

Nature Imagery and Mystery on Attention Restoration

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The attention restoration theory centres on the environment's capacity to restore attentional deficits and suggests that there are certain qualities in the environment that restore attention, which leads to improvements in our physical, mental, and social well-being. An environment can be restorative through the activation of involuntary attention, which limits the need for directed attention.

Keywords: attention restoration ; environment settings ; mystery

1. Introduction

Environmental psychology is the study of interrelationships between people and their physical environments, including how people perceive and respond to the physical environment ^[1]. Understanding the physical environment has important implications on how we react to the world around us. People's physical, mental, and social well-being can be affected by the surrounding environments and landscapes ^[2]. Understanding how the different environments and landscape elements can contribute to health improvement is essential to provide new landscape designs beneficial to human health.

The factors contributing to urbanization, such as population growth and the development of mega-cities, have increased environmental stressors on top of everyday stressors, resulting in information overload. This has led to the increasing incidence of direct attentional fatigue, which causes stress and mental fatigue among urban residents ^[4]. Natural environments can help reduce stress and promote the recovery of mental fatigue ^{[3][4][5]}. Restoration "proceeds in tandem with other processes that also affect the resources that people use to meet everyday demands" ^[6] (p. 2). According to the attention restoration theory (ART), full restoration does not amount to a mere recovery of directed attention capacity, because part of the restorative experience is for individuals to reflect on unsolved life issues ^[3].

The investigation of the beneficial effects of nature and urban settings departs from two theoretical perspectives. According to the ART, nature exposure experiences allow for either improvements in mood states accompanied by physiological changes ^[7] or the restoration of attention deficit ^{[3][4]}. Roger Ulrich's ^[5] stress reduction theory centres on the environments' capacity to influence affective states. In this model, affective responses towards the environment are mediated by changes in mood states, which may result from exposure to different environments that have varying stress-reducing capacities. The rapid, automatic, and unconscious process through which individuals respond to the environment can be attributed to the important subcortical areas in the brain, especially the amygdala, which is involved in modulating stress-related hormones ^[8]. This explains why different types of environments can have a different influence on autonomic stress responses. For instance, there is evidence which suggests a much stronger stress-reducing capacity of nature as compared to urban environments ^{[9][10]}. Exposure to nature can lead to greater psychological well-being, fewer negative mood states, stronger positive affect, and other physiological symptoms such as lower heart rates and reduced muscle tension as compared to urban environments ^[11].

This contrasts with the framework of Kaplan's attention restoration theory (ART), which centres on the environment's capacity to restore attention deficits. The ART holds that intensive or prolonged use of directed attention, which is a limited resource, leads to the fatigue of the mechanisms that serve it ^{[4][12][13]}. Directed attention fatigue has negative consequences that include negative emotions, irritability, impulsivity, decreased sensitivity to interpersonal cues, reduced ability to plan, and decrements on tasks requiring directed attention ^[14]. Thus, overworking the mind can result in the depletion of resources and a reduction in the ability to utilize higher-order executive functions used in cognition. In contrast, switching over to involuntary attention allows for the attentional system to rest and recover, since it is effortless. This provides an opportunity for the individual to restore and be recharged through clearing away unwanted thoughts, ultimately enabling a contemplative state of mind.

Specifically, an environment can be restorative by attracting the activation of involuntary attention and limiting the need for directed attention ^[15]. Such settings are known as restorative settings. Natural environments (e.g., preserved parks,

nature trails, forests) have been demonstrated to be inherently restorative by freeing up directed attention resources through involuntary attention. In contrast, the array of stimuli in urban environments requiring directed attention is distracting rather than restorative [13]. Cognitive benefits for children with attentional deficits [16] and normal adults [12][14][17] have been demonstrated outcomes of interaction with nature, as have been improvements in short-term memory [18] and school success [19]. However, natural environments are not all equal in the level of restoration afforded to people who are mentally fatigued. The ART asserts that there are four properties of restorative settings: being away, extent, compatibility, and fascination.

Being away involves distancing oneself from usual activities that are taxing on directed attention, leading to attentional fatigue [20]. Being away can either be physical, such as leaving the office for a walk or a beach vacation, or conceptual, where well-worn mental content is avoided [12]. For example, a sense of “being away” can be induced by watching a favourite television programme or reading a favourite book. Scopelliti and Giuliani [21] highlighted that it is often more restorative to be conceptually distinct from the everyday environment as compared to a physical change.

Extent is generated by environments that have sufficiently rich content and a coherent structure, which allows one to feel connected and engaged in a “whole other world” [4] (p. 173). Extent is defined by the experience of two components: scope and connectedness. Scope refers to the scale of the domain (e.g., conceptual, perceptual) in which the activity occurs, wherein there is more than the immediate environment available, either physically just out of sight or even within the imagination [3]. On the other hand, connectedness is defined by the series of relationships between immediately perceived environmental features that relate to each other and to a larger environment [22]. Such environments engage the mind for a sufficient duration so that directed attention rests while supporting extended exploration. Extent, via scope and connectedness, can be experienced not only in physical environments, but also in psychological processes [22].

Compatibility requires that a setting be well-suited both to the individual's purpose and to the types of activity anticipated in the setting [23]. The potential for engaging an individual is dependent on the available information in supporting the individual's intentions or what the individual is trying to achieve. Natural settings can be compatible with a wide range of activities (e.g., biking, observing wildlife, kite flying, etc.) that align with the desires or interests of visitors [23]. These types of activities create familiarity and ease, thus creating opportunities for individuals to withdraw their voluntarily directed attention and gain restoration through engagement with the environment. Kaplan and Berman [13] argue that compatibility between the environment and the person is needed to restore directed attention, a common resource used in executive functioning and self-regulation tasks.

Fascination is a crucial component of the ART because inherently interesting stimuli capture attention without requiring effort, and thereby allows for the restoration of directed attentional capacity [4][23]. Fascination is elicited when the individual is engaged in inherently interesting stimuli that capture one's attention effortlessly, without having to use directed attention [3].

Settings can range along a spectrum from soft fascination to hard fascination. Soft fascination is usually a response to gentle stimuli which are moderate in intensity (e.g., the changing shape of cloud formations, or rain drops glistening on leaves), whereas hard fascination is usually high in intensity and rivets one's attention (e.g., tracking the action in a sports game, or engaging in gambling activities) [4]. Both soft and hard fascination share the aspect of captured attention but have different restorative effects. Soft fascination is common in natural settings (e.g., viewing a sunset) and best promotes attention restoration as it allows one to think freely [24].

Many studies have shown that fascination can be triggered by the attention-drawing qualities of natural settings (e.g., forests, beaches). Berto [25] has shown that attention restoration can occur in less than 10 min through exposure to images of natural environments rated as being high on perceived fascination. Similarly, photographs of environments rated as displaying content high in fascination that engage involuntary attention generate fewer eye fixations as compared to low-fascination photographs [26]. This suggests that less capacity of directed attention and focus is required for images high in fascination, thereby allowing for greater attention restoration.

However, fascination is not only engaged in the processes of landscape perception (i.e., exploring and making sense of the environment). It can also be activated by particular content (e.g., animals, people, water, nature), events (e.g., storytelling, watching competitive sports, gambling) and processes in which there is an element of uncertainty involved (i.e., reading a book that is unresolved until the end) [4]. It is important to consider the pleasantness, intensity, and functionality dimensions of fascination, which may differ for each individual [22]. While soft fascination appears to be advantageous for restoration, restoration might be advanced by more intense fascination, especially if it contributes to a sense of extent.

The proposed three other components—being away, extent, and compatibility—are likely to enhance and contribute to attentional recovery and, together with fascination, their combined effect is what makes an environment restorative [4].

2. The Impact of Restorative Environments

A vast amount of literature has been devoted to examining the applied utility of the ART in terms of the cognitive benefits of nature exposure. In addition to improved attentional capacity, direct exposure to nature has also been associated with increased connectedness to nature, positive emotions, and improved ability to reflect on life problems [27]. Most research has examined the restorative effects of participants being physically immersed in the natural environment as compared to urban environments, but these benefits also carry over when simulated forms or visual representations of nature are used. Simply observing natural scenes has been shown to improve executive attention in young adults, as compared to viewing pictures of urban scenes [28]. Similarly, Berto [25] reported improved attentional capacity from measures of accuracy, reaction time, and target detection after viewing restorative nature images on a sustained attention test. Large dramatic nature murals, especially those containing elements of water, were also perceived by students as being more restorative places to study than settings of real mundane natural environments with built structures present [20]. This suggests that large nature murals used in indoor settings for study breaks may provide attentionally fatigued students with opportunities for attention restoration. This is especially advantageous in urban cities where views of nature are unavailable or limited in resource.

3. The Role of Mystery in ART

Natural settings are not all equal in their ability to enable mental restoration. It appears that high-mystery natural settings may enable restoration more so than low-mystery settings, and mystery can be used to predict environmental preference [29][30][31]. Kaplan and Kaplan [3] proposed that dual needs to understand and to explore an environment determine one's visual preference for a landscape. These two dimensions were utilized to produce a preference matrix containing four variables. Mystery is a scenic quality and is one of the informational variables proposed in the Kaplans' environmental preference matrix. Mystery refers to features that draw one's curiosity or attention through indications that the landscape has more to offer [29]. Other variables such as coherence, legibility, and complexity play an equally important role in influencing an individual's preference for an environment [30]. These four visual preference predictors provide information to further our understanding of the preference and perceived comfort of such environments. Therefore, it is possible to manage and design natural and urban environments based on these informational needs [32].

In the case of mystery, physical attributes (e.g., depth of field, spatial definition) that often contribute to a person's perception of mystery may enhance the perception of the level of complexity [31]. Examples include partially concealed views (e.g., sinuous paths or views obscured by tall grasses or shrubs) which draw the viewer's attention through the impression that there is more to be found. Thus, these kinds of settings contain the element of fascination as they increase the potential to learn something new and thereby prompt interest. Szolosi et al. [31] also suggest how mystery is a component of fascination from the tests of mediation which showed that mystery affects recognition performance as a consequence of such perceptions. Hence, images depicting settings high in mystery usually include soft fascination. Through a novel oculometric methodology to explore engagement with environments depicted in images, Marois et al. [33] proposed that it is the voluntary engagement with mystery and soft-fascination components of nature that helps bring about restoration by reducing cognitive demand.

Among the four predictors of visual landscape preference, only mystery was significant in explaining the perceived restoration potential in nature and urban environments [32]. However, there is no general consensus on this line of argument. No significant correlations were found between mystery and preference in natural and built environments [34][35].

4. Perceived vs. Actual Attention Restoration

Perceived restorative potential is defined as the individual's judgement of the degree to which an environment can aid in the recovery of mental resources [36]. For example, an individual's perception of a setting with high restorative potential will lead to the expectation of psychological, emotional, or physiological recovery after spending time in that perceived restorative space. However, perceived restoration differs from actual psychological restoration, which is an improvement to an individual's well-being (e.g., recovery of cognitive resources, reduced stress).

Most recently, studies have begun to discuss the ART in the context of the different cognitive processes that attention may require [9][17][25][28]. Natural environments capture involuntary attention, which requires little top-down processing, and

thereby tends to have a positive effect on cognitive performance [37]. In contrast, urban or city-like environments capture dramatic attention and require directed attention and show no improvement on cognitive performance. Kaplan [4] linked the ART to the attention theory through a specific reference to processes such as selection, problem solving, and inhibition, amongst others. An individual would need to hold and replay visual and auditory stimuli and manipulate them according to the rules stored in short-term memory, while suppressing distracting alternative attentional cues in order to perform well on such measures [18]. As such, the higher demands on executive functions of attention such as working memory can be used as a measure of actual restoration.

With the assumption that nature affords opportunities for effortless attention, it is generally expected that participants perform better on cognitive tasks when exposed to natural scenes as opposed to urban scenes. Research has shown improved performance after exposure to natural settings, directly or through images, on the Necker cube pattern control task [9][38], the attention network task (ANT) [28], the digit span task [28][38], the sustained attention to response task (SART) [39], and the digit symbol substitution test (DSST) [40]. Berman et al. [28] reported substantially more correct trials on a digit span task after a walk in nature compared to a walk in city streets. A similar pattern has also been observed as performance on the digit span task and the executive portion of the ANT also increased by nearly 30% during exposure to natural pictures when compared to viewing urban pictures [28]. Likewise, this trend is observed on the DSST in individuals when walking alone or with a friend in natural settings [40] as well as on the digit span task in individuals diagnosed with depression [41] and in children with attention deficits [16].

A distinction needs to be made between the properties of objects (e.g., images, videos, actual environments) that affect perceived restoration and objectively measured attention restoration following exposure to such properties. In fact, the extent to which perceived restoration predicts actual attention restoration appears to be overestimated [42]. While it is often assumed that individuals are aware of their own cognitive processes and are able to accurately predict and estimate how different environments will affect them, such an assumption is not well evidenced [43].

Most studies have either investigated the effect of attention restoration using self-reported questionnaires similar to the PRS (e.g., [20]) or performance task measures alone [25][28]. Furthermore, restoration should occur regardless of whether it is perceived if there is an interaction between directed attention and the object's properties. Thus, the true restorative effect of natural environments may be overrepresented, and the restorative effect of built environments misrepresented, since there is no concrete evidence that perceived restoration has an impact on related cognitive effects.

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