less strain on their mental capacities. For many people, including college students, interacting with nature provides a much-needed respite from the demands of the modern world. R. Kaplan and S. Kaplan (1989) have suggested that the rest and recovery of a person’s attentional resources can occur when a person interacts with a setting that offers a sense of being away, fascination, extent, and compatibility. Previous research has indicated that natural settings tend to possess each of those factors at high levels (Hartig et al., 1996). Even so, there are likely certain types of natural settings that are more supportive and effective at facilitating the restoration process than others.

A natural setting that a person perceives as fascinating could be a critical resource for resting attention. Fascination presumably calls on a person’s involuntary attention, a form of attention that is undemanding and effortless (S. Kaplan, 2001). As a person engages stimuli that he or she perceives as fascinating, demands on that person’s
attentional resources should diminish. The types of stimuli that people find fascinating revolve around certain kinds of cognitive contents and processes (S. Kaplan, 1978). For example, people often find the process of exploration, both visual and mental, to be fascinating. Informational activities such as these tend to arouse and sustain a person’s interest by promoting an increased sense of involvement. Some natural settings, however, are more equipped with the physical properties needed to elicit a person’s fascination.

A natural setting that contains patterns of mystery can compel a person to explore an area further by presenting only partial information about what lays ahead (S. Kaplan, 1987). Mystery refers to those features of a setting where a portion of the visual landscape is blocked, suggesting that additional information is available to a person who proceeds deeper into that setting. With the promise of additional information, a person will usually think of several alternative hypotheses as to what he or she might discover. These experiences in and of themselves can be quite involving, and mind-filling. As a result, settings that contain mystery may be more apt to elicit fascination, and could provide a person with certain cognitive benefits. In having a better understanding of the environmental patterns that enhance fascination, a college could more effectively design its campus and promote experiences that would enable students to rest their directed attention capacity.

To explore these possibilities, this study had four primary objectives. First, the study aimed to determine the effect that natural scenes, containing patterns of mystery, had on a student’s capacity to direct attention. Second, the study intended to examine the relationship between natural scenes that contained patterns of mystery and students’
perceptions of fascination for those settings. Third, the study planned to assess whether the effect that natural scenes, containing patterns of mystery, on a student’s capacity to direct attention was mediated by his or her perception of fascination. Finally, the study expected to examine the durational effects that natural scenes, containing patterns of mystery, had on a student’s capacity to direct attention.

The study proceeded from a variety of assumptions. First, the study operated under the assumption that college students are a population segment affected by directed attention fatigue. Second, the study assumed that recreational areas, such as a metro park or wilderness area, are both plausible and accessible resources that students utilize to find relief when in need of a mental break. Third, the study assumed that recovery from fatigue was contingent on a person being able to rest his or her directed attention capacity. Finally, the study assumed that students’ performance on a recognition memory task would be indicative of the attentional resources devoted or required for that task.

**Hypotheses**

Based on the presented literature review, the following hypotheses were tested.

**Hypothesis 1:** The duration of time for stimulus presentation will have a significant effect on participants’ recognition memory performance based on scene type.

**Hypothesis 2:** Nature scenes rated higher in perceived mystery will be associated with an increased rate of recognition memory performance.

**Hypothesis 3:** Nature scenes rated higher in perceived mystery will be associated with greater perceived fascination.

**Hypothesis 4:** Recognition memory performance will be mediated by differences in perceived fascination based on scene type.
CHAPTER III

METHODS

The purpose of this study was to examine the effect of mystery, mediated by perceptions of fascination, on college students’ capacity to direct attention. This chapter describes the methods employed to address and investigate that intention. The organization of the chapter includes seven main sections. These sections comprise: a) the study’s setting, b) the study’s participants, c) the study’s research design, d) the study’s measurement scales, e) the study’s research design procedures, f) the study’s procedures for data analysis, and g) an examination of the research design in terms of the potential threats to making valid inferences.

Setting

Data collection occurred on the University of Utah campus in the Department of Psychology’s Cognitive Science Laboratory. Utilizing the mass testing room of that laboratory, participants in the study took part in one of three experimental phases. For each experimental phase, participants were asked to complete a series of tasks that required some thinking and concentration. For example, participants were asked to follow instructions, solve simple math problems, complete various paper and pencil activities, memorize images, and respond to questions about those images.
Stimuli. Images used for the study consisted of scenes from various nature trails in the Columbus, Ohio metropolitan area. The deliberate use of trail landscapes was twofold. First, interactions with the natural environment often occur by way of a linear opportunity (trail) while on-site. As a result, presented images aimed to simulate the types of trail scenes people would likely encounter when visiting a natural area. On a more pragmatic note, trail landscapes tend to lend themselves to the design process. Identifying specific landscape qualities that have the potential to create a more rewarding visitor experience could be beneficial. For the purpose of this study, specific focus was devoted to examining the possible cognitive benefits associated with trail scenes that contained patterns of mystery. Mystery was defined as the extent to which a setting promised additional information, if one were to go deeper into that setting (Hammitt, 1980; S. Kaplan & R. Kaplan, 1982). In total, 160 images were obtained during the early spring season using a Cannon PowerShot SD100 Digital Camera. None of the images included people or the presence of water as each of those variables has been found to be powerful distractors (Herzog, 1984; S. Kaplan, & R. Kaplan, 1982).

Participants

The sample consisted of 229 introductory psychology students (113 males and 116 females) from the University of Utah. All students who participated in the study received partial course credit for their involvement. Participant ages ranged from 18 to 54 (M = 22, SD = 5.19) with the greatest percentage of participants being in their freshman year of college (35.8%). The collective sample of participants represented a wide variety of academic majors with 33.2 % of the participants majoring in psychology. Participant recruitment occurred through the Department of Psychology’s Human Subject
Pool. To assist in the recruitment process a brief description of the experiment was posted online and in the Department of Psychology. Only those students who registered through the Department of Psychology’s secure, online website were allowed to participate in the study. Under no circumstances were students excluded from participating because of gender, age, or other factors. All participants filled out a consent form prior to their involvement in the study (see Appendix A).

Research Design

Students who volunteered for the study participated in one of three experimental phases. Phase 1 of the experiment required participants to rate a series of images, comprised of natural settings, for the presence of mystery. In Phase 2 of the experiment, a different group of participants carried out a Recognition Memory Task (RMT) for images rated both high and low in perceived mystery. In the third and final phase of the study, another sample of college students evaluated each of the images used in the test portion of the RMT for perceived fascination. Utilizing an independent sample for each study phase avoided potential tautological problems that might have occurred from having a single sample rate images for certain physical qualities and then testing that sample’s recognition memory for the same images. A more detailed explanation of the research design for each study phase follows.

Phase 1. The basic design of Phase 1 involved presenting participants with a pool of 160 trail scene images in random order. For each image displayed on the computer, participants provided a response rating for mystery in accordance to Kaplan’s definition of that term. Although a participant’s assessment of each image was self-paced, the amount of time needed to make that assessment was recorded. The response ratings
obtained in Phase 1 of the study served as the basis for the categorization of images: high mystery settings and low mystery settings (Scene Type). In essence, the purpose of Phase 1 was to norm a set of images perceived to be high or low in mystery.

**Phase 2.** Using a 2 x 4 within-subjects experimental design, the RMT investigated the effect scene type (images perceived to be high in mystery vs. images perceived to be low in mystery) and presentation duration (300msec, 1 second, 5 seconds, or 10 seconds) had on a student’s recognition memory performance. Performance scores, such as those obtained through the use of a RMT, have often served as an indicator of the attentional resources required or devoted for that task. The use of presentation duration as an independent variable provided a means by which to simulate attentional demand and examine the extent to which certain type of images might evoke a more automatic form of attention.

Images presented at a given duration limit the amount of time for processing and maintenance (Towse & Hitch, 1995). As a result, when attention switches from one image to the next, a time-related decay will occur. The refreshing of these decaying memory traces necessitates their retrieval from memory through attentional focus. The rapid switching that occurs during processing places increased demand on one’s attentional resources. Interestingly enough, when the duration of a given task is held constant, as it was in this study, memory should vary as a function of the cognitive costs associated with a particular processing component (Barrouillet et al., 2004). The processing component for this study was the image presented on the computer screen. Limiting the amount of time subjects had to view each image in the RMT allowed for an unequivocal examination of the effect scene type had on a person’s capacity to direct
attention. The four presentation durations selected for this study represented a general range within which a person can process information.

**Phase 3.** For the third and final phase of the study, another independent sample of college students evaluated each of the images used in the test portion of the RMT for perceived fascination. Following a similar design to the one utilized in Phase 1, participants’ assessments for each image were self-paced. The amount of time it took a participant to make that assessment however was recorded. Scores for fascination were used to determine whether fascination was the generative mechanism through which the independent variable (scene type) influenced the dependent variable of interest (recognition memory performance). Once again, similar to Phase 1, the purpose of Phase 3 was to norm a set of images for perceived fascination.

**Measurement**

The study utilized three primary measurement tools to address the stated hypotheses. Initial effort focused on obtaining a set of images rated low for perceived mystery, and a set of images rated high for perceived mystery. To accomplish that goal, a group of participants were asked to rate each presented image based on the mystery component of the Kaplans’ (1982) information processing model of landscape preference. The study then examined the effect that scene type had on a person’s capacity to direct attention through the use of a RMT. Using a modified version of the Perceived Restorativeness Scale (PRS), a separate group of participants evaluated images included in the test portion of the RMT for perceived fascination. A description of each measurement tool follows.
Mystery rating. Using a 7-point Likert scale, participants indicated a response rating according to the Kaplans’ (1982) definition of mystery for each image displayed on the computer screen in Phase 1 (see Appendix B). Response ratings denoted the extent to which a setting promised more to be seen if you could have walked deeper into that setting (0 = not at all, 6 = Very much so). Digital images served as surrogates for the actual environments. Previous research has shown that the use of photographs as surrogates is a valid approach for assessing visual landscapes (Zube, Simcox, & Law, 1987). In a study conducted by Stamps (1990), on-site preference ratings yielded results similar to those obtained through photographic simulations. These types of findings would seem to suggest that photographs are indeed valid simulations for scenic assessment. In the few studies that have evaluated scenes for the presence of mystery, split-half reliability estimates have ranged from .64 to .98 (Gimblett et al., 1985; Herzog, 1989; Herzog & Smith, 1988).

In order to evaluate the reliability of this study’s scenic assessment for mystery, the final sample of participants in Phase 1 (n = 38) was divided into half-samples. For each half-sample set, mean mystery ratings for individual images were calculated. The two sets of mean ratings were then intercorrelated. Corrections to those correlations occurred through the use of the Spearman-Brown formula, which in turn yielded a split-half reliability coefficient. The reliability coefficient of the scenic assessment for mystery used in Phase 1 of the study was .64. Not only does that reliability estimate fall within the range of previous research, but also well within the conventional standards established by Guilford (1954) and Nunnally (1967).
The RMT was a two-part task designed to assess the demand that certain stimuli placed on a person’s capacity to direct attention. In the first part of the task, participants viewed 40 images, in which a computer screen displayed each image for a specific duration. The presented images represented one of two categories; either an image perceived to be low in mystery (coded as 0) or an image perceived to be high in mystery (coded as 1). In total, 20 images from each scene type were included in this portion of the RMT. Within the allotted time, participants attempted to study and memorize each image to the best of their ability.

During the test portion of the task, participants viewed the same 40 images randomly intermixed with 40 new images. Similar to the study portion of the RMT, the 40 new images included 20 images perceived to be low in mystery, and 20 images perceived to be high in mystery. For each image presented, participants decided whether or not an image was one they had previously seen (OLD, coded as 0) or an image that they were seeing for the first time (NEW, coded as 1). Participant responses yielded an accuracy score for each test image (0 = an image incorrectly identified, 1 = an image correctly identified). In order to obtain a measure of a participant’s recognition memory performance, both hit and false alarm rates were calculated.

Calculating participant hit rates involved tallying the number of “OLD” images correctly identified as “OLD” for each scene type and then dividing by the total number of “OLD” images studied from that scene type. For example, during the test portion of the RMT, a participant may have correctly identified 10 of the 20 “OLD” images categorized as low mystery and 15 of the 20 “OLD” images categorized as high mystery. This in turn would produce a 50% hit rate for low mystery images and a 75% hit rate for
high mystery images. Although obtaining participants’ hit rates is an important aspect in evaluating recognition memory performance, that measure of performance is incomplete without also calculating the false alarm rates.

To calculate the false alarm rates, a similar procedure was utilized; the total number of “NEW” images incorrectly identified as “OLD” for each scene type divided by the total number of “NEW” images from that scene type. For example, during the test portion of the RMT, a participant may have incorrectly identified 10 of the 20 “NEW” low mystery images as “OLD”, and only 5 of the 20 “NEW” high mystery images as “OLD”. The resulting scores would yield a 50% false alarm rate for low mystery images and 20% false alarm rate for high mystery images. Subtracting participants’ hit rates from their false alarm rates generates the corrected rate of recognition memory for both high and low mystery images. Participants’ corrected rate of recognition memory served as the dependent measure in the study, and from this point forward appears in the document as recognition memory performance.

In addition to assessing recognition memory performance, the RMT also provided a means by which to evaluate the strength of particular memory trace. If a participant responded that an image was “OLD” (meaning that it was presented during the study portion of the experiment), participants were then prompted to make a remember/know judgment for that image. A “REMEMBER” response (coded as 1) indicated that there was something specific a participant remembered about the test image. A “KNOW “ response (coded as 0) indicated that a participant could not recollect any contextual details for a test image, but possessed a sense of familiarity that allowed that participant to be reasonably confident that the test image was presented during the study session.
Corrected rates for both remember and know responses were also calculated. Although the test portion of the RMT was completely self-paced, reaction times for participant responses were also recorded. A sample screen capture of the RMT can be seen in Appendix C.

A few design issues are noteworthy. Using Adobe Flash and ActionScript programming, the research team created a total of 16 RMT programs. Originally, RMT programs differed solely on the basis of presentation duration; the amount of time an image appeared on the computer screen. To ensure that participants’ performance on the RMT was not merely an artifact of presenting certain images during the study portion of the task, images were counterbalanced across cell conditions. Thus, for each recognition memory task program that differed in presentation duration, there was also a Subset A and Subset B of that program. For example, in any given duration, half of the participants studied one set of 40 images (Subset A; images 1-40), and half of the participants studied the other set of 40 images (Subset B; images 41-80). During the test portion of the task, participants viewed all 80 images (Images 1-80). In addition, for each RMT program that differed in presentation duration and subset, there was also a “study” and “test” version of those programs.

**PRS (fascination).** The PRS is a scale designed to measure the qualities of restorative person-environment interactions. ART serves as the theoretical basis for the PRS (Hartig et al., 1996). Consequently, scale items have been designed with each of ART’s four factors in mind: fascination, being away, extent, and compatibility. In its full version, the PRS is comprised of 26 items. For each item, a participant indicates the extent to which the given statement describes the experience he or she is having while
viewing a presented landscape (0 = Not at all, 6 = Very much so). Given the intention of this study, participants provided responses for items that pertained exclusively to the fascination domain. Fascination has been defined as the perception of stimuli capable of attracting a person’s attention without effort (S. Kaplan, 1995a).

The original fascination subscale included 8 items. Cronbach reliability estimates for that scale have ranged from .83 to .93 across a variety of setting types (Hartig et al., 1996, 1997). This study utilized a shortened or modified version of the fascination subscale due to the large number of images participants were asked to rate. Hartig et al. (1997) analyzed the responses to each of the 26 PRS items through factor analysis. The researchers reported the factor loadings and item communalities for each ART domain. Based on those results, the fascination items selected for omission had either loaded on other ART factors, possessed substantial secondary loadings, or had represented content already addressed by a different item.

The modified version of the fascination subscale included a total of three items (see Appendix D). In the present study, a mean score on fascination for each image was calculated based on the sum average of a participant’s responses to each item. With a Cronbach’s alpha of .96, the modified fascination subscale demonstrated a high level of internal consistency.

Measures of Individual Differences

Due to an inability to randomly assign participants to experimental conditions, certain measures of individual differences were included as part of each phase of the study. Those measures included the Automated Operation Span Task (Aospan) and the Dissociative Experience Scale (DES). The Aospan is a task designed to assess a person’s
working memory capacity. The use of that task provided a measure by which to evaluate the attentional resources that a given person had available to them when carrying out a cognitively challenging task (Unsworth, Heitz, Schrock, Engle, 2005). The inclusion of the DES (See Appendix E) provided some additional insight into whether or not certain participants were predisposed toward fascination (Berstein & Putnam, 1986). Finally, the English Fluency and Task questionnaire, while not a cognitively based assessment, provided a measure from which to review questionable or confounding results (see Appendix F).

Research Design Procedures

To help ensure consistency across lab sessions, each experimenter received a set of written procedures for all three phases of the experiment (see Appendix G, H, and I). Each experimental phase ran in multiple lab sessions with 1-6 participants per session. Lab sessions lasted approximately 1½ hours and involved a series of tasks. When all of the participants had arrived for a given session, the experimenter distributed copies of the Consent Document to each participant. After reviewing that document aloud, participants had the opportunity to ask questions. Participants who returned a signed copy of the consent form received an assigned identification (ID) number for the study. Participants who did not wish to take part in the experiment proper but still desired to receive research credits for their undergraduate psychology course, as an alternative, read a published research article by Hartig et al. (1991). The following article helped to form the basis of the hypotheses for the study. In addition to reading that article, participants had to complete the Alternative Questions Sheet (Appendix J) to receive credit. To
maintain a degree of uniformity, all participants who signed up for a given lab session participated in the same experimental phase.

Once each participant had received an ID number, the experimenter distributed participant instructions for the experimental phase dedicated to that particular lab session (see Appendix K, L, and M). The experimenter read the instructions aloud, making sure to provide ample opportunity to answer any possible questions participants had about the forthcoming tasks. After participants had confirmed that they sufficiently understood the directions for the tasks they were about to undertake, participants were then instructed to continue on with the start of the experiment. Initial involvement required participants to fill in a series of demographic questions presented on a computer screen. When participants had completed this portion of the experiment, they clicked on an icon labeled NEXT which directed each participant to a screen that contained a brief instructional reminder for the upcoming task.

When all participants had indicated to the experimenter that they were ready to begin, they then clicked on the START icon. The “mystery rating” and “perceived fascination” portions of Phase 1 and Phase 3 lasted approximately 20-30 minutes. The RMT task used in Phase 2 lasted anywhere from 10-20 minutes. At the conclusion of each of those tasks, participants were given a short 2-3 minute rest break. Following that rest break, participants performed the Aospan. Once again, participants were asked to enter their ID number prior to starting. The task took participants between 15-20 minutes. As soon as a participant had completed that task, the experimenter recorded his/her results. All participants received a 2-3 minute break prior to moving onto the final portions of the experiment.
The final two tasks that each participant completed were the DES and English Fluency and Task Questionnaire. As paper and pencil activities, participants were instructed to write in their ID number in the spot provided. Each task took approximately 10 minutes or less to complete. When all participants had completed these portions of the experiment, the experimenter provided each participant with a debriefing form (see Appendix N). While the debriefing form provided student participants with a more thorough explanation of the study, it also provided an additional educational opportunity for those students who volunteered to participate in the psychology experiment.

Procedures for Data Analysis

To test each of the stated research hypotheses, two primary sets of analyses were performed on the data garnered from the study. The first set of analyses examined the effect that scene type and presentation duration had on participants’ recognition memory performance for images included in the RMT. The second set of analyses involved testing for mediation. Mediation testing helped to determine if participants’ performance on a RMT that included images rated high and low in perceived mystery was mediated by differences in participants’ perception of fascination for those settings. Findings from these analyses addressed both the potential link between mystery and attention, as well as the possible role perceived fascination played in that relationship.

ANOVA. Initial testing involved running a 2 x 4 Analysis of Variance (ANOVA) to determine the effect that scene type and presentation duration had on a participant’s recognition memory performance. Recognition memory was calculated by subtracting a participant’s hit rate from his or her false alarm rate for each scene type. Subsequently, the RMT provided two observations for each participant; a recognition memory
performance score for each scene type (low and high mystery images). In this case, the
unit of analysis is participant observations, rather than the participant per se. With
recognition memory performance as the dependent variable, and scene type and
presentation duration as fixed factors, a 2 x 4 ANOVA tested for main effects, and for a
possible interaction effect. Drawing on the results of that analysis, testing for mediation
occurred within durations in which scene type had a significant effect on recognition
memory performance; a necessary first step in testing for mediation.

**Multiple regression.** According to Kenny, Kashy, and Bolger (1998), testing for
mediation is a four-step process that involves running a series of regression equations.
Prior to running those equations, it was necessary to collapse the data down to a level
consistent across each of the three phases of the study. Although each phase of the study
utilized a different group of participants, participants viewed the same images. As a
result, testing for mediation at the image level was the most logical approach for data
analysis. In Phase 1 of the study, participants provided a response rating for mystery for
each image presented on the computer screen. Mean response ratings served as the basis
for the categorization of images: 40 high and 40 low mystery images (n = 80). Using a
similar method in Phase 3, participants provided a response rating for fascination for each
image depicted on the computer screen. Once again, data analysis involved calculating
the mean response rating for fascination for each image (n = 80). Participant
involvement in both Phase 1 and Phase 3 provided a means by which to norm a set of
images for mystery and fascination. The process of norming stimuli is a common practice
utilized within many cognitive studies.
In Phase 2, the RMT garnered performance scores that were participant-based. Consequently, data obtained from this phase of the study required collapsing in order to achieve a more palatable and uniform test of mediation. The collapsing of data obtained from the RMT required calculating the mean recognition performance score for each image. In order to accomplish that goal, data analysis involved treating participants as variables and each image as a single observation ($n = 80$).

Within a given duration, half of the participants viewed one subset of images (i.e., images 1-40; Subset A) at study while the other half viewed a different subset of images (i.e., images 41-80; Subset B) at study. Participants in “Subset A” provided the hit rate for images 1-40, and participants in “Subset B” provided the hit rate for images 41-80. To determine the hit rate of a given image, one simply divided the total number of hits (number of participants who correctly identified an Old image as Old) by the total number of participants within that specific subset. The resulting percentage represented the rate at which participants correctly identified that image as Old.

Regardless of a participant’s subset grouping, all participants viewed the same 80 images during the test portion of the RMT. As a result, participants in “Subset A” provided the false alarm rate for images 41-80, and participants in “Subset B” provided the false alarm rate for images 1-40. Determining the false alarm rate of a given image required following a similar procedure to the one utilized to calculate hit rates. To establish the mean recognition performance score for each image, one simply subtracted the hit rate of a given image from the false alarm rate of that image. The resulting mean performance score (recognition memory performance) for each image played an integral role in all steps of mediation testing.
In the first step for mediation testing, recognition memory performance served as the criterion variable and scene type as the predictor, to estimate the effect of scene type on recognition memory performance (see Path c in Figure 1). The underlying intention of the first regression equation is to establish that there is in fact an effect to mediate.

In second step, fascination served as the criterion variable and scene type as the predictor to estimate the effect of scene type on fascination (see Path a in Figure 2). In the third step, recognition memory performance is regressed on both scene type and fascination. This test examines whether there is a relationship between fascination and recognition memory performance (Path b), as well as provides an estimate of the relation between scene type and recognition memory performance when controlling for fascination (Path c’). If the relation between the predictor and the outcome variable is completely zero, when controlling for the mediating variable, then the data are consistent with a complete mediation model (Baron & Kenny, 1986). If the relation between the predictor and the outcome variable is significantly smaller when the mediator is included in the model (Path c’), than when it is not (Path c), then the data are consistent with partial mediation. To test the significance of the mediated effect, the fourth step according to Kenny et al. (1998), involves taking the product of Path a and Path b divided by the square root of its standard error term ($b^2sa^2 + a^2sb^2 + sa^2sb^2$). If the resulting z score is greater than 1.96, then the mediated effect is significant at the .05 level.

<table>
<thead>
<tr>
<th>Predictor Variable X</th>
<th>Outcome Variable Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g., Scene type; low mystery or high mystery)</td>
<td>(e.g., Recognition Memory)</td>
</tr>
</tbody>
</table>

Figure 1. Diagram of Path c in Mediation Model
Figure 2. Diagram of Complete Mediation Model

Note: Dummy coded; low mystery = 0, high mystery = 1
Threats to Making Valid Inferences

Within any study there is the likelihood that the inferences drawn, result from a cause other than the variable or variables studied. Tables 1, 2, and 3 present the potential threats to making valid inferences.
Table 1.

Threats to Internal Validity

<table>
<thead>
<tr>
<th>Threat</th>
<th>Controlled</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Partially</td>
<td>Events within each experimental phase were consistent across all groups.</td>
</tr>
<tr>
<td>Maturation</td>
<td>Yes</td>
<td>Due to the short duration of each experimental phase, maturation did not occur.</td>
</tr>
<tr>
<td>Testing</td>
<td>Yes</td>
<td>Each measurement tool was used only once.</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>Yes</td>
<td>The measurement tools utilized for each experimental phase have consistently produced results from which valid inferences may be made across a number of studies.</td>
</tr>
<tr>
<td>Statistical regression</td>
<td>Partially</td>
<td>Focus was on group differences (Scene Type).</td>
</tr>
<tr>
<td>Selection bias</td>
<td>Partially</td>
<td>Measures of individual differences assessed due to an inability to randomly assign participants to experimental groups.</td>
</tr>
<tr>
<td>Attrition</td>
<td>Yes</td>
<td>Due to the short duration of each experimental phase, attrition did not occur.</td>
</tr>
<tr>
<td>Diffusion of treatment</td>
<td>Yes</td>
<td>Participants performed tasks independent of other participants. Furthermore, interactions between participants during lab sessions were kept to minimum.</td>
</tr>
</tbody>
</table>
Table 2.

Threats to External Validity

<table>
<thead>
<tr>
<th>Threat</th>
<th>Controlled</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generality across subjects</td>
<td>Partially</td>
<td>Group differences were assessed.</td>
</tr>
<tr>
<td>Generality across settings</td>
<td>No</td>
<td>Only natural scenes containing trails were used for the study.</td>
</tr>
<tr>
<td>Generality across response</td>
<td>Unknown</td>
<td>Unknown.</td>
</tr>
<tr>
<td>Generality across time</td>
<td>Partially</td>
<td>Participation in the proposed study occurred on different days and at different times of the day.</td>
</tr>
<tr>
<td>Generality across behavior</td>
<td>No</td>
<td>Images were systematically selected based on physical attributes related to mystery.</td>
</tr>
<tr>
<td>change agents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactive experimental</td>
<td>No</td>
<td>Participants willingly volunteered to participate in the study.</td>
</tr>
<tr>
<td>arrangements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactive assessment</td>
<td>No</td>
<td>Participants were aware that their performance was being evaluated.</td>
</tr>
<tr>
<td>Pretest sensitization</td>
<td>Yes</td>
<td>No pretest was administered.</td>
</tr>
<tr>
<td>Multiple-treatment</td>
<td>Yes</td>
<td>Participants participated in only one of the three experimental phases.</td>
</tr>
<tr>
<td>interference</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.

Threats to Statistical Conclusions

<table>
<thead>
<tr>
<th>Threat</th>
<th>Controlled</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low statistical power</td>
<td>Yes</td>
<td>Adequate statistical power.</td>
</tr>
<tr>
<td>Violation of assumptions</td>
<td>Partially</td>
<td>Statistical assumptions were assessed.</td>
</tr>
<tr>
<td>Unreliability of measures</td>
<td>Yes</td>
<td>Reliability of measures were assessed.</td>
</tr>
<tr>
<td>Consistency of treatment implementation</td>
<td>Yes</td>
<td>Each experimenter underwent extensive training.</td>
</tr>
<tr>
<td>Random irrelevancies in the experimental setting</td>
<td>Partially</td>
<td>Experimenter noted irrelevancies when possible.</td>
</tr>
<tr>
<td>Random heterogeneity of subjects</td>
<td>Partially</td>
<td>Subjects were randomly assigned.</td>
</tr>
</tbody>
</table>
CHAPTER IV

RESULTS

This study examined the effect that natural settings, which contained patterns of mystery, mediated by the perception of fascination, had on college students’ capacity to direct attention. In order to address the study’s stated purpose, students participated in one of three experimental phases. Phase 1 of the study involved participants rating a series of images for the presence of mystery. Mystery ratings served as the basis for the categorization of images: images perceived as either high or low in mystery. In Phase 2, participants took part in a RMT in order to assess the demand that certain settings placed on a participant’s capacity to direct attention. The third and final phase of the study required a different group of participants to rate all images included in the test portion of the RMT for fascination. This chapter provides a summary of the results of data analysis for each phase of the study, including hypothesis testing.

Descriptive Statistics

Phase 1. The results obtained from Phase 1 provided a means by which to norm a set of images perceived to be either high or low in mystery. Results appeared in the form of point ratings for mystery for each image rated by a participant. The analysis of those results involved examining the arithmetic means and standard deviations for each image through rank order. Standard deviations served as a measure of consensus among
participants. Data analysis resulted in the selection of 80 images, 40 of which represented the highest ranked images (high mystery), and 40 of which represented the lowest ranked images (low mystery). An expert panel reviewed all images selected for the RMT in order to ensure images were both theoretically congruent and absent of any potential nuisance variables.

Table 4 presents the mean mystery rating for images within each scene type. The mean rating for images perceived low in mystery was 2.51 (SD = 0.16) on a 7-point scale. Based on that mean statistic, participants tended to perceive low mystery images as offering very little in the way of additional information. The mean response rating for images perceived as high mystery was 4.02 (SD = .30). In contrast, response ratings were positively skewed, indicating participants viewed high mystery images as offering more in the way of additional information if they were to go deeper into that setting. An independent samples t-test demonstrated significant differences in mystery ratings for each of the 80 images based on scene type [t (78) = 7.77, p < .01]. This test provided additional support for the validity of mystery as a perceivable attribute in trail scenes.

Table 4
Mean Mystery Rating for Images Grouped by Scene Type

<table>
<thead>
<tr>
<th>Scene Type</th>
<th>Mean</th>
<th>Std.</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Mystery</td>
<td>2.51</td>
<td>.165</td>
<td>-1.79</td>
<td>3.98</td>
</tr>
<tr>
<td>High Mystery</td>
<td>4.02</td>
<td>.30</td>
<td>1.52</td>
<td>2.04</td>
</tr>
<tr>
<td>Total</td>
<td>3.27</td>
<td>.80</td>
<td>.167</td>
<td>-1.48</td>
</tr>
</tbody>
</table>
Phase 2. In Phase 2, participants carried out a RMT for images obtained during Phase 1. The RMT provided a means to assess the demand that scene type and presentation duration had on a student’s capacity to direct attention. As shown in Table 5, participants’ recognition memory performance gradually increased with study time. At 300 msec, there was virtually no difference in participants’ recognition memory ($n = 288$, participant observations) for low mystery (.07) and high mystery (.08) images. With additional study time however, participants’ recognition memory performance began to separate at 1 second for low mystery (.08) and high mystery (.19) images. While increases in participants’ recognition performance continued for both high and low mystery images at the 5 second and 10 second durations, high mystery images tended to demonstrate more of an advantage across time.

Table 5

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>300ms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mystery</td>
<td>.071</td>
<td>.155</td>
<td>36</td>
</tr>
<tr>
<td>High Mystery</td>
<td>.081</td>
<td>.232</td>
<td>36</td>
</tr>
<tr>
<td><strong>1 second</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mystery</td>
<td>.081</td>
<td>.149</td>
<td>36</td>
</tr>
<tr>
<td>High Mystery</td>
<td>.193</td>
<td>.212</td>
<td>36</td>
</tr>
<tr>
<td><strong>5 second</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mystery</td>
<td>.121</td>
<td>.121</td>
<td>36</td>
</tr>
<tr>
<td>High Mystery</td>
<td>.322</td>
<td>.165</td>
<td>36</td>
</tr>
<tr>
<td><strong>10 second</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mystery</td>
<td>.267</td>
<td>.163</td>
<td>36</td>
</tr>
<tr>
<td>High Mystery</td>
<td>.476</td>
<td>.147</td>
<td>36</td>
</tr>
</tbody>
</table>
Remember-know responses. As part of the RMT, participants who identified an image as “Old” during the recognition test were then required to make a “remember-know” judgment for that image. The study devoted specific focus to remember responses, as this type of response represents a greater strength effect for a particular memory trace. Table 6 displays the rate of remember-know judgments as a function of presentation duration and scene type. An examination of that table reveals that at the 10 second duration, high mystery images (.48) elicited more remember responses than low mystery images (.36). Under all other conditions, there were very few noticeable differences in participants’ rate of remember responses for images seen at study. Among nonstudied images, participants were more likely to make a “remember” false alarm for a low mystery image, more so than a high mystery image in all presentation durations.

Table 6
Response Probability as a Function of Presentation Duration and Scene

<table>
<thead>
<tr>
<th>Duration</th>
<th>Hits (studied images)</th>
<th>False alarms (non-studied images)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Mystery</td>
<td>High Mystery</td>
</tr>
<tr>
<td>300 msec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember</td>
<td>.207</td>
<td>.204</td>
</tr>
<tr>
<td>Know</td>
<td>.335</td>
<td>.214</td>
</tr>
<tr>
<td>1 second</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember</td>
<td>.292</td>
<td>.269</td>
</tr>
<tr>
<td>Know</td>
<td>.304</td>
<td>.249</td>
</tr>
<tr>
<td>5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember</td>
<td>.340</td>
<td>.351</td>
</tr>
<tr>
<td>Know</td>
<td>.310</td>
<td>.258</td>
</tr>
<tr>
<td>10 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember</td>
<td>.356</td>
<td>.478</td>
</tr>
<tr>
<td>Know</td>
<td>.338</td>
<td>.213</td>
</tr>
</tbody>
</table>
Phase 3. Similar to Phase 1, the purpose of Phase 3 was to norm a set of images for a given variable. In Phase 3, participants rated images selected for the RMT (n = 80) for perceived fascination. In order to determine the mean score on fascination for each image, the sum average of participants’ responses to the three fascination items was calculated. With a Cronbach’s alpha of .96, the modified fascination subscale demonstrated a high level of internal consistency among the set of items used for this phase of the study. Table 7 presents the mean fascination rating calculated for each scene type. Low mystery (low mystery = 2.59, SD = 1.33) images tended to receive a lower rating of fascination in comparison to images categorized as high mystery (high mystery = 3.11, SD = 1.24). These findings support the proposed relationships presented in the restorative environment literature. That relationship suggests that settings perceived to be high in mystery offer a person more to think about, which subsequently enhances their overall involvement and is more likely to elicit fascination.

Table 7
Mean Fascination Rating for Images Grouped by Scene Type

<table>
<thead>
<tr>
<th>Scene Type</th>
<th>Mean</th>
<th>Std.</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Mystery</td>
<td>2.59</td>
<td>1.33</td>
<td>.458</td>
<td>-.151</td>
</tr>
<tr>
<td>apartment (n = 40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Mystery</td>
<td>3.11</td>
<td>1.24</td>
<td>.037</td>
<td>-.525</td>
</tr>
<tr>
<td>apartment (n = 40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.85</td>
<td>1.31</td>
<td>.207</td>
<td>-.498</td>
</tr>
</tbody>
</table>
Measures of individual differences. Recognizing that people possess certain innate qualities that could influence their performance on a cognitively challenging task, two measures of individual differences were included as part of the experiment proper in each phase of the study. Those measures were the Aopsan and the DES. Participants’ mean scores on both the Aopsan and DES were comparable across each study phase. A correlational analysis indicated that there was no significant relationship between each of the individual difference measures and participants’ recognition memory performance, participants’ perception of fascination, or perception of mystery. These results suggest that despite different participants in each study phase, certain similarities existed within the same sample of college students.

Hypothesis Testing

ANOVA. The data collected from students’ involvement in a RMT provided a way to assess the demand that certain types of settings place on a person’s attentional resources. The evaluation of that effect occurred through a 2 (scene type: high and low mystery) x 4 (presentation duration: 300 msec, 1 second, 5 seconds, and 10 seconds) analysis of variance (ANOVA) on participants’ recognition memory performance. Participant observations served as the unit of analysis (n = 288). The criterion of significance, unless noted otherwise, was .05.

As predicted, a 2 (Scene type) x 4 (Presentation duration) ANOVA on participants’ recognition memory performance produced a significant interaction effect, F(3, 288) = 5.34, p < .05. Table 8 presents the summary of ANOVA results. The model as a whole, including both main effects and the interaction effect, accounted for 39.2% of the variance in participants’ recognition memory (R² = .392). In order to better
Table 8

Summary of ANOVA Results: Recognition Memory Performance

<table>
<thead>
<tr>
<th></th>
<th>SS</th>
<th>Df</th>
<th>MS</th>
<th>F</th>
<th>( \rho )</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Treatments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scene Type</td>
<td>1.28</td>
<td>1</td>
<td>1.28</td>
<td>43.54</td>
<td>&lt; .000</td>
<td>.135</td>
</tr>
<tr>
<td>Duration</td>
<td>3.55</td>
<td>3</td>
<td>1.18</td>
<td>40.26</td>
<td>&lt; .000</td>
<td>.301</td>
</tr>
<tr>
<td>Scene Type*Duration</td>
<td>.471</td>
<td>3</td>
<td>.157</td>
<td>5.34</td>
<td>&lt; .01</td>
<td>.054</td>
</tr>
<tr>
<td>Within Treatments</td>
<td>8.23</td>
<td>280</td>
<td>.029</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25.22</td>
<td>288</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ R^2 = .392 \]

understand the nature of the interaction effect, a follow-up analysis examined the simple main effects within the model. Results from that analysis indicated that differences in participants’ recognition memory at the 5 second duration based on scene type were significant, \( F(1, 280) = 24.83, p < .05 \). Participants’ involvement in the RMT produced a similar simple main effect at the 10 sec duration as well. With no significant differences found at the faster durations (i.e. 300 msec, 1 second), tests for mediation occurred on only the 5 second and 10 second durations. Overall, these results suggest that a person may not require as much time with high mystery images to obtain a level of performance consistent with low mystery images at longer durations.

Testing for mediation. Following Kenny et al. (1998), a series of regression equations were run in order to test for mediation. At the 5 second duration, the first equation regressed the outcome variable (recognition memory performance) on the predictor variable (scene type) to determine if there was an effect to mediate. As predicted, the unstandardized regression coefficient (\( B = .199 \)) associated with the effect of scene type on recognition memory (Path c) was significant (\( p < .001 \)). Having met the first requirement for mediation, a second regression equation assessed the effect of scene
type on fascination. The unstandardized regression coefficient ($B = .519$) associated with this relationship was also significant ($p < .001$), satisfying the second requirement for mediation. To test whether a relationship existed between fascination and recognition memory, recognition memory was regressed simultaneously on both fascination and scene type. The resulting coefficient associated with the relationship between fascination and recognition memory (when controlling for scene type) was significant ($B = .205, p < .001$). Based on that result, the third step needed for mediation was also satisfied. Table 9 contains each of the analyses utilized to establish mediation.

The third regression equation provided an estimate of the relationship between scene type and mean recognition, when controlling for fascination (Path $c'$). Although the path of that relationship was not 0, but rather .01, the model is representative of full mediation. As is the case in this example, perceived fascination had a mediating effect

Table 9

Testing for Mediation Through Multiple Regression (5 second duration)

<table>
<thead>
<tr>
<th>Testing Steps in Mediation Model</th>
<th>B</th>
<th>SE B</th>
<th>95% CI</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing Step 1 (Path c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Corrected Recognition</td>
<td>.199</td>
<td>.045</td>
<td>.108, .289</td>
<td>.20**</td>
</tr>
<tr>
<td>Predictor: SceneType</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing Step 2 (Path a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Fascination</td>
<td>.519</td>
<td>.077</td>
<td>.365, .673</td>
<td>.37**</td>
</tr>
<tr>
<td>Predictor: SceneType</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing Step 3 (Path b and c')</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Corrected Recognition</td>
<td>.293</td>
<td>.058</td>
<td>.178, .408</td>
<td>.40**</td>
</tr>
<tr>
<td>Mediator: Fascination (Path b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predictor: SceneType</td>
<td>.047</td>
<td>.050</td>
<td>-.052, .145</td>
<td>.01</td>
</tr>
</tbody>
</table>

** $p < .001$
on recognition memory performance. To estimate the significance of that effect, the product of Path a and Path b, divided by a standard error term yielded a z score of 4.22. According to Kenny et al. (1998), z scores greater than 1.96 are significant at the .05 level. Based on this parameter, the reduction from .199 to .047 (i.e., from c to c’) was significant, thereby demonstrating that fascination is indeed a potent mediating variable.

Data garnered from participants’ involvement in an RMT indicated that there were significant differences in participants’ recognition memory scores based on scene type at the 10 second duration. As a result, a test for mediation occurred for this duration as well. Table 10 presents each analysis conducted to establish mediation. In the first regression equation, the unstandardized regression coefficient (B = .196) associated with the effect of scene type on recognition memory was significant (p < .001). Having met this initial requirement for mediation, a second regression equation found that the

Table 10

<table>
<thead>
<tr>
<th>Testing Steps in Mediation Model</th>
<th>B</th>
<th>SE B</th>
<th>95% CI</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing Step 1 (Path c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Corrected Recognition</td>
<td>.196</td>
<td>.047</td>
<td>.102, .291</td>
<td>.18**</td>
</tr>
<tr>
<td>Predictor: SceneType</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing Step 2 (Path a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Fascination</td>
<td>.519</td>
<td>.077</td>
<td>.365, .673</td>
<td>.37**</td>
</tr>
<tr>
<td>Predictor: SceneType</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing Step 3 (Path b and c’)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome: Corrected Recognition</td>
<td>.215</td>
<td>.065</td>
<td>.060, .350</td>
<td>.28**</td>
</tr>
<tr>
<td>Mediator: Fascination (Path b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predictor: SceneType</td>
<td>.085</td>
<td>.056</td>
<td>-.027, .196</td>
<td>.03</td>
</tr>
</tbody>
</table>

** p < .001
unstandardized regression coefficient (B = .519) associated with effect of scene type on fascination was again significant (p < .001). In the final regression equation, the effect of fascination on recognition when controlling for scene type yielded a significant effect (B = .215, p < .01). Estimates of the mediating effect resulted in a z score of 3.03, which indicates that fascination is an effective mediator in the 10 second duration as well.

Table 11 presents a summary of the results from hypothesis testing. The results obtained from the various analyses suggest that within the study, settings perceived as being high in mystery offered participants certain attention related benefits. Tests for mediation established that the effect of scene type (high vs. low mystery settings) on recognition memory performance was almost fully mediated by differences in perceived fascination for natural scenes presented in the RMT under specific durational conditions. In other words, perceptions of fascination provided, to an extent, an explanation for the effects that mystery had on recognition memory performance for the RMT, a task that requires the capacity to direct attention.
Table 11
Summary of Hypothesis Test Results

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H$_1$</strong> The duration of time for stimulus presentation will have a</td>
<td>Null Rejected</td>
</tr>
<tr>
<td>significant effect on participants’ recognition memory performance based</td>
<td></td>
</tr>
<tr>
<td>on scene type.</td>
<td></td>
</tr>
<tr>
<td><strong>H$_2$</strong> Nature scenes rated higher in perceived mystery will be</td>
<td>Null Rejected</td>
</tr>
<tr>
<td>associated with an increased rate of recognition memory performance.</td>
<td></td>
</tr>
<tr>
<td><strong>H$_3$</strong> Nature scenes rated higher in perceived mystery will be</td>
<td>Null Rejected</td>
</tr>
<tr>
<td>associated with greater perceived fascination.</td>
<td></td>
</tr>
<tr>
<td><strong>H$_4$</strong> Recognition memory performance will be mediated by differences</td>
<td>Null Rejected</td>
</tr>
<tr>
<td>in perceived fascination based on scene type.</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER V

DISCUSSION

Although still in its infancy, research on restorative environments has amassed a considerable amount of evidence in support of the benefits that natural settings can have on a person’s capacity to focus or direct attention. Hartig et al. (1991) found that natural settings offered a restorative advantage over urban settings when comparing participant scores on a proofreading task. Other researchers have shown that there is a strong positive relationship between the amount of nature viewed from a student’s dormitory window and a student’s performance on a series of attention-related tests (Tennessen & Cimprich, 1995). In addition, there have been a number of other studies documenting the restorative effects that interactions with nature can have on cognitive functioning (Berman, Jonides, & Kaplan, 2008; Betro, 2005; Hartig, Evans, Jamner, Davis, & Garling, 2003). ART, developed by S. Kaplan (1995a), has served as the theoretical framework guiding much of the research in this area.

In this study, ART provided a theoretical framework from which to examine the effect of mystery on attention. Natural settings that contain patterns of mystery tend to arouse people’s interest and enhance their sense of involvement in a setting (S. Kaplan, 1978). A sense of involvement plays an important role in eliciting a person’s fascination, a critical component of ART (Cimprich, 1992; Felsten, 2009; Kaplan, 1995a). With that in mind, this study investigated the effect of mystery, mediated by fascination, on
students’ capacity to direct attention. Results from participants’ involvement in a Recognition Memory Task (RMT) demonstrated that images rated high in perceived mystery offered attention-related advantages over images rated low in perceived mystery for certain durational conditions. This chapter discusses the results of the study in more detail, the theoretical implications, the limitations to the study, as well as directions for future research.

**Interpretation of Results**

According to ART, recovery from directed attention fatigue is contingent upon a person being able to rest his/her directed attention capacity, a capacity that requires effort (S. Kaplan, 1995a). One approach to resting directed attention is to interact with settings that minimize the demands on that capacity. Without question, there are certain types of settings more effective than others at facilitating the rest needed to restore directed attention. Previous studies have centered on this very premise by comparing the restorative effects of both urban and natural settings. For many people, natural settings serve as a source of rest and escape when the stresses of urban life become too demanding. Research has not ignored this human proclivity. With its rough and elusive topography, an abundance of greenery, and the presence of wildlife, natural settings offer a person a variety of rich and captivating stimuli. Such sources of interest presumably elicit a person’s fascination and allow that person to function without placing demand on his or her attentional resources (S. Kaplan, 1995a). All natural settings, however, are not equal.

In this study, the RMT provided a means by which to assess the cognitive costs associated with certain types of natural settings. More specifically, the RMT offered an
opportunity to investigate the extent to which nature scenes containing patterns of
mystery could elicit fascination and evoke a more automatic or effortless form of
attention. An alternative form of attention that occurs effortlessly is fundamental to ART
in that it provides a basis from which to rest a depleted attentional system (Berman et al.,
2008; S. Kaplan, 1995a). The use of presentation duration in conjunction with the RMT
helped to determine whether or not the processing of presented nature scenes was more
automatic (effortless) or under deliberate conscious control (effortful).

The present study proceeded with the expectation that nature scenes perceived
high in mystery would offer the greatest attention advantages, as these types of scenes are
theoretically more likely to evoke a form of attention that is effortless. Nature scenes
presented at the 300 msec duration provided the best prospect to investigate and test this
notion. At faster durations, processing often reflects more of an automatic or effortless
response. Consequently, there was a strong belief that at faster durations, images
presumed to evoke an effortless form of attention would outperform images that would
seemingly place more demand on a person’s attentional resources.

At the 300 msec duration, participants achieved similar recognition memory
performance scores on the RMT for both low mystery and high mystery images. These
results would seem to indicate that at this duration, the processing of images, regardless
of scene type, relied on a form of attention that was very much top-down oriented. That
is, recognition performance for both scene types required the expenditure of mental
effort. This initial evaluation of the effect that scene type had on a person’s capacity to
direct attention demonstrated that images perceived high in mystery did not truly call
upon a form of attention that was effortless as believed. A closer review of ART offers a
potential explanation for the outcome produced from participants’ involvement in the RMT at this duration.

ART asserts that the restoration will occur to the extent that the person-environment interaction allows a person to feel a sense of fascination, being away, extent, and compatibility (S. Kaplan, 1995a). While fascination has long been thought to provide the basis for resting attention, fascination is only one of four interrelated properties needed to supply the rest that is so critical to a restorative experience (Hartig, et al., 1997; R. Kaplan & S. Kaplan, 1989). In many cases, researchers often view being away as a necessary first condition for the rest and recovery of directed attention (Hartig et al., 1997). Being away requires obtaining both physical and cognitive distance from those aspects placing demand on directed attention. With only 300 msec to view an image during the study portion for this durational condition of the RMT, participants were likely to have difficulty establishing the cognitive distance needed to free themselves from the demands occupying the mind. In turn, the demands on a person’s attentional resources would have precluded that person from allowing fascination to come into function. While eliciting a person’s fascination is likely critical to resting and restoring attention, maintaining that fascination over time is just as important to the process.

In order to sustain a person’s fascination, ART suggests that the person-environment interaction must also offer a sense of extent (Kaplan, 2001; Staats, Kieviet, Hartig, 2003). Settings that have a sense of extent imply that they are both rich and coherent enough to comprise a “whole other world” (Kaplan, 1995a, p.173). With so much to see and experience, a setting that has sufficient content and structure can allow
one to remain engaged. That sustained level of engagement is critical to the restorative experience in that it allows fascination to remain in use. Once again, presenting images at a rate of 300 msec likely did not provide an adequate amount of time for a person to readily organize and explore the elements of the immediately perceived image. Subsequently, there would have been little opportunity for each image to capture a person’s fascination, let alone sustain that fascination over time.

The final restorative property considered to play a role in resting attention is compatibility. Compatibility refers to the degree to which a person’s inclinations and the demands or requirements of a given setting support the intended activity (Hartig et al., 1996; R. Kaplan & S. Kaplan, 1989). As part of the RMT, the participants’ task or goal was to memorize to the best of their ability the nature images presented to them on a computer screen. At 300 msec, there was likely a lack of fit between participants’ inclinations and the duration of time for which information was available to support the intended activity; to correctly identify images previously viewed during the study portion of the RMT. In this case, the presentation duration for each image served as a major environmental limitation to carrying out the defined task. The lack of compatibility not only undermined the intentions of the participants, but also required participants to expend a considerable amount of mental effort, evidenced by the low performance scores for the 300 msec duration of the RMT.

In addition to the explanation that ART may offer, intuitively one might expect that the type of rest needed to restore attention would require a more meaningful experience. Realistically, there are few scenarios wherein a person’s exposure to a setting is for a mere fraction of a second. More often than not, a person has ample time
to both physically and/or perceptually explore his or her surroundings. Through that act of exploration there is a greater likelihood the mind will become involved and fascinated with its surroundings. That level of fascination is presumably beneficial, whether a person is attempting to carry out a recognition memory task, or trying to escape the demands of daily life. Here in lies a critical point. Although no one setting can provide restorative benefits indefinitely, it is also likely that human-nature interactions must also be of sufficient duration in order for a person to realize the benefits of those interactions. Given this notion, images presented at longer durations during the RMT perhaps represented a condition more theoretically aligned with all of ART’s properties.

By increasing the duration of time participants had to study a given image from 300 msec to 1 sec, performance scores for each scene type improved. Naturally, one would expect to see an improvement in recognition performance as a result of having additional time to study each image. With additional time to study each image, participants had more time to purposively direct their attention to encode each image into memory. If all things were equal among presented images, then participants’ recognition performance for both scene types would have likely increased at the same rate. In contrast, performance scores for the 1 sec duration of the RMT demonstrated more of a distinction between low mystery and high mystery images than they did at the 300 msec duration. Though the results obtained were not statistically significant, they provided the origin of an evolving trend within the data.

In both the 5 sec and 10 sec durations of the RMT, participants’ recognition memory once again improved for each scene type. Unlike previous durations though, participants performed significantly better on high mystery images than they did on low
mystery images. These results highlight two key observations. First, the data clearly showed that participants received some benefit from having additional time to study and focus on each image, as performance scores on the RMT improved for both scene types. That improvement was to an extent derived from the mental effort participants invested as a result of having additional time to study each image. After all, longer presentation durations represent conditions more in line with controlled processing; a form of processing that requires effort. Although the results obtained during each of these durations revealed that participants exerted some level of mental effort, the data also reflected characteristics consistent with a form of processing that is less demanding; a second important observation to emerge from the data.

At each of these later durations, participants performed significantly better on images perceived high in mystery than they did on images perceived low in mystery. When variations of this sort occur, they are generally due to the cognitive costs associated with the particular processing component (Barrouillet et al., 2004). Images perceived high in mystery provided a number of hidden views that perhaps enticed participants to explore the area of those images further. In these instances, the processing of an image was not solely the result of the mental effort a person expended, but also driven by the patterns present within that image. Under the right conditions, this form of bottom-up processing can place less demand on a person’s attentional resources. Consider the results obtained from participants’ involvement in the 5 sec and 10 sec durations of the RMT. For each of these durational conditions, images perceived high in mystery appeared to have an additive effect on a person’s recognition performance. The
contextual details present within these images were likely not only compatible with the participants’ goal for that duration of the RMT, but also inherently interesting.

According to ART, some source of interest or fascination is vital to the restorative experience (R. Kaplan & S. Kaplan, 1989). For many daily tasks, a person must willfully direct their focus in order to block out distractions. On other occasions, that same person may find that the interest inherent within the immediate environment is enough to guide his or her behavior. Given this, researchers have contended that stimuli perceived as fascinating tend to evoke an effortless form of attention, enabling a person to rest directed attention (Betro, Massaccesi, & Pasini, 2008; S. Kaplan, 1995a). Although the data garnered from the RMT did not completely correspond with this notion, performance scores on high mystery images indicated that a less effortful form of processing was also in play.

Tests for mediation provided a means by which to examine the role measured fascination played in mediating the effects between scene type and recognition performance. Initial results of that analysis established scene type as a significant predictor of participants’ performance on the RMT for both the 5 sec and 10 sec durations. These results by themselves, however, offer little insight into understanding the nature of the relation between scene type and recognition performance. As a result, the second step in testing for mediation involved examining the relationship between scene type and fascination. In the present study, images perceived high in mystery were found to be associated with higher ratings of fascination. That finding not only supported earlier work that has theorized about such a link between the two variables (S. Kaplan, 1978), but also satisfies an important condition needed for mediation. In the final step of
the mediation analysis, when controlling for participants’ perception of fascination, scene
type was no longer associated with recognition performance in each of the two durations.
These results are consistent with the notion that perceptions of fascination fully mediated
the effects of scene type on recognition performance.

As a mediator then, fascination helps to explain how and why certain physical
attributes within the presented images take on more internal significance for a person.
Humans have long had an interest in opportunities to discover that which is just beyond
their realm. A trail that meanders around a bend can create a circumstance of
uncertainty, allowing a person to develop a set of predictions about what might lie ahead.
These types of informational activities tend to capture a person’s interest and can serve as
a source of attraction. In addition to keeping a person from getting bored, researchers
contend that interactions of this sort produce an attentional shift, allowing a person to rely
on a form of attention that is effortless. Although the results clearly suggest the
importance of fascination in mediating the effects between scene type and recognition
performance, they do not completely reflect a conception of attention that is effortless.
With that in mind, the findings obtained from the study may contribute to a deeper
theoretical understanding of fascination as a restorative property.

Theoretical Implications

The significance of fascination, as a restorative property, stems from William
James’ (1892) delineation between two forms of attention; one that he referred to as
voluntary, and another that he had termed involuntary. According to James, the latter
form is a mode of attending that occurs without effort and is the result of stimuli
perceived to be interesting or fascinating. Drawing on this conception of attention, S.
Kaplan (1995a) adopted the term fascination and ventured to assume that a person who was in an involuntary or effortless mode of attending would be able to rest the more effortful form of attention. The evidence garnered from the 5 sec and 10 sec durations of the RMT indicated that images perceived high in mystery evoked both top-down and bottom-up processing among participants. While that finding may initially appear in opposition to the notion of fascination often identified within the literature (S. Kaplan, 1995a; Wells, 2000), there is, in point of fact, some existing synergies.

Researchers have often conceptualized fascination along a dimension that varies from soft to hard (Berto et al., 2008; Herzog et al., 1997; S. Kaplan, 1995a). Hard fascination exemplifies those situations in which the stimuli in the environment are so intense they rivet a person’s attention, leaving little opportunity for contemplation. Events such as auto racing have often typified this form of fascination. In such cases, shifts in attention are likely more immediate as the experience or stimuli that are present tend to consume a person completely. Soft fascination, on the other hand, reflects those circumstances in which the hold on a person’s attention is more modest, so as to not preclude a person from thought. Implicit within this notion of fascination is the understanding that a person is capable of exercising some volition over where she or he may be directing focus. From this perspective, the significance of fascination as a restorative property may not rely on the absence of mental effort, but rather the kind of effort a person may be expending.

In today’s society, there is a great deal of disparity between what a person deems important and what person finds interesting. As a result of that disparity, the kind of mental effort a person must exert for many daily tasks is often more top-down oriented.
That is, the processing of information is largely the result of a person allocating certain attentional resources that are of a limited capacity. Despite the prevalence of this form of processing, there are a number of other instances throughout a given day in which the actions of a person are more effortless in nature. For example, there are certain sensorimotor tasks that require little to no attention at all from a person, relying instead on more automatic control (i.e., reacting to the ringing of a phone). While there is no doubt that each mode of attention may at times oppose the other, there are also circumstances in which each may be mutually enhancing.

A comparison of recognition performance scores across all durations showed that while participants benefited from having additional time to study an image, the advantages were often far greater for high mystery images. Based on the data obtained, participants did not have to spend as much time viewing images perceived high in mystery to obtain the same level of performance they achieved for images perceived low in mystery at longer durations. In essence, participants were able to get more return on their investment of attention for images perceived high in mystery. This may in fact create the illusion that certain images are less demanding, or even effortless. Regardless, the type of processing employed by participants was neither fully controlled (effortful), nor fully automatic (effortless). Rather, the type of mental effort expended by participants reflected a degree of attentional resonance between both forms of processing; processing driven by the goal of the task, and processing guided by certain scenic qualities present within the images.

Images perceived high in mystery often contained hidden views that encouraged participants to look more carefully. As a result, participants were more inclined to
experience a greater depth of processing for these types of stimuli. A review of participants’ Remember/Know responses supports this notion (See Table 6). In each of the presentation durations, images perceived high in mystery tended to elicit more remember responses than images perceived low in mystery. While deeper levels of processing often suggest the exertion of mental effort, these results may also demonstrate the extent to which a person’s capacity to direct attention can become more fully engaged when viewing certain stimuli of interest. In this way, fascination may more accurately represent the perception of stimuli of interest that resonate with a person’s attention, allowing that capacity to become more fully engaged.

At one point or another, everyone has likely had such an experience of fascination. These types of experiences most often take place when a person faces an engaging, but enjoyable activity or setting. In these situations, the stimuli present within a setting are not so significant to preclude a person’s ability from making sense of his or her surroundings. What's more, the stimuli are also interesting enough to maintain a person’s involvement and keep that person from getting bored. The match between making sense and involvement enables a person to enter into a state of exceptionally focused, yet seemingly effortless attention. In many ways, the relationship outlined between making sense and involvement with respect to fascination parallels that of challenge and skill in discussions on flow. Interestingly enough, Nakamura and Csikszentmihalyi (2002) have often described flow as a state in which explicit and implicit control systems achieve an optimum level of balance. Under these types of conditions, conscious attention becomes even more engaged as performance may tend to
feel increasingly effortless. For many people, interactions with nature can often elicit a similar sensation.

Nature can often provide a person with a number of rich and aesthetically pleasing scenes. These types of interactions tend to invoke a person’s attention more modestly, which in turn allows a person to utilize the interest inherent with a setting to meet certain intentions. For that reason alone, many people may seek out natural settings when in need of a break. The advantages these types of settings may offer are not necessarily due to an absence of mental effort, but rather the kind of effort a person may expend and the kind of rest a person may experience. Obtaining the appropriate variety depends on the presence of certain source fascinations. Although some source fascinations are likely to effortlessly consume a person’s attention, others can provide the freedom to maintain flexible awareness. In the present study, images perceived high in mystery offered participants an opportunity to experience attentional resonance; a degree of balance between bottom-up and top-down processing. Such experiences, although not completely effortless, may in fact, more appropriately characterize the quality of rest that is so central to ART.

Study Limitations

Although this study was able to obtain initial evidence in support of the differential effects that mystery can have on a person’s capacity to direct attention, there are certain study limitations. The first limitation relates to the ecological validity of the study. Information obtained was the result of participants viewing images in a lab setting, as opposed to the actual environment. Although previous research has shown that the use of digital photographs as surrogates is a valid approach, others have called it
into question (S. Kaplan, 2001). Clearly, there are differences that exist between a simulated setting and one that involves the “real word.” Nature interactions simulated in a lab setting lack some of the sensorial richness (i.e., touch, smell, etc.) that plays such a critical role in defining a person’s experience. Despite these recognized differences, the current approach offered a very unique and vital means of unraveling how mystery can affect a person’s capacity to direct attention.

Another limitation to the present study centers on the issue of sampling. For the purpose of this study, the exclusive use of a single population, college students, occurred. The use of this population segment is clearly justified, as many college students are at an increased risk for directed attention fatigue (Tennesen & Cimprich, 1995). At the same time however, the perennial problem of using one exclusive population creates certain procedural limitations in terms of the generalizations one can make to populations outside of college students. In a similar light, the images utilized in each phase of the study represented a sampling of settings that did not encompass a broad range of settings. Images selected for use in the study comprised trails scenes from a variety of metropolitan parks in the Columbus, Ohio area. Given this limited environmental sampling, the generality of the results is restricted to settings that are of a similar biome.

One final and important limitation to address within the current study is that the study did not explicitly address the issue of restoration. Rather, the research design utilized in this study purposely examined the cognitive costs that certain types of nature scenes placed on a person’s attentional resources. That methodological approach afforded the opportunity to address a very fundamental premise of ART; the need to interact with settings that enable a person to ‘rest’ his or her mental capacity. Based on
data obtained in previous studies, natural settings seemingly offer a person the opportunity to rest directed attention (Hartig et al., 1991). There have been, however, few studies that have empirically tested the cognitive costs associated with these types of settings. Understanding the extent to which certain nature scenes can evoke a less effortful form of attention is an important prerequisite to explaining the restorative effects of those scenes. Thus, the aims of this research are more theoretical, and serve as a foundation from which to establish the restorative value of mystery in nature.

**Directions for Future Research**

Extensions to the present study could proceed in a variety of directions. The most logical track to pursue would involve examining the effect that mystery has on restoring a person’s capacity to direct attention. Although the results obtained in the current study indicated that images perceived high in mystery provided participants with certain advantages on the RMT, they did not specifically address the issue of restoration. To accomplish that goal likely requires obtaining both a baseline measure of attention, as well as a measure of attention following exposure to a given set of nature images. In a recent study, Berman et al. (2008) utilized the backwards digit-span task and the Attentional Network Task (ANT) as a way of assessing the restorative value nature scenes had over urban scenes. Participants carried out each of these tasks prior to and immediately following their exposure to a set of images from one of the two scene types. Differences in performance indicated that participants who viewed images from the nature category showed consistent improvement on both tasks, more so than urban images. Adopting a similar approach may provide a means by which to assess the effects mystery may have on restoring a person’s attention.
Initial efforts to understand the effect of mystery on attention stemmed from earlier work that had identified mystery as a reliable predictor of preference for natural settings. Examinations of preference have often shown that people tend to prefer those settings that satisfy certain informational needs; the need to make sense and the need for involvement (S. Kaplan & R. Kaplan, 1982). Each of these needs presumably resides within a set time dimension that addresses current as well as future needs. Within that framework, the Kaplans (1982) have asserted that there are four factors contributing to a person’s preference of a setting.

Mystery is one of the informational factors shown to influence preference (Herzog, 2007). Settings containing patterns of mystery often align with people’s longer range needs in relation to involvement. There are, however, three other informational factors that previous research has identified as having an influence on a person’s preference for a setting; all of which align with many of the central tenets of ART. Those factors include complexity, coherence, and legibility. With that in mind, future studies may wish to examine the influence that each of these informational factors have on a person’s capacity to direct attention. Developing a better understanding of each factor in relation to ART is likely to provide valuable insight into the role those factors may play in resting a person’s cognitive capacity when fatigued.

Finally, future research may wish to further explore the notion of attentional resonance with regard to certain types of nature scenes. The data obtained from participants’ involvement in the RMT indicated that images perceived high in mystery evoked both top-down and bottom-up processing. This type of processing may best represent those experiences people often characterize as restorative. Replicating this
study’s results through the use of other assessment approaches would provide added credence to the idea that certain nature scenes offer a person the opportunity to function using a unique form of processing that is mutually enhancing. Experiments constructed from the dual-task paradigm may offer such an approach. These types of experiments generally require participants to carry out two concurrent tasks. Evaluating a participant’s performance on each task could serve as an indicator of the type of processing utilized to complete those tasks.

**Conclusion**

This study set out to examine the effect mystery, mediated by fascination, had on students’ capacity to direct attention. To that end, the study obtained results that indicated differences in recognition performance based on scene type and the duration of time participants had to view presented images. Although the results of the study satisfied certain expectations, there were other facets of the results that contributed to new understanding. For example, differences in recognition performance were not a result of the absence of mental effort as originally thought, but rather the type of mental effort expended. Furthermore, tests for mediation supported the notion that perceptions of fascination mediated differences in recognition performance based on scene type. Taken collectively, the results of the study provide a deeper understanding of fascination as a restorative property and serve as foundation from which to explain the value these types of settings may have on resting a person’s attention.
APPENDIX A

PARTICIPANT CONSENT DOCUMENT
Andrew Szolosi, Ph.D. Candidate, Principal Investigator  
Jason Watson, Ph.D., Co-Investigator  
Nature’s Effect on Attention  
CONSENT DOCUMENT

BACKGROUND
You are being invited to participate in a research study that will examine the demands that different types of natural settings have on a person’s attentional resources. Studies that investigate the processes of attention typically look at how performance on a given measure (e.g. memory, reading) might vary when carrying out two tasks simultaneously or a single task under a time constraint. Before you decide to participate, you should consider the purpose that underlies this research, and what your involvement in the study will entail. Please read the brief description before deciding whether to volunteer.

This study involves research about human-nature interactions and the demands that certain types of interactions may have on a person’s attentional resources. The purpose of this research is to better understand whether a person could obtain cognitive benefits from certain types of nature experiences.

STUDY PROCEDURE
The entire experiment will take place in one session and last approximately an hour and a half. During your involvement in the study, you will be asked to complete a series of tasks that require some thinking and concentration. For example, you may be asked to follow instructions, solve math problems, memorize photographs, respond to questions about those photographs, and complete various paper and pencil activities.

RISKS
The risks of this study are minimal. For example, you may become a little fatigued mentally from the length of the study. You may also feel upset or uncomfortable if you find some of the tests difficult. These risks are similar to the frustrations you might feel when you are unable to remember something that you wanted to remember. There may be other risks, which are currently unforeseeable.

BENEFITS
There are no direct benefits to you from your participation in this study. This study may provide information to increase scientific understanding about how certain types of natural settings can affect a person’s attentional resources.

ALTERNATIVE PROCEDURES
If for any reason you do not want to participate in the study, you may do so without any disadvantage to you. For students who do not wish to take part in the lab experiment but would still like to receive research credits for your undergraduate psychology course, as an alternative you may read a published research article which helped form the basis of the hypotheses that will be tested and the manipulations that will be used in the present study.
CONFIDENTIALITY
All of the information that you provide during the course of the study will remain strictly confidential. Specifically, all paperwork and all data will be kept in a locked filing cabinet or on a password protected computer. Only the PI and his research team will have access to this information. For the purpose of this study, each participant will receive an identification (ID) number. That ID number, rather than the participant’s name, will be attached to all data collected for the study. Portions of the data collected in this experiment, stripped of any identifying characteristics, may be presented at a conference or published in a scientific journal.

PERSON TO CONTACT
If you have any questions, concerns, or complaints regarding this research study or if you feel you have been harmed as a result of participation, please contact the PI of the study, Andrew Szolosi, at 614-886-1598 (24 hour voice mail) or by email at andrew.szolosi@health.utah.edu. As well, you may also contact the Co-investigator of the research study, Dr. Jason Watson, at 801-585-7956 (24 hour voice mail), or by email at jason.watson@psych.utah.edu.

INSTITUTIONAL REVIEW BOARD
Contact the Institutional Review Board (IRB) if you have questions regarding your rights as a research participant. Also, contact the IRB if you have questions, complaints or concerns which you do not feel you can discuss with the investigator. The University of Utah IRB may be reached by phone at (801) 581-3655 or by e-mail at irb@hsc.utah.edu.

VOLUNTARY PARTICIPATION
You may decide whether to participate in this study. If you decide to take part, you will be asked to sign a consent form. You are still free to withdraw at any time without giving a reason. Refusal to participate or withdrawal from the study will involve no penalty or loss of benefits to which you are otherwise entitled.

COSTS AND COMPENSATION TO PARTICIPANTS
You will be compensated with 1-2 hours of research credits for your participation in the study (depending on the actual length of the experiment).

CONSENT
By signing this consent form, I confirm I have read the information in this consent form and have had the opportunity to ask questions. I will be given a signed copy of this consent form. I voluntarily agree to take part in this study.

_____________________________       __________________________     _________
Printed Name of Participant                        Signature of Participant                        Date

______________________________      __________________________     _________
Printed Name of Researcher or Staff                Signature of Researcher or Staff                Date
APPENDIX B

PHASE 1: MYSTERY RATING
Phase I: Mystery Rating (Sample Screen Capture)
Instructions:
Please rate the extent to which the setting promises more to be seen if you could walk deeper into that setting.

START TEST
1. Please rate the extent to which the setting promises more to be seen if you could walk deeper into that setting.

<table>
<thead>
<tr>
<th>Not at all</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Very much so</th>
</tr>
</thead>
</table>
APPENDIX C

PHASE 2: RECOGNITION MEMORY TEST
Phase II: Recognition Memory Test (Sample Screen Capture)
APPENDIX D

PHASE 3: PRS FOR “FASCINATION”
Phase III: Perceived Restorativeness Scale (PRS) for “Fascination”  
(Sample Screen Capture)
Instructions:
Please read each question. Click on the number (0-6) that most closely corresponds to the experience you are having as you look at the landscape on the screen. Then, click the "Next Question" button.

START TEST
1. This place has qualities that fascinate me.
2. I would like to spend more time looking at the surroundings here.

Not at all 0 1 2 3 4 5 6 Very much so
APPENDIX E

DES QUESTIONNAIRE
Questionnaire

This questionnaire consists of 27 questions about experiences that you may have in your daily life. We are interested in how often that you have these experiences. It is important, however, that your answers show how often these experiences happen to you when you are not under the influence of substances like alcohol. To answer the questions, please determine to what degree the experience described in each question applies to you and circle the appropriate answer. Please ask the experimenter if you have any additional questions. Thank you.

1. Some people have the experience of driving a car and suddenly realizing that they don’t remember what has happened during all or part of the trip. Please indicate how often this happens to you.

   Never         Rarely         Average         Frequently         Always

2. Some people find that sometimes they are listening to someone talk and they suddenly realize that they did not hear part or all of what was just said. Please indicate how often this happens to you.

   Never         Rarely         Average         Frequently         Always

3. Some people have the experience of finding themselves in a place and having no idea how they got there. Please indicate how often this happens to you.

   Never         Rarely         Average         Frequently         Always

4. Some people have the experience of finding themselves dressed in clothes that they don’t remember putting on. Please indicate how often this happens to you.

   Never         Rarely         Average         Frequently         Always

5. Some people have the experience of finding new things among their belongings that they do not remember buying. Please indicate how often this happens to you.

   Never         Rarely         Average         Frequently         Always
6. Some people sometimes find that they are approached by people that they do not know who call them by another name or insist that they have met them before. Please indicate how often this happens to you.

Never       Rarely       Average       Frequently       Always

7. Some people sometimes have the experience of feeling as though they are standing next to themselves or watching themselves do something and they actually see themselves as if they were looking at another person. Please indicate how often this happens to you.

Never       Rarely       Average       Frequently       Always

8. Some people are told that they sometimes do not recognize friends or family members. Please indicate how often this happens to you.

Never       Rarely       Average       Frequently       Always

9. Some people find that they have no memory for some important events in their lives (e.g. a wedding or graduation) Please indicate how often this happens to you.

Never       Rarely       Average       Frequently       Always

10. Some people have the experience of being accused of lying when they do not think that they have lied. Please indicate how often this happens to you.

Never       Rarely       Average       Frequently       Always

11. Some people have the experience of looking in a mirror and not recognizing themselves. Please indicate how often this happens to you.

Never       Rarely       Average       Frequently       Always

12. Some people sometimes have the experience of feeling that other people, objects, and the world around them are not real. Please indicate how often this happens to you.

Never       Rarely       Average       Frequently       Always
13. Some people sometimes have the experience of feeling that their body does not seem to belong to them. Please indicate how often this happens to you.

Never Rarely Average Frequently Always

14. Some people have the experience of sometimes remembering a past event so vividly that they feel as if they were reliving that event. Please indicate how often this happens to you.

Never Rarely Average Frequently Always

15. Some people have the experience of not being sure whether things that they remember happening really did happen or whether they just dreamed them. Please indicate how often this happens to you.

Never Rarely Average Frequently Always

16. Some people have the experience of being in a familiar place but finding it strange and unfamiliar. Please indicate how often this happens to you.

Never Rarely Average Frequently Always

17. Some people find that when they are watching television or a movie they become so absorbed in the story that they are unaware of other events happening around them. Please indicate how often this happens to you.

Never Rarely Average Frequently Always

18. Some people sometimes find that they become so involved in a fantasy or daydream that it feels as though it were really happening to them. Please indicate how often this happens to you.

Never Rarely Average Frequently Always

19. Some people find that they sometimes are able to ignore pain. Please indicate how often this happens to you.

Never Rarely Average Frequently Always
20. Some people find that they sometimes sit staring off into space, thinking of nothing, and are not aware of the passage of time. Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
<th>Always</th>
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</table>

21. Some people sometimes find that when they are alone they talk out loud to themselves. Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
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22. Some people find that in one situation they may act so differently compared with another situation that they feel almost as if they were two different people. Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
<th>Always</th>
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23. Some people sometimes find that in certain situations they are able to do things with amazing ease and spontaneity that would usually be difficult for them (e.g., sports, work, social situations, etc.). Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
<th>Always</th>
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24. Some people sometimes find that they cannot remember whether they have done something or have just thought about doing that thing (e.g., not knowing whether they have mailed a letter or have just thought about mailing it). Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
<th>Always</th>
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25. Some people sometimes find writings, drawings, or notes among their belongings that they must have done but cannot remember doing. Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
<th>Always</th>
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</table>
26. Some people sometimes find that they hear voices inside their head that tell them to do things or comment on things that they are doing. Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
<th>Always</th>
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</table>

27. Some people sometimes feel as if they are looking at the world through a fog so that people and objects appear far away or unclear. Please indicate how often this happens to you.

<table>
<thead>
<tr>
<th>Never</th>
<th>Rarely</th>
<th>Average</th>
<th>Frequently</th>
<th>Always</th>
</tr>
</thead>
</table>
APPENDIX F

ENGLISH FLUENCY AND TASK QUESTIONNAIRE
Questionnaire
Participant ID # _____

Instructions: Please take 5-10 minutes to provide answers to the following five questions.

(1) Before today’s experiment, did you have any knowledge of the effects that nature could have on attention. If so, please briefly describe where you previously learned about this topic (e.g., class lectures, other experiments in which you participated, other sources)?

(2) Before today’s experiment, did you have any knowledge of the questionnaire that asked you to identify the frequency with which certain imaginative experiences occur in your daily life? If so, please briefly describe where you previously learned about this questionnaire (e.g., class lectures, other experiments in which you participated, other sources)?

(3) Before today’s experiment, did you have any knowledge of the short math/memory individual differences task that was administered during the present study? If so, please briefly describe where you previously learned about this task (e.g., class lectures, other experiments in which you participated, other sources)?

(4) Would you consider yourself to be a native English speaker (i.e., English is your 1st language)? If not, would you consider yourself to be a fluent speaker of English?
APPENDIX G

PHASE 1: EXPERIMENTER INSTRUCTIONS
PHASE I: Experimenter Instructions

Background

For PHASE I of the experiment, approximately thirty participants will rate 160 photographs of natural scenes for the presence of “mystery”. Participants will indicate their responses, ranging from 0 (low mystery) to 6 (high mystery) in accordance to the Kaplans’ definition of mystery, which they defined as the degree to which you can gain additional information by proceeding further into a setting. Mystery ratings will serve as the basis for the categorization of photographs: high mystery settings and low mystery settings.

Lab Preparation

The Cognitive Science Laboratory will require a certain amount of preparation prior to the participants’ arrival. To initiate the computer program needed for PHASE I of the study, please do the following:

1. Click on the desktop folder labeled, Nature’s Effect on Attention.

2. Having opened that folder, locate the Internet Shortcut labeled PHASE I and double click this shortcut to open it.

NOTE: A web page requesting a participant’s ID Number and other demographic information will open and fill the entire screen. Due to the number of photographs presented during PHASE I of the study, the demographic web page may take a few minutes to load.

3. After the web page has successfully loaded, please minimize the Internet Browser displaying that information so that participants will not begin PHASE I of the study prematurely.

NOTE: You may close (shut down) the file folder labeled Nature’s Effect on Attention.

Introduction to the Lab Session

The experiment used for PHASE I of the study will run in multiple sessions with 1-4 participants per session. For each lab session, please take attendance as participants arrive at the laboratory. Copies of blank attendance sheets will be set aside in the laboratory binder designated for the present study. Once all of the participants for a session have arrived, present each participant with two copies of the ‘Campus Consent and Authorization Form’. Participants who wish to participate in the study must submit a signed copy of the consent form to the experimenter. Signed consent forms can be placed inside the green hanging folder labeled SIGNED CONSENT FORMS. Participants can retain the second copy of that form for their personal records.
After reading the campus consent form aloud, offer participants an opportunity to ask questions. Participants who return a signed copy of the consent form will receive an assigned Identification (ID) Number for the study. Participants who do not wish to take part in the experiment proper but would still like to receive research credits for their undergraduate psychology course, can, as an alternative, read a published research article by Hartig, Mang, and Evans (1991), an article that helped to form the basis of the hypotheses for the proposed study. Copies of that article will be inside the green hanging folder labeled PARTICIPANT ALTERNATIVE: ARTICLE. To receive credit, participants must also complete the ALTERNATIVE CREDIT QUESTIONS sheet.

**Rating Natural Settings for Mystery**

Once each participant has received an ID number, please handout the experimental protocol (participant instructions) for PHASE I of the study. Copies of those instructions will be inside a manila envelope labeled PHASE I INSTRUCTIONS. Read aloud the instructions to participants. Be sure to provide ample opportunity for any questions participants may have regarding the instructions for the forthcoming tasks. After participants have confirmed that they sufficiently understand the directions for the tasks they are about to undertake, you may continue on with the start of the experiment.

At the bottom of each computer screen there will be a window in the task bar labeled PHASE I. Please have each participant click on that window. A web page requesting the participant’s ID Number and other demographic information will appear. Please instruct the participants to fill in the following information, reminding each participant to enter his or her assigned ID number. When participants have completed this portion of the experiment, they may click on the button labeled NEXT. That button will direct participants to page two of the experiment, a web page that presents the instructions for the ‘mystery rating’ portion of the experiment. Participants who are ready can begin this portion of the experiment by clicking on the button labeled START.

Once participants have clicked on the START button and begun the experiment, they will evaluate photographs for the presence of mystery. After participants have evaluated all 160 photographs, a web page will appear on the computer screen instructing participants to wait for further instructions. The ‘mystery rating’ portion of the experiment should last approximately 20-30 minutes. Participants who finish early will be given a short 2-3 minute rest break. Once the last participant has completed the ‘mystery rating’ portion of the experiment, an additional 2-3 minute break may be given to ensure that each participant has had an opportunity to rest before beginning the next part of the experiment. During that rest-break, please close (shut down) the window that instructs participants to wait for further instructions.

**Automated Operation Span Task (AOSPAN)**

When the 2-3 minute rest break has concluded, inform participants that they will be performing a combination math memory task that will involve memorizing a series of letters while simultaneously performing simple math problems.
To open up this program, please click on the **Nature’s Effect on Attention** desktop folder. Having opened that folder, double click on the **Automated OSPAN** icon. A new window will open up and fill the entire computer screen. Locate the **RUN** button on the tool bar at the top screen. Once you have clicked on that button, a small screen will appear prompting you to enter the subject ID number. Have the participants enter their assigned ID number, and click OK. Please stress to the participants the importance of taking the practice sessions seriously, as it will help them later on in the experiment. The entire task should take approximately 15-20 minutes to complete. When participants complete this task, they may take a short rest break. Once the last participant has completed the **AOSPAN** portion of the experiment, an additional 2-3 minute break may be given to ensure that each participant has had an opportunity to rest before beginning the test portion of the recognition memory task.

**Dissociative Experience Scale (DES)**

When the 2-3 minute rest break has concluded, please handout the Dissociative Experience Scale (DES). Copies of that questionnaire will be inside a manila envelope labeled **DES QUESTIONNAIRE**. Remind participants to fill in their assigned ID number in the top right-hand corner of the page. The entire questionnaire should take approximately 10 minutes to complete. When a participant completes the questionnaire, ask him or her to wait patiently while their fellow participants are finishing up. Once all students have completed the questionnaire, the debriefing portion of the experiment will begin. When a participant has finished the DES questionnaire you may place that participant’s DES questionnaire in the green hanging folder labeled **COMPLETED DES QUESTIONNAIRES**.

**English Fluency & Task Questionnaire**

After administering the DES Questionnaire, please handout the **ENGLISH FLUENCY & TASK QUESTIONNAIRE**. This questionnaire will allow the research team to determine the extent to which participants have any experience or prior exposure with the tasks performed during the experiment. At the same time, the questionnaire will enable the research team to determine if English is the native language of a subject. Completed questionnaires can be placed in the green hanging folder labeled **COMPLETED ENGLISH FLUENCY & TASK QUESTIONNAIRE**

**Debriefing the Experiment**

When all participants have completed the DES portion of the experiment, each participant can receive a copy of the Debriefing Form, which can be found in a manila envelope labeled **DEBRIEFING FORMS**. Please read that form aloud to participants, pausing for possible discussion opportunities (e.g. Can you think of ways in which this information may be used?) or participant questions. If participants have any additional questions about the study, they are encouraged to contact the PI by phone at 614-886-1598 or via email at andrew.szolosi@health.utah.edu. Participants may also contact the Co-Investigator by phone at 801-585-7956 or via email at jason.watson@psych.utah.edu. In conclusion, please thank each of the participants for their involvement in the study.
APPENDIX H

PHASE 2: EXPERIMENTER INSTRUCTIONS
PHASE II: Experimenter Instructions

Background

For PHASE II of the study, three groups of 30 participants will perform a recognition memory task in which each group will have a different duration for stimulus presentation. The recognition memory task will occur in two parts: a study portion and a test portion. During the study portion of the task, participants will view 40 photos, consisting of natural scenes that earlier research participants rated as either high or low in mystery. A computer screen will display each photo for a given duration of time (e.g. 1 second/photo). In the time allotted, participants will have to study and memorize the presented photos to the best of their ability.

During the test portion of the experiment, a total of 80 photos (40 old and 40 new) will be displayed on a computer screen. For each photo, participants will be asked whether that photo was presented during the study portion of the experiment. Participants can respond that a test photo was presented earlier by clicking on “OLD” or that a test photo is being displayed for the first time by clicking “NEW”. If a participant responds that a particular photo was “old” (meaning that it was presented during the study portion of the experiment), that participant will also be asked if he or she “remembers” something specific about that test photo or if he or she just “knows” that the test photo was presented during the study session of the experiment because it seems familiar.

A few design issues are noteworthy. First, the research team created a recognition memory task program for each of the 3 presentation durations used in the study and test portion of the experiment (300 milliseconds, 1 second, and 5 seconds). Second, the research team utilized a counterbalance technique in order to ensure that participants’ performance on the recognition memory task was not merely an artifact of certain photos being presented during the study portion of the experiment. As a result, for each recognition memory task program that differs in presentation duration, there is also a subset A and subset B of that program. Subset A contains a series of 40 photos presented during the study portion of the experiment. Subset B contains a different series of 40 photos presented during the study portion of the experiment. Approximately 15 participants will perform the recognition memory task for each subset of photos in a given duration.

Lab Preparation

The Cognitive Science Laboratory will require a certain amount of preparation prior to the participants’ arrival. To initiate the program needed for PHASE II of the study, please do the following:

1. Determine which recognition memory task program will be used for the current lab session.
**Lab Preparation** (continued)

**NOTE:** Each lab session will be dedicated to a specific presentation duration and subset group of photos (Either **Subset A** or **Subset B**).

1. **NOTE:** Each lab session will be dedicated to a specific presentation duration and subset group of photos (Either **Subset A** or **Subset B**).

2. To initiate the computer program needed for that session, please click on the desktop folder labeled **Nature’s Effect on Attention**.

3. Having opened that folder, please click the subfolder labeled **PHASE II**.

4. When you have opened the **PHASE II** subfolder, find the icon (program) for the presentation duration and subset group of photos that will be used for that lab session.

**NOTE:** There will be a total of 12 memory recognition task programs in the **PHASE II** subfolder. For each presentation duration of the recognition memory task program there is a **STUDY** and **TEST** version as well as a Subset A and Subset B version of those programs. The names for each program are presented below.

- 300mStudyA
- 300msStudyB
- 1secStudyA
- 1secStudyB
- 5secStudyA
- 5secStudyB
- 10secStudyA
- 10secStudyB
- 300msTestA
- 300msTestB
- 1secTestA
- 1secTestB
- 5secTestA
- 5secTestB
- 10secTestA
- 10secTestB

5. Please double click on the “**Study**” version for the presentation duration and subset group of photos that will be used during that lab session.

**NOTE:** A web page requesting a participant’s ID Number and other demographic information will open and fill the entire screen. Due to the number of photographs presented during **PHASE II** of the study, the demographic web page may take a few minutes to load.

6. After the web page has successfully loaded, please minimize the Internet Browser displaying that information so that participants will not begin **PHASE II** of the study prematurely.
**Introduction to the Lab Session**

The experiment for **PHASE II** will run in multiple sessions with 1-4 participants per session. For each lab session, please record attendance as participants arrive at the laboratory. Copies of blank attendance sheets will be set-aside in the laboratory binder designated for this study. Once all of the participants for a session have arrived, present each participant with two copies of the ‘Consent and Authorization Form’. Participants who wish to participate in the study must submit a signed copy of the consent form to the experimenter. Signed consent forms can be placed inside the green hanging folder labeled **SIGNED CONSENT FORMS**. Participants can retain the second copy of that form for their personal records.

Once each participant has had an opportunity to read the CONSENT FORM, ask if there are any questions. Participants who return a signed copy of the consent form will receive an ID Number for the study. Participants who do not wish to take part in the experiment proper but would still like to receive research credits for their undergraduate psychology course, can, as alternative, read a published research article by Hartig, Mang, and Evans (1991), an article that helped to form the basis of the hypotheses for the proposed study. Copies of that article will be inside a green hanging folder labeled **PARTICIPANT ALTERNATIVE: HARTIG, MANG, & EVANS**. To receive credit, participants must also complete the **ALTERNATIVE CREDIT QUESTIONS** sheet.

**Recognition Memory Task: Study Portion**

Once each participant has received an ID number, please handout the Participant Instructions for **PHASE II** of the study. Copies of those instructions will be inside a green hanging folder labeled **PHASE 2 INSTRUCTIONS**.

**NOTE:** Please remember to read the set of instructions for the presentation duration that will be used during that lab session.

300 milliseconds ---- Participant Instructions for Phase II Experiment (A)  
1 Second---- Participant Instructions for Phase II Experiment (B)  
5 Second---- Participant Instructions for Phase II Experiment (C)  
10 Second---- Participant Instructions for Phase II Experiment (D)

Read aloud the instructions to participants. Be sure to provide ample opportunity for any questions participants may have regarding the instructions for the forthcoming tasks. After participants have confirmed that they sufficiently understand the directions for the tasks they are about to undertake, you may start the experiment.

At the bottom of each computer screen there will be a window in the task bar labeled with the recognition memory task program that was opened earlier during lab preparation. Please have each participant click on that window. A web page requesting the participant’s ID Number and other demographic information will open and fill the computer screen. Please instruct the participants to fill in the following information, reminding each participant to enter his or her assigned ID number. When participants
have completed this portion of the experiment, they may click on the icon labeled NEXT. That icon will direct participants to page two of the experiment, a web page that informs participants to wait patiently until the experimenter has directed participants to start the test. When the experimenter informs the participants to start, participants can then click on the icon labeled START.

Once participants have clicked on the START icon and begun the study session of the experiment, a series of 40 photos will be presented for a given duration (e.g. 1 second/photo). This portion of the experiment will last between 12 seconds and 3 ½ minutes, depending on duration of stimulus presentation. When the study portion of the experiment has concluded, a web page will appear on the computer screen instructing participants to wait for further instructions. At that point, you may instruct each participant to close (shutdown) the window for the study portion of the experiment.

**Review of Recognition Memory Task Instructions**

When the study portion of the experiment has concluded, you may read aloud the “Review” Phase 2 instructions. After reading those instructions aloud, you may initiate the “TEST” program needed for Phase 2 of the study. Please do the following:

1. To initiate the computer program needed for the TEST portion of the experiment, please click on the desktop folder labeled Nature’s Effect on Attention.

2. Having opened that folder, please click the subfolder labeled PHASE II.

3. When you have opened the PHASE II subfolder, find the icon (program) for the “TEST” version of the presentation duration and subset group of photos run earlier during the study portion of the experiment.

**NOTE:** For example, if you originally opened the 300ms “Study” program for the subset A group of photos, you would now want to open the 300ms “Test” program for the subset A group of photos.

4. Please double click on the “TEST” version for the presentation duration and subset group of photos that was run earlier during the “study” portion of the experiment.

**NOTE:** A web page requesting participants to wait patiently until the experimenter directs participants to start the test will appear.
**Recognition Memory Task: Test Portion**

Once you have opened the appropriate “TEST” program on each participant’s computer, you may then inform participants that they can start the test. At that point, participants can click on the button labeled CONTINUE, and begin the test.

Participants may take as long as they like in completing this portion of the experiment (recognition memory test), although the entire group will likely finish in about 15-20 minutes. When participants complete the recognition memory task, a web page will appear on the computer screen instructing participants to wait for further instructions. Participants who finish early will be allowed to take a short rest break. Once the last participant has completed the test portion of the experiment, an additional 2-3 minute break may be given to ensure that each participant has had an opportunity to rest before beginning the next part of the experiment.

**Automated Operation Span Task**

The AOSPAN is a computer-based, mouse driven task that requires participants to solve a series of basic math operations that necessitate a “true” or “false” response, while at the same time trying to remember a set of unrelated letters or words. The AOSPAN is a task designed to assess a person’s working memory capacity, and is considered to be related to cognitive control.

To open up this program, please click on the Nature’s Effect on Attention desktop folder. Having opened that folder, double click on the Automated OSPAN icon. A new window will open up and fill the entire computer screen. Locate the RUN button on the tool bar at the top screen. Once you have clicked on that button, a small screen will appear prompting you to enter the subject ID number. Have the participants enter their assigned ID number, and click OK. Please stress to the participants the importance of taking the practice sessions seriously, as it will help them later on in the experiment. The entire task should take approximately 15-20 minutes to complete. When participants complete this task, they may take a short rest break. Once the last participant has completed the AOSPAN portion of the experiment, an additional 2-3 minute break may be given to ensure that each participant has had an opportunity to rest before beginning the test portion of the recognition memory task.

**Dissociative Experience Scale (DES)**

When the 2-3 minute rest break has concluded, and participants are once again sitting down at their computers, please handout the DES questionnaire. Copies of that questionnaire will be inside a manila envelope labeled, DES QUESTIONNAIRE. Inside that envelope, there will also be a set of pens in case participants are without a writing utensil. Remind participants to fill in their assigned ID number in the top right hand corner of the page. The entire questionnaire should take approximately 10 minutes to complete. When a participant completes the questionnaire, ask him or her to wait
patiently while their fellow participants are finishing up. Once all students have completed the questionnaire, the debriefing portion of the experiment will begin.

**English Fluency & Task Questionnaire**

After administering the DES Questionnaire, please handout the **ENGLISH FLUENCY & TASK QUESTIONNAIRE**. This questionnaire will allow the research team to determine the extent to which participants have any experience or prior exposure with the tasks performed during the experiment. At the same time, the questionnaire will enable the research team to determine if English is the native language of a subject. Completed questionnaire can be placed in the green hanging folder labeled **COMPLETED ENGLISH FLUENCY & TASK QUESTIONNAIRE**

**Debriefing the Experiment**

When all participants have completed the DES portion of the experiment, each participant should receive a copy of the Debriefing Form, which can be found in a manila envelope labeled **DEBRIEFING FORM**. Please read that form aloud to participants, pausing for possible discussion opportunities (e.g. Can you think of ways in which this information may be used?) or participant questions. If participants have any additional questions about this study, they are encouraged to contact the PI by phone at 614-886-1598 or via email at andrew.szolosi@health.utah.edu. Participants may also contact the Co-Investigator by phone at 801-585-7956 or via email at jason.watson@psych.utah.edu. In conclusion, please thank each of the participants for their involvement in the study.
APPENDIX I

PHASE 3: EXPERIMENTER INSTRUCTIONS
PHASE III: Experimenter Instructions

Background

For PHASE III of the experiment, approximately thirty participants will rate 80 photographs, comprised of natural scenes, in terms of perceived fascination. Using a 7-point scale, participants will be asked to indicate the extent to which a given statement describes their reaction to the natural scene displayed on the computer screen (i.e. My attention is drawn to many interesting things here). Each photo presented on the computer screen will require a participant to make three responses, ranging from 0 (Not at all) to 7 (Very much so). Participants’ assessments of each photograph will help the research team identify which types of natural settings are more likely to elicit a person’s fascination.

Lab Preparation

The Cognitive Science Laboratory will require a certain amount of preparation prior to the participants’ arrival. To initiate the computer program needed for PHASE III of the study, please do the following:

1. Click on the desktop folder labeled Nature’s Effect on Attention.

2. Having opened that folder, locate the Internet Shortcut labeled PHASE III and double click this shortcut to open it.

   NOTE: A web page requesting a participant’s ID Number and other demographic information will open and fill the entire screen. Due to the number of photographs presented during PHASE III of the study, the demographic web page may take a few minutes to load.

3. After the web page has successfully loaded, please minimize the Internet Browser displaying that information so that participants will not begin PHASE III of the study prematurely.

   NOTE: You may close (shut down) the file folder labeled Nature’s Effect on Attention.

Introduction to the Lab Session

The experiment for PHASE III will run in multiple sessions with 1-4 participants per session. For each lab session, please take attendance as participants arrive at the laboratory. Copies of blank attendance sheets will be set-aside in the laboratory binder designated for the present study. Once all of the participants for a session have arrived, present each participant with two copies of the ‘Campus Consent and Authorization Form’. Participants who wish to participate in the study should submit a signed copy of the consent form to the experimenter. Signed consent forms can be placed inside the
green hanging folder labeled **SIGNED CONSENT FORMS**. Participants can retain the second copy of that form for their personal records.

After participants have had an opportunity to read the consent form, offer those participants an opportunity to ask questions. Participants who return a signed copy of the consent form will receive an assigned ID Number for the study. Participants who do not wish to take part in the experiment proper but would still like to receive research credits for their undergraduate psychology course, can, as alternative, read a published research article by Hartig, Mang, and Evans (1991), an article that helped to form the basis of the hypotheses for the proposed study. Copies of that article will be inside a green hanging folder labeled **PARTICIPANT ALTERNATIVE: ARTICLE**. To receive credit, participants must also complete the **ALTERNATIVE CREDIT QUESTIONS** sheet.

**Rating Natural Settings for Fascination**

Once each participant has received an ID number, please hand out the experimental protocol (participant instructions) for **PHASE III** of the study. Copies of those instructions will be inside a green hanging folder labeled **PHASE III INSTRUCTIONS**. Read aloud the instructions to participants. Be sure to provide ample opportunity for any questions participants may have regarding the instructions for the forthcoming tasks. After participants have confirmed that they sufficiently understand the directions for the tasks they are about to undertake, you may continue on with the start of the experiment.

At the bottom of each computer screen there will be a window in the task bar labeled **PHASE III**. Please have each participant click on that window. A web page requesting the participant’s ID Number and other demographic information will appear. Please instruct the participants to fill in the following information, reminding each participant to enter his or her assigned ID number. When participants have completed this portion of the experiment, they may click on the button labeled **NEXT**. That button will direct participants to page two of the experiment, a web page that presents the instructions for the ‘fascination rating’ portion of the experiment. Participants may begin the study session of the experiment whenever they are ready by clicking on the button labeled **START**.

Once participants have clicked on the **START** button and begun the experiment, they will evaluate photographs in terms of perceived fascination. After participants have evaluated all 80 photographs, a web page will appear on the computer screen instructing participants to wait for further instructions. The ‘fascination rating’ portion of the experiment should last approximately 20-30 minutes. Participants who finish early will be given a short rest break. Once the last participant has completed the ‘fascination rating’ portion of the experiment, an additional 2-3 minute break may be given to ensure that each participant has had an opportunity to rest before beginning the next part of the experiment. **During that rest-break, please close (shut down) the window that advises participants to wait for further instructions.**
Automated Operation Span Task (AOSPAN)

When the 2-3 minute rest break has concluded, inform participants that they will be performing a combination math memory task designed to assess their working memory capacity. To open up this program, click on the desktop folder labeled Nature’s Effect on Attention. Having opened up that folder, double click on the icon labeled OSPAN. A window will open displaying the script or code to run the OSPAN program. Click on the RUN button at the top of the tool bar to initiate that program. The screen will prompt the participant for his or her ID number. While participants can complete the task independently of the experimenter, be sure to remind each participant to enter to take the practice sessions seriously. The entire task should take approximately 15-20 minutes to complete. When participants complete this task, they may take a short rest break. Please instruct each participant to return to the lab in 2-3 minutes. Once the last participant has completed the AOSPAN portion of the experiment, an additional 2-3 minute break may be given to ensure that each participant has had an opportunity to rest before beginning the next portion of the experiment.

Dissociative Experience Scale (DES)

When the 2-3 minute rest break has concluded please hand out the DES questionnaire. Copies of that questionnaire will be inside a green hanging folder labeled DES QUESTIONNAIRE. Inside that envelope, there will also be a set of pens in case participants are without a writing utensil. Remind participants to fill in their assigned ID number in the top right hand corner of the page. The entire questionnaire should take approximately 10 minutes to complete. When a participant completes the questionnaire, ask him or her to wait patiently while their fellow participants are finishing up. Once all students have completed the questionnaire, the debriefing portion of the experiment will begin. When a participant has finished the DES questionnaire you may place that participant’s DES questionnaire in the green hanging folder labeled COMPLETED DES QUESTIONNAIRES.

English Fluency & Task Questionnaire

After administering the DES Questionnaire, please handout the ENGLISH FLUENCY & TASK QUESTIONNAIRE. This questionnaire will allow the research team to determine the extent to which participants have any experience or prior exposure with the tasks performed during the experiment. At the same time, the questionnaire will enable the research team to determine if English is the native language of a subject. Completed questionnaire can be placed in the green hanging folder labeled COMPLETED ENGLISH FLUENCY & TASK QUESTIONNAIRE

Debriefing the Experiment

When all participants have completed the DES portion of the experiment, each participant should receive a copy of the Debriefing Form, which can be found in the green hanging folder labeled DEBRIEFING FORM. Please read that form aloud to
participants, pausing for possible discussion opportunities (e.g. Can you think of ways in which this information may be used?) or participant questions. If participants have any additional questions about this study, they are encouraged to contact the PI by phone at 614-886-1598 or via email at andrew.szolosi@health.utah.edu. Participants may also contact the Co-Investigator by phone at 801-585-7956 or via email at jason.watson@psych.utah.edu. In conclusion, please thank each of the participants for their involvement in the study.
APPENDIX J

ALTERNATIVE CREDIT QUESTIONS
Alternative Credit Questions

Participants who do not wish to take part in the experiment proper but would still like to receive research credits for their undergraduate psychology course, can, as alternative, read a published research article by Hartig, Mang, and Evans (1991), an article that has helped to form the basis of the hypotheses for the proposed study. After reading the article, please respond to each of the short answer questions. Each question addresses some of the main points presented by the authors.

1. Identify and briefly describe each of the four facets (factors) of a restorative setting that the authors present in their article (1 sentence for each factor is sufficient).

2. The article presents two studies (Study 1 and Study 2). State the purpose of Study 1 and identify the major finding for that study.

3. What significant changes or additions did the authors make for Study two and identify the major finding for that study?
APPENDIX K

PARTICIPANT INSTRUCTIONS FOR PHASE 1
Participant Instructions for Phase 1

You are participating in a two-part experiment. The first part of the experiment will ask you to evaluate a series of photographs for the presence of mystery. In the second part of the experiment you will carry out a combination math memory task that involves memorizing letters and solving math problems. For this portion of the experiment you will also complete a brief questionnaire that examines the degree to which certain imaginative experiences occur in your daily life. Directions for those tasks will appear at the start of each test.

In the first part of the experiment, you will be presented with a series of photos of natural scenes. For each photo displayed on the computer screen, you will indicate a response, ranging from 1 (low mystery) to 5 (high mystery), in accordance to the provided definition of mystery.

Please allow me to explain the definition of MYSTERY. For the purpose of this study, MYSTERY is defined as the degree to which you could gain additional information if you were to go further into a setting. For example, certain settings may contain features where a portion of the visual landscape is obstructed, enticing you to explore that area further. Your assessment of each photo will help the research team distinguish between natural scenes rated high and low in mystery.

Please feel free to ask the experimenter any questions that you may have at this point by raising your hand. If you feel that you understand these instructions, please signal to the experimenter that you are ready to begin the first portion of the experiment by nodding your head and saying “OK.” You may take as long as you like in completing this portion of the experiment, although I expect that the entire group will be done in about 20-30 minutes. When you have finished part one of the experiment, the computer will instruct you to wait patiently in order to give your fellow participants a chance to finish. Participants will be given a short rest break after completing part one of the experiment.

When everyone has finished the combination math memory task, an additional rest break will be provided. Following that rest break, participants will be given a questionnaire designed to assess the frequency with which imaginative experiences occur in their daily life. When everyone has completed that questionnaire we will begin the final portion of the lab.
APPENDIX L

PARTICIPANT INSTRUCTIONS FOR PHASE 2
Participant Instructions for Phase 2

You are participating in a two-part experiment. The first part is known as the study portion and the second part is referred to as the recognition memory test.

For the study portion of the experiment, you will be presented with a series of photos in which each photo is displayed on a computer screen for a fraction of a second. With the allotted time, you are to study and memorize each photo to the best of your ability. After all of the photos have been presented, you will be asked to carry out a combination math memory task that involves memorizing letters and solving math problems. Directions for that task will appear at the start of the test. A short rest break will occur when all participants have completed the combination math memory task.

For the recognition memory test, a series of photos will be displayed on the computer screen. For each photo, you will be asked whether that photo was presented during the study portion of the experiment. You can respond that a test photo was presented earlier by clicking on “OLD” or that this is the first time a test photo is being presented by clicking “NEW”. If you respond that a particular photo was “old” (meaning that it was presented during the study portion of the experiment), you will also be asked if you “remember” something specific about that test photo or if you just “know” that the test photo was presented during the study session of the experiment because it seems familiar to you.

Please allow me to explain the distinction between REMEMBER and KNOW responses. A REMEMBER response should be made for photos for which you remember a particular aspect of the presented photo. For example, you might distinctly remember a waterfall that appeared in a particular photo, or a specific tree that helped you remember that the photo had been shown earlier during the study portion of the experiment. In contrast, a KNOW response would be made for photos that you cannot recollect any specific aspect of the test photo, but that you have a sense of familiarity that allows you to be reasonably confident that it was presented during the study session.

So, please click on the icon REMEMBER or the icon KNOW for each photo you identify as OLD. Please note that making these REMEMBER/KNOW judgments for any photo that you identify as NEW is unnecessary.

Please feel free to ask the experimenter any questions that you may have at this point by raising your hand. If you feel that you understand these instructions, please signal to the experimenter that you are ready to begin this portion of the experiment by nodding your head and saying “OK.” You may take as long as you like in completing the second part of the experiment (recognition memory test), although I expect that the entire group will be finished in about 20-30 minutes. When you have finished the second part of the experiment, the computer will instruct you to sit quietly in order to give your fellow participants a chance to finish the experiment. A short rest break will occur when all participants have completed the recognition memory test.
Following that rest break, participants will be given a questionnaire designed to assess the frequency with which imaginative experiences occur in their daily life. When everyone has completed that questionnaire we will begin the final portion of the lab.
APPENDIX M

PARTICIPANT INSTRUCTIONS FOR PHASE 3
Participant Instructions for Phase 3

You are participating in a two-part experiment. The first part of the experiment will ask you to evaluate a series of photographs in terms of perceived fascination. In the second part of the experiment you will carry out a combination math memory task that involves memorizing letters and solving math problems. For this portion of the experiment you will also complete a brief questionnaire that examines the degree to which certain imaginative experiences occur in your daily life. Directions for those tasks will appear at the start of each test.

In part one of the experiment, you will be presented with a series of photos of natural scenes. Using a 7-point scale, you will be asked to indicate the extent to which a given statement would describe your reaction to the natural scene displayed on the computer screen (i.e. My attention is drawn to many interesting things here). Each photo presented on the computer screen will require you to make three responses, ranging from 0 (Not at all) to 7 (Very much so).

Please allow me to clarify the meaning of FASCINATION. For the purpose of this study, FASCINATION is the perception of stimuli that are capable of capturing and holding a person’s attention without effort. A variety of circumstances can produce such an effect. For example, people often perceive visits to the zoo, watching a mid-day thunderstorm, or solving a puzzle as inherently interesting. Your assessment of each photograph will help the research team identify which types of natural settings are more likely to elicit a person’s fascination.

Please feel free to ask the experimenter any questions that you may have at this point by raising your hand. If you feel that you understand these instructions, please signal to the experimenter that you are ready to begin part one of the experiment by nodding your head and saying “OK.” You may take as long as you like in completing this portion of the experiment, although I expect that the entire group will be done in about 20-30 minutes. When you have finished part one of the experiment, the computer will instruct you to wait patiently in order to give your fellow participants a chance to finish. Participants will be given a short rest break after completing part one of the experiment.

When everyone has finished the combination math memory task, an additional rest break will be provided. Following that rest break, participants will be given a questionnaire designed to assess the frequency with which imaginative experiences occur in their daily life. When everyone has completed that questionnaire we will begin the final portion of the lab.
APPENDIX N

DEBRIEFING FORM
In the present study, we were interested in understanding the effect that certain types of natural settings have on a person’s capacity to direct attention. Directed attention refers to your ability to stay on task by blocking out competing distractions (Kaplan, 2001). Under certain conditions, that capacity can become fatigued, which can make it difficult to sustain focus. When people become fatigued, they often seek out settings that place less strain on their mental capacities. For many people, natural settings provide a much-needed break from the demands of everyday life. Even so, all natural settings are not equal. People tend to have strong preferences for certain kinds of natural settings. Settings that contain mystery, or features that compel a person to go further into a setting, are often among the most preferred settings (Herzog, 1984). With that in mind, we asked some of you to evaluate a pool of photographs for the presence of mystery. Those evaluations will allow us to distinguish between settings rated high in mystery, from those rated low. Having established a set of photos that represented each extreme, we wanted to see if there were cognitive benefits associated with a particular scene type (e.g. Do certain types of scenes require less of a person’s attentional resources than others?).

Some of you participated in a recognition memory task, in which you viewed a series of photos for a given duration (e.g. 1 second/photograph). While studying those photos, did you find that some of them were easier to remember than others? Was there anything unique about those photos that you were able to remember? Scenes that contain mystery can presumably elicit a person’s fascination, a form of attention that is effortless (Hartig, Mang, Evans, 1991). The responses that you provided for the recognition memory task will allow us to examine the effect that natural settings which are rated high in mystery have on a person’s capacity to direct attention. For this study, memory accuracy served as an indicator of the level of attention devoted or required for a particular stimulus. As a participant, you may have also been asked to assess a series of photos for their potential to elicit fascination. Those assessments will allow us to examine the role fascination has on people’s capacity to direct attention. Understanding why certain settings place less demand on a person’s attentional resources can have a number of practical applications. Can you think of ways in which this information may be used?

For additional information on both the manipulations used and the hypotheses tested in the present study, we would like to refer you to the following research articles:


If you have any additional questions about this study, please do not hesitate to contact the PI by phone at 614-886-1598 or via email at andrew.szolosi@health.utah.edu. You may also contact the Co-Investigator by phone at 801-585-7956 or via email at jason.watson@psych.utah.edu. The PI and his research team thank you for your participation. Please take this debriefing form with you upon completion of the study.

Thanks again, and have a great day!
REFERENCES


