Scenes of natural areas were used as stimuli to analyze the psychological and physiological responses of subjects while viewing wildland scenes. Attention Restoration Theory [Kaplan, S., 1995. The restorative benefits of nature: toward an integrative framework, J. Environ. Psychol. 15, 241–248.] and theorized components of restorative environments were used as an orientation for selection of the visual stimuli. Conducted in Taiwan, the studies recorded the psychophysiological responses of 110 laboratory participants while viewing 12 images that hypothetically represented the Being Away, Extent or Coherence, Fascination, and Compatibility components of restorative environments. Psychological responses were measured using the perceived restorativeness scale and physiological responses were recorded by electromyography (EMG), electroencephalography (EEG), and blood volume pulse (BVP) measurements. Results revealed a large degree of congruency between the psychological measures of restorativeness and the three physiological responses. Improved scores on the perceived restorativeness scale corresponded to increased EMG and EEG readings and lower BVP measurements. These findings provide some objective evidence toward the psychophysiological values; and perhaps benefits, of wildland–wilderness environments. The potential importance of wildland–wilderness environments for the restoration of human well-being is discussed.

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Keywords: Attention; Benefit; Therapeutic landscape; Biofeedback

1. Introduction

Hiking and walking for pleasure in wildland/wilderness areas is strongly associated with viewing of the natural environment. Wilderness offers the best of natural environments for people to view, an experience ranked high in participation surveys of outdoor and wilderness users (Cordell, 1999). Yet, we know little, in an empirical sense, about the visual perception and psychophysiological response of people while viewing the naturalness of wilderness environments.

Based on empirical studies, nature has been shown to provide better physiological, emotional, and attention restoration than urban environments (Hartig et al., 2003). Attention Restoration Theory (ART, Kaplan, 1995; Kaplan et al., 1998) provides a theoretical basis for this finding, and the foundation for our research question concerning the popular activities of hiking and sight-seeing in natural environments. It also addresses the following question, “what influence does the viewing of visual images of natural scenes and landscapes have on humans, and what are the benefits of this activity-experience?" Hiking for pleasure and relaxation are hardly sufficient, scientific answers.

It is largely out of research on natural environments that Attention Restoration Theory (ART) has emerged. ART, pro-
posed by the Kaplans (Kaplan, 1995; Kaplan et al., 1998), builds on the assumptions of limited human cognitive capacity, mental fatigue, and the possibilities of psychological recovery when in restorative environments, such as natural areas. It is concerned with the directed attention capacity that individuals use in demanding and/or uninteresting environments, such as work and stressful interactions with people–places. Directed attention capacity is subject to fatigue, which leaves the individual less capable of dealing with uncertainty, confusion and demanding tasks that are of little human interest. ART also posits that environments and functions requiring indirect attention allow for recovery from mental fatigue and thus the restorativeness of psychological processes and properties in individuals (Kaplan, 1995; Hartig et al., 1997).

Although ART, as proposed by the Kaplans, does not theorize any physiological aspects associated with psychological restorativeness, other researchers have suggested a link between psychological and physiological responses in natural environments (Ulrich, 1988; Ulrich et al., 1991). In addition, even though ART may not be directly intended for psychophysiological hypothesis testing, other Kaplan writings do suggest linkages between the psychological and physiological processes of individuals when functioning in natural environments (Kaplan and Kaplan, 1982). In our opinion, it seems reasonable to hypothesize that the psychological processes of recovery from mental fatigue could be associated with the physiological processes of brain and blood pulse activity during and/or resulting from the recovery/restoration process.

Attention restoration theory proposes that restoration occurs in environments and situations that involve four components: Being Away, Extent or Coherence, Fascination, and Compatibility (Kaplan, 1995). Restoration requires psychological and geographical distancing from aspects of one’s usual environs, routines and situations (Being Away), immersion in a coherent physical or conceptual environment that is of sufficient scope to sustain exploration (Extent), effortless attention as drawn by objects in the environment or engaged in the process of making sense of the environment (Fascination), and a good match between personal inclinations and purposes, environmental supports for intended activities, and environmental demands for action (Compatibility). Environments with elements of all four components promote the involuntary attention mode of information processing, and can lead to restorative experiences in which individuals may develop a state of cognitive clarity, enabling a pleasurable and contemplative state of mind (Korpela et al., 2001, p. 576). While ART proposes that all four of the restoration components must be present in an environment for it to be restorative (Kaplan, 1995), it does not posit that all must be present in equal proportion.

As mentioned, much of the research that ART developed from has been conducted in natural environments, including wilderness-type environments (Kaplan, 1984; Kaplan and Talbot, 1983; Talbot and Kaplan, 1986). Wilderness recreation and natural environments tend to rank high in the four properties of restoration environments and restorative experiences. However, there are other types of environments besides wilderness that have restorative properties—benefits, and these have been researched, as well. Rather than review the many studies that involve ART, the reader is referred to two recent special issues of journals that include 16 articles on restorative environments (Hartig, 2001; Hartig and Staats, 2003).

In this paper, ART was used to select images of natural environments that were hypothesized to have restorative character benefits (Ulrich et al., 1991). The scenes from the hypothetical recreation–restorative environments were then investigated to see if they elicited improved psychological and physiological reactions in people. Thus, the paper provides objective measures of experiential or in situ responses of a fairly large sample (n = 110) of laboratory individuals to a variety of natural settings (visual images). Because on-line measures of psychophysiological responses in the leisure sciences are rare, and large samples of these kinds of data even more rare, the data set represents a potentially valuable window into human responses to natural wilderness environments. Compared with initial researches that applied cardiac inter-beat interval (IBI) or diastolic blood pressure to measure participants’ reaction (Hartig et al., 2003; Laumann et al., 2003), we collect the direct and real-time data, such as muscle tension, with the input equipments instituted on a specific personal computer.

Through this research, we aimed to establish the recovery/restoration benefits response to natural environments. On the other hand, we also bridged the gap correlation between psychological and physiological reactions to naturalness/wilderness images.

2. Methods

2.1. Study area and participants

The research was conducted in the psychophysiological laboratory at the National Chung-Hsing University at Taichung, Taiwan. The laboratory is well equipped for psychophysiological research and several studies have been conducted with a focus on natural recreation areas, and psychophysiological response (Chang, 2003; Chang and Peng, 2000; Chang and Tzeng, 1998; Chang and Uan, 1999). This particular study was completed with 110 participants, consisting mainly of students and faculty of Chung-Hsing University.

2.2. Visual stimuli

The four components of Kaplan’s (1995) attention restoration theory – Being Away, Extent, Fascination, and Compatibility – served as indicators for choosing pictures of landscapes with hypothetical attention restorative capability. Images were chosen according to the theorized features and suggested examples of restorative environments mentioned and illustrated in Kaplan et al. (1998, pp. 67–80). Although these authors do not specify particular landscapes at the exclusion of others to exemplify the four restorative components, they do attempt to apply the concepts to environment design and management, and offer practical guidance through illustrative media and landscape examples. As an illustration, when discussing the component of Extent, the authors of ART suggest that Extent can be found in extensive
environments, such as mountain wilderness (p. 20); in small environments, such as Japanese gardens (p. 72); and/or abstract environments, such as a view from the window (p. 76). We used this type of guidance to select three photos to represent Extent. Similarly, the hypothesized Being Away set of three photos illustrated a sense of remoteness where one could forget the tasks and routines of everyday life (i.e., lying on the beach, lake views, and mature forests). Fascination scenes were selected to illustrate the theorized elements of soft fascination (i.e., sunsets, and flowing water) and organism fascination (i.e., fishing). Kaplan et al. (1998, p.69) provide illustrative scenes and text that guided our selection of fascination photos by stating, “open woods and rushing streams are just two of the many patterns of nature that can be fascinating” and that “fishing, canoeing, and wildlife viewing are activities that involve quiet fascination.” Compatibility scenes depicted functional opportunities, such as shorelines and field-trails to walk. In total, 12 images (three per each of the four restorativeness components) were shown to participants on a large screen.

2.3. Materials and procedures

2.3.1. Viewing images

To encourage participants to relax, soothing music was played during the instructional–explanation stage of the study, before the viewing of study images. Participants were also seated on a couch at a 3 m distance from the picture screen. In order to eliminate the influence of the viewing order of pictures, the images were projected randomly in 12 different combinations. Participants viewed each slide for 10 s, with measurement scores based on the entire viewing period. Instead of geometrical patterns as used by Berto (2005), this study’s non-viewing time between slides consisted of a solid blue image, projected for an equal time of 10 s. This option ensured the participants did not view a stimulus during non-viewing time that might vary in color, light level, texture, composition and configuration, as would have a view of scenery. An AELTA (AV 600) digital projector was used to show the visual scenes. The projector and physiological equipment were all placed behind participants to decrease annoyance of the machines on participant response.

2.3.2. Testing of physiological reactions

Physiological reaction values were recorded by using the Pro-comp+/Biograph V2.0 Biofeedback System made by Thought Technology Ltd., a system with a multi-modality 8-channel system. The biofeedback instrument is non-invasive, measuring human response by electrodes attached to the body. The response readings – feedback – are picked up as electrical signals displayed on equipment. Electromyography (EMG), brainwave activity (EEG), and blood volume pulse (BVP) are popularly used indicators. Guidelines for the facial and head placement of electrodes on subjects followed those specified by Cacioppo et al. (2000). Testing procedures and instrument application also followed procedural guidelines specified by Cacioppo et al. (2000). The resulting information was sent directly to the computer via a fiber-optic cable. Computer analysis software and precise sensors are included as part of the equipment. Skeletomuscular (muscle tension) or electromyography (EMG) response was measured using the facial muscles of the forehead. Facial muscles on the forehead can reflect mental and emotional stress better than other muscles. Tension felt by the forehead extends to other parts of the body, even while other parts of the body are relaxed. Therefore, three electrodes were placed 1.5 in. above the eyebrows of each participant, the middle one was “the reference,” a reference point of the other two electrodes, called “source 1” and “source 2.” By using the potential difference between the reference and source 1 as well as source 2, unrelated information is eliminated. An increase in EMG amplitude indicates a level of muscle tension increase, and vice versa.

Bioelectrical (brain wave) or electroencephalography (EEG) response was detected by placing the electrodes on the scalp, through which the brain waves, produced by the cerebral cortex, are amplified and recorded by the electroencephalograph. The medial prefrontal cortex is the main position where the EEG is performed; therefore the electrodes are attached, at equal distance, at the front, back, left, and right of the forehead. An increase in EEG values indicates an increase in level of alpha brainwave activity. Both the alpha wave of the left hemisphere of the brain (EEGa) and the right hemisphere brainwave (EEGb) were recorded.

Cardiovascular blood volume pulse (BVP) was measured using an infrared detector, which senses the degree of cardiovascular change by emitting infrared waves, which in turn are reflected by blood cells in participants’ fingertips. A sensor was placed on the middle finger of the non-dominant hand to measure BVP. By analyzing the spectrum of the signals reflected by the blood cells, it is possible to know a participant’s pulse and his/her speed of blood circulation. An increase in BVP amplitude indicates decreased sympathetic arousal and greater blood flow to peripheral vessels.

2.3.3. Testing of psychological reactions

The scale items of the perceived restorativeness scale (PRS) proposed by Purcell et al. (2001) was translated into traditional Chinese and used for the evaluation of participants’ psychological reactions. Based on the four components of restorative environment (six items for Being Away, four items for Extent or Coherence, seven items for Fascination, and six items for Compatibility) were selected. In order to be consistent with the features proposed in the Attention Restoration Theory, the additional subscale for the Scale developed in that article was not used), 23 items such as “This place is a refuge from unwanted distractions (Being Away),” “This place is fascinating (Fascination),” “There is a clear order in the physical arrangement of the place (Coherence),” and “This place does not place demands on me to act in a way I would not choose (Compatibility)” were used to test degree of attention restorativeness after viewing each image. The 23 items were rated on a 5-point scale of agreement ranging from 1 = very much agree, 3 = neutral, 5 = very much disagree. Cronbach alphas were computed on the specific number of items for each of the four PRS components. The repeated measures analysis of variance (ANOVA) was adopted to compare the participant’s physiological responses (EMG, EEG, and
Table 1
The mean value of the attention restoration score for each restoration component (PRS items) while viewing the four sets of images depicting each component

<table>
<thead>
<tr>
<th>Restorative features</th>
<th>Attention Restoration Score</th>
<th>Mean</th>
<th>S.D.</th>
<th>Rank</th>
<th>Pairwise comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being Away</td>
<td>Being Away</td>
<td><strong>1.90</strong></td>
<td><strong>0.56</strong></td>
<td>1</td>
<td>Being Away vs. Coherence</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td>2.24</td>
<td>0.55</td>
<td>4</td>
<td>Being Away vs. Coherence</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td>1.99</td>
<td>0.55</td>
<td>2</td>
<td>Coherence vs. Fascination</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>2.18</td>
<td>0.65</td>
<td>3</td>
<td>Fascination vs. Compatibility</td>
</tr>
<tr>
<td>Coherence</td>
<td>Being Away</td>
<td>2.75</td>
<td>0.71</td>
<td>3</td>
<td>Being Away vs. Coherence</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td><strong>2.42</strong></td>
<td><strong>0.61</strong></td>
<td>1</td>
<td>Being Away vs. Fascination</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td>2.55</td>
<td>0.75</td>
<td>2</td>
<td>Coherence vs. Compatibility</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>2.79</td>
<td>0.66</td>
<td>4</td>
<td>Fascination vs. compatibility</td>
</tr>
<tr>
<td>Fascination</td>
<td>Being Away</td>
<td>2.36</td>
<td>0.82</td>
<td>2</td>
<td>Fascination vs. Compatibility</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td>2.40</td>
<td>0.55</td>
<td>3</td>
<td>N.S.</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td><strong>2.27</strong></td>
<td><strong>0.82</strong></td>
<td>1</td>
<td>N.S.</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>2.47</td>
<td>0.93</td>
<td>4</td>
<td>N.S.</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Being Away</td>
<td>2.02</td>
<td>0.50</td>
<td>4</td>
<td>Being Away vs. Fascination</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td>2.01</td>
<td>0.59</td>
<td>3</td>
<td>Coherence vs. Fascination</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td><strong>1.88</strong></td>
<td><strong>0.58</strong></td>
<td>1</td>
<td>N.S.</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td><strong>1.94</strong></td>
<td><strong>0.63</strong></td>
<td>2</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

The bold values represent the rank of the scores.

* Means based on a 5-point scale of agreement, where 1 = very much agree, 3 = neutral, 5 = very much disagree.

* Pairwise comparisons that were significantly different, *p* ≤ 0.05; N.S. = not significant.

BVP) on different restorative environments (Being Away, Fascination, Coherence, Compatibility).

In summary, previous psychological research concerning ART has shown that the PRS has had success at measuring the theoretical, restorative components in natural landscapes/environments. Psychophysiological research, associated with measuring stress recovery/restoration response to natural environments, has also suggested a relationship between improved psychological restorativeness and physiological condition. Oriented by this theoretical perspective and past research findings, the following hypotheses were developed for investigating the psychophysiological responses to visual images of natural and wilderness environments.

1. Although restorative environments must contain all four of the theorized components of ART, visual landscapes selected to hypothetically rate higher on a particular component will receive higher perceived restorativeness scores (PRS) on that specific component, as compared to the other three components present.

2. Viewing of the restorative environment images will produce improved physiological responses over the non-viewing control image.

3. Results and discussion

3.1. Psychological response

The internal consistency (reliabilities) for the four restorative components was computed by calculating the Cronbach’s alpha for all 23 PRS items ratings that were completed for each of the four trio of photos selected to represent the four restorative components. The Cronbach alphas were acceptable, being 0.86 (Being Away), 0.90 (Coherence), 0.95 (Fascination), and 0.91 (Compatibility). After each trio of component images was established as being a reliable measure, the PRS mean values for the four restorative components were computed for each trio of images. The means compared within each trio of slides to determine if the images selected to hypothetically represent a component of restorativeness scored higher on that specific component as compared to the other three components (Hypothesis 1). Congruent results were obtained for the Being Away, Coherence, and Fascination image categories, with each set of photos

Table 2
The mean value of respondents’ physiological responses

<table>
<thead>
<tr>
<th>Physiological responses</th>
<th>Landscape feature</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEGa</td>
<td>Being Away</td>
<td>22.14</td>
<td>28.76</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td>19.04</td>
<td>25.46</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td>19.05</td>
<td>26.72</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>19.53</td>
<td>29.28</td>
</tr>
<tr>
<td></td>
<td>Non-viewing</td>
<td>6.18</td>
<td>4.01</td>
</tr>
<tr>
<td>EEGb</td>
<td>Being Away</td>
<td>23.86</td>
<td>35.48</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td>20.21</td>
<td>28.06</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td>18.72</td>
<td>26.74</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>17.36</td>
<td>24.40</td>
</tr>
<tr>
<td></td>
<td>Non-viewing</td>
<td>6.03</td>
<td>3.60</td>
</tr>
<tr>
<td>EMG</td>
<td>Being Away</td>
<td>11.45</td>
<td>7.70</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td>10.96</td>
<td>8.01</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td>9.63</td>
<td>7.05</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>10.03</td>
<td>8.08</td>
</tr>
<tr>
<td></td>
<td>Non-viewing</td>
<td>8.67</td>
<td>7.77</td>
</tr>
<tr>
<td>BVP</td>
<td>Being Away</td>
<td>25.02</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>Coherence</td>
<td>25.04</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Fascination</td>
<td>25.01</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>25.02</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>Non-viewing</td>
<td>25.22</td>
<td>0.73</td>
</tr>
</tbody>
</table>

EEGa, alpha wave of left side of brain; EEGb, alpha wave on right side of brain.
Table 3
Repeated measures ANOVA of participant’s physiological responses on different restorative environments

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III SS</th>
<th>d.f.</th>
<th>F</th>
<th>Significance</th>
<th>Pairwise comparisonsa</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEGa</td>
<td>17386.36</td>
<td>3.41</td>
<td>11.09</td>
<td>1 &lt;0.001</td>
<td>Being away vs. non-viewing; Coherence vs. non-viewing; Fascination vs. non-viewing; Compatibility vs. non-viewing</td>
</tr>
<tr>
<td>EEGb</td>
<td>19858.99</td>
<td>2.86</td>
<td>12.01</td>
<td>1 &lt;0.001</td>
<td>Being Away vs. non-viewing; Coherence vs. non-viewing; Fascination vs. non-viewing; Compatibility vs. non-viewing</td>
</tr>
<tr>
<td>EMG</td>
<td>530.97</td>
<td>2.77</td>
<td>18.58</td>
<td>1 &lt;0.001</td>
<td>Being Away vs. Fascination; Being Away vs. compatibility; Being Away vs. non-viewing; Coherence vs. Fascination; Coherence vs. compatibility; Coherence vs. non-viewing; Fascination vs. non-viewing; Compatibility vs. non-viewing</td>
</tr>
<tr>
<td>BVP</td>
<td>3.54</td>
<td>2.31</td>
<td>10.45</td>
<td>1 &lt;0.001</td>
<td>Being Away vs. non-viewing; Coherence vs. non-viewing; Fascination vs. non-viewing; Compatibility vs. non-viewing</td>
</tr>
</tbody>
</table>

a, alpha wave of left side of brain; b, alpha wave on right side of brain. Note: the Mauchly’s W Statistic was significant in all four cases (i.e., 0.000 < p < 0.05, Mauchly’s Test of Sphericity), and therefore, the Greenhouse–Geisser correction was used.

a Pairwise comparisons that were significantly different, p ≤ 0.05.

ranking first on its respected restorative component (i.e., lowest mean score, Table 1). In the case of the Compatibility categ-

ory, the images ranked first on the PRS Fascination component and second on Compatibility. Laumann and others (2003) found

using verbal stimuli, that Compatibility was not always differenti-
tiated from Fascination by respondents. In the same way, maybe

the subjects’ motivations and intended activities (e.g., mountain

climbing) are restrained by the photos. Although some of the

comparisons were not statistically significant, these results pro-

vide an element of construct validity and offer partial support

for Hypothesis 1.

The images proposed as examples of the four restorative

components were generally rated as hypothesically selected,

although not cleanly enough to be treated as representing those

components. Although Kaplan et al. (1998) do not necessarily

expect the exemplar environments offered in their text to be

clean representatives of the different components, our findings
do largely uphold their notions, enhancing our confidence in the

validity of the restorative components. Perhaps this is the con-

tribution of our research; that there is a degree of congruence
between the actual PRS scores of participants and the theorized
examples of restorative environments of Kaplan and others.

3.2. Physiological response

Because the restorative environment images cannot be a pure
example of certain specific restorative components, we cannot
interpret the physiological changes as responses to a particular
component of the restorative images. The responses are likely
a complex response to a combination of the restorative com-
ponents. This is a reality despite our attempt to select visual
stimuli to perhaps represent certain restorative components over
others within the images, based on literature guidance. How-
ever, the significant differences between the images selected to
represent certain restorative components and the non-viewing
images do provide a better understanding of baseline levels
(mean scores associated with non-viewing) and changes of phys-

iological response to restorative images.

Table 2 reports four physiological measurements for the four
sets of restorative images and the non-viewing control image,

thus reflecting the degree of change from the non-viewing
condition. All four of the physiological responses reveal an
improved condition over the non-viewing measurements, with
EEGa, EEGb, and EMG measures increasing and BVP decreasing
(Hypothesis 2). When examined for significant change over the
non-viewing condition, the differences were found to be
statistically significant, p ≤ 0.05 (Table 3).

These findings provide an element of converging psychophy-

siological evidence for restoration when viewing natural
images. The findings also support and extend previous findings
related to stress recovery and restoration in natural environments
(Ulrich et al., 1991; Parsons et al., 1998) where the authors have
found faster, more complete, and longer lasting improvements in
physiological conditions after viewing natural-restorative envi-

ronments.

4. Conclusions

What influence does the viewing of visual images of natural
scenes have on humans and what might be the psychophysio-
logical response? This was the general question that was the
driving force behind this study. It was proposed that natural
environments (images) selected to contain features of the four
restorative components of Being Away, Coherence, Fascina-
tion, and Compatibility, would elicit improved psychological
(PRS values) and physiological (EEG, EMG, BVP values)
responses from viewers, inferring that visual resources of wilder-
ness environments produce nature related restorative-leisure
benefits (Ulrich et al., 1991). Results from the psychophysiol-
ogical responses lend support for this proposed relationship, and
confirms previous research demonstrating the value of natural
and wilderness environments at producing restorative experi-
ences.

There has been considerable research supporting the psycho-
logical response (i.e., PRS scores) associated with hypothesized
restorative environments (Hartig, 2001; Hartig et al., 1991,
1997, 2003). However, there has been little corresponding
research that has examined the degree of congruency between
psychophysiological responses to hypothesized components of
restorative environments. Our psychophysiological findings
contribute an element of knowledge to this area of research, suggesting that there is a degree of congruency between actual PRS scores and physiological responses of human subjects and the theorized examples of restorative environments proposed by Kaplans and others. Additional research concerning the theorized examples and character of restorative environments should contribute to the application and design elements of restorative environments and experiences (Kaplan et al., 1998).

As new knowledge is gained concerning the application and design elements of restorative environments and experiences, landscape and urban planners will have an opportunity to be leaders in this new area of study. There is already considerable societal interest in understanding the restorative character and health benefits of natural environments for children, as documented in the recent book, “Last Child in the Woods” (Louv, 2006). If there truly is a nature-deficit disorder in today’s children, then the understanding of restorative environments and their utility is crucial.

Our research, though but one narrow investigation into the potentially rich field of recreation–restorative environments, offers several future research questions. For example, to what extent do different wildland recreation environments evoke different psychophysiological responses? Do favorite places and wilderness areas of extreme naturalness rank higher in value/benefits from a psychophysiological perspective? And, what environmental features and/or recreation settings yield the “higher” responses? From a “negative” response perspective, what are the psychophysiological repercussions when daily hassle and conflict settings (e.g., crowding) occur in wilderness environments? Urban environments are not the only sources of stress: there are examples within wilderness and other recreation environments! How does recovery from stressful settings in recreation environments occur in a psychophysiological sense? Secondly, to what extent do individuals differ in their responses to a given wilderness environment? Do individuals prone to stress or those with a strong coping strategy repertoire respond differently? Thirdly, given that these data are on-line, how do responses develop and/or change over time? To which degree can physiological response be recorded as a wilderness environment and experience unfolds in the field?

Because our research is only an initial exploration of the congruency between PRS scores and physiological responses of subjects and the theorized examples of restorative environments proposed, it contains some limitations. The first concern is construct validity. While we are measuring positive human response to natural environments and believe it to be related to the restorative components and character of these environments, we are limited in the certainty of this conclusion. A second limitation involves the complexity of interpreting biofeedback readings. There are different interpretations by scientists as to the exact contextual meaning of brain wave readings, plus there are confounding factors that are difficult to limit in laboratory settings. These limitations suggest that more study is required concerning both the mechanism and the complexity of the interpretation of human response to restorative environments.

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References


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