

# 6 Restorative environments



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## CHAPTER OUTLINE

- 6.1 INTRODUCTION** 58
- 6.2 RESTORATIVE ENVIRONMENTS RESEARCH** 58
- Stress recovery theory 59
  - Attention restoration theory 60
- 6.3 THE EVOLUTIONARY ORIGINS OF RESTORATIVE NATURE EXPERIENCES** 61
- 6.4 RECENT THEORETICAL AND EMPIRICAL DEVELOPMENTS** 62
- Perceptual fluency account 62
  - Connectedness to nature 62
  - Micro-restorative experiences and instorative effects 63
- 6.5 APPLICATIONS AND IMPLICATIONS** 64
- 6.6 SUMMARY** 65
- GLOSSARY** 65
- SUGGESTIONS FOR FURTHER READING** 66
- REVIEW QUESTIONS** 66

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## 6.1 INTRODUCTION

What would you recommend to a friend who is feeling stressed and worried? Go to sleep? See a funny movie? Or take a walk in the forest? Chances are high that you will pick the latter option. Indeed, going into nature is probably among the most widely practiced ways of obtaining relief from **stress** and fatigue in modern Western societies. How can this be explained? More than 150 years ago, the American landscape architect Frederik Law Olmsted already noted that ‘scenery worked by an unconscious process to produce relaxing and “unbending” of faculties made tense by the strain, noise and artificial surroundings of urban life’ (Beveridge, 1977, p. 40). This analysis seems strikingly modern and prefigures recent theoretical formulations concerning the so-called ‘restorative’ or stress-relieving effects of nature. In this chapter, we will give an overview of theories on restorative effects of natural environments, along with a discussion of empirical findings and practical implications.

## 6.2 RESTORATIVE ENVIRONMENTS RESEARCH

The word **restoration** is an umbrella term that, within environmental psychology, refers to the experience of a psychological and/or physiological recovery process that is triggered by particular environments and environmental configurations, i.e. **restorative environments**. A substantial number of experiments have shown that natural environments tend to be more restorative than urban or built environments (see Box 6.1). Exposure to restorative natural environments may contribute to well-being and the prevention of disease and illness. As such, restorative environments are a prominent topic in the study of health benefits of nature (see Chapter 5).

Research into restorative environments has primarily been guided by two theoretical explanations, each with its own interpretation of the construct of restoration. First, **stress recovery theory** (SRT: Ulrich, 1983; Ulrich et al., 1991) is concerned with restoration from the stress which occurs when an individual is confronted with a situation that is perceived as demanding or threatening to well-being. Second, **attention**

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## BOX 6.1 THE EXPERIMENTAL PARADIGM IN RESTORATIVE ENVIRONMENTS RESEARCH

Restorative effects of natural and urban environments are typically studied in an experimental paradigm. In this paradigm, healthy volunteers first receive a stress or fatigue induction treatment (e.g. watching a scary movie; performing mentally fatiguing tasks). Next, they are randomly exposed to real or simulated natural versus built environments. Stress and/or mental fatigue are measured at (at least) three points in time: at the start of the experiment (Time 1), after the stress-induction (Time 2), and after exposure to the natural or built environment (Time 3). Changes from Time 1 to Time 2 indicate the effectiveness of the stress induction, while changes from Time 2 to Time 3 indicate the restorative effect of the environment. The three main categories of dependent measures used in restorative environments research are

- *affective measures* (e.g. how happy/sad/stressed do you feel at this moment?);

- *cognitive measures* (e.g. **attention** and memory tasks);
- *physiological measures* (e.g. heart rate, blood pressure, skin conductance, cortisol levels).

These experiments consistently demonstrate that stressed and/or fatigued individuals who are exposed to scenes dominated by natural content have more positive mood changes, perform better on attention tasks and display more pronounced changes characteristic of physiological stress recovery than stressed individuals who are exposed to scenes dominated by built content. These restorative effects have been found for all kinds of natural environments including forests, rural scenery, waves on the beach and golf courses (Velarde, Fry, & Tveit, 2007).

**restoration theory** (ART: Kaplan, 1995; Kaplan & Kaplan, 1989) focuses on the restoration from attentional fatigue that occurs after prolonged engagement in tasks that are mentally fatiguing. Although there has been discussion on the compatibility of SRT and ART (Kaplan, 1995; Ulrich et al., 1991), the two theories are generally regarded as complementary perspectives that focus on different aspects of the restorative process (Hartig, Evans, Jamner, Davis, & Gärling, 2003). In the sections that follow the two theories are explained in more detail.

### **Stress recovery theory**

Roger Ulrich laid the foundations for SRT in the 1983 article 'Aesthetic and affective response to natural environment'. Based on the work of Zajonc (1980), he argued that people's initial response towards an environment is one of generalised affect (i.e. like, dislike), which occurs without conscious recognition or processing of the

environment. Initial positive **affective** responses come about when specific environmental features or **preferenda** are present in the environment. These features include the presence of natural content (e.g. vegetation) as well as more structural features such as complexity, gross structural features (e.g. symmetries), depth/spatiality cues, an even ground surface texture, deflected vista (e.g. a path bending away) and absence of threats. Quick positive affective responses to these features initiate the restorative process because they provide a breather from stress, accompanied by liking and reduced levels of **arousal** and negative feelings such as fear. If the scene draws enough interest, more conscious **cognitive** processing of the environment may take place, which may result in a more conscious and deliberative restorative experience.

### Attention restoration theory

While SRT considers restoration as a quick, affect-driven process, ART emphasises the importance of slower, cognitive mechanisms in restoration. ART was fully described for the first time in 1989 by Rachel and Stephen Kaplan in the book *The experience of nature*. In this book, the Kaplans provide a broad overview of their long-term research on people's relationship with nature, which encompasses not only restorative experiences but also perceptions and visual preferences. In the latter domain, Kaplan and Kaplan (1989) are well known for their 'preference matrix', a framework for predicting people's landscape preferences (see Chapter 4 for a detailed discussion of this model). The preference matrix is sometimes confused with ART, because both models consist of four components and were developed by the same authors. However, the preference matrix and ART should be considered as distinct models, each focusing on different aspects of the people-nature relationship.

A core assumption of ART is that people only have a limited capacity to direct their attention to something that is not in itself interesting. The cognitive mechanism necessary to inhibit or block out competing stimuli, called the **central executive**, becomes depleted with prolonged or intensive use (Kaplan & Berman, 2010). Depletion of this central executive mechanism can result in **directed attentional fatigue (DAF)**. ART predicts that environments can counter DAF when the human-environment relationship is characterised by four qualities: **fascination** or the capacity of an environment to automatically draw attention without cognitive effort, a sense of **extent** or connectedness, **being away** from daily hassles and obligations, and a **compatibility** between the individual's inclinations and the characteristics of the environment (see also Box 6.2). Because the combination of these four qualities is most typical for human interactions with natural environments, these environments tend to be far more effective in countering DAF than most built settings. However, restorative experiences are also possible in other settings, such as monasteries (Ouellette, Kaplan, & Kaplan, 2005) or museums (Kaplan, Bardwell, & Slakter, 1993).

## BOX 6.2 PERCEIVED RESTORATIVENESS

In addition to measuring actual changes in people's restorative state after exposure to environments (see Box 6.1), a second line of research has focused on measuring the perceived restorative potential of environments. Most of these studies have used the *perceived restorativeness scale* (PRS; Hartig, Korpela, Evans, & Gärling, 1996, 1997) or some variation of it. The PRS consists of statements that tap the four restorative characteristics described by ART. For each statement, respondents are asked to indicate on a Likert-type scale the extent to which the statement fits their experience of a given environment (ranging from 'not at all' to 'completely'). Sample items are:

- *There is much going on (extent/coherence);*
  - *Spending time here gives me a break from my day-to-day routine (being away);*
  - *I can do things I like here (compatibility).*
- A recurrent finding is that natural environments tend to be perceived as more restorative than built environments (Berto, 2005; Hartig et al., 1997; Herzog, Colleen, Maguire, & Nebel, 2003; Laumann, Gärling, & Stormark, 2001). The scale has been successfully used to evaluate the restorativeness of landscape designs (Tenngart Ivarsson & Hägerhäll, 2008) and zoo attractions (Pals, Steg, Siero, & Van der Zee, 2009).
- *My attention is drawn to many interesting things (fascination);*

## 6.3 THE EVOLUTIONARY ORIGINS OF RESTORATIVE NATURE EXPERIENCES

Restorative responses are often interpreted as relics of human evolution in a natural world. Specifically, it has been proposed that certain natural features (e.g. verdant vegetation) and particular natural landscapes (e.g. savannahs) could offer ancestral humans resource opportunities and safety (e.g. trees as shelters), and in so doing, promoted human survival (Ulrich, 1983; Ulrich et al., 1991). Consequently, humans may have developed a biologically prepared readiness to display positive affective responses to such elements (Ulrich, 1999; see also Chapter 4).

Although widely held in the field of restorative environments research, this evolutionary account has been put into question (Joye & De Block, 2011; Joye & Van den Berg, 2011). One empirical criticism is that the already few studies on restoration are often performed with undergraduate students in Western countries. The results

obtained with such a limited group can hardly provide any justification for the evolutionary, universalist assumptions underlying restoration theories. A more conceptual problem is that the human species has always inhabited more or less vegetated environments during its evolutionary history. Because this implies that greenery has always been available to everybody, it is unclear why there would have been any selection pressure for evolving preferences for these elements, as restoration theories seem to imply.

## 6.4 RECENT THEORETICAL AND EMPIRICAL DEVELOPMENTS

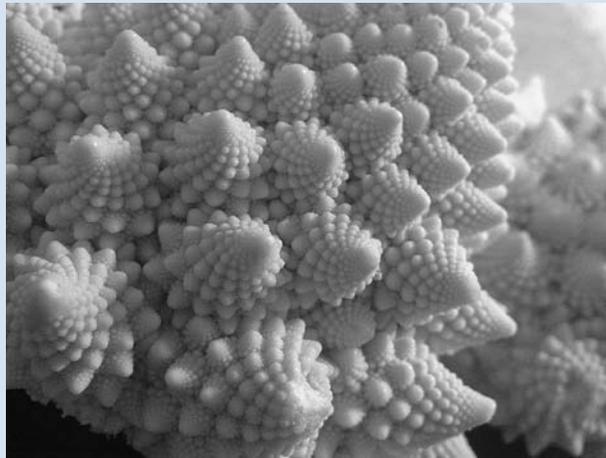
In this section, we will discuss three recent theoretical and empirical approaches that have focused on further unravelling the conditions and mechanisms underlying restorative environment experiences.

### *Perceptual fluency account*

The perceptual fluency account (PFA) is based on the phenomenon of **perceptual fluency** and aims to provide an integration of both SRT and ART (Joye, 2007; Joye & Van den Berg, 2011). The central assumption of PFA is that natural environments are processed more fluently than urban settings, and this fluency difference leads to a difference in restorative potential. Perceptually fluent processing of natural stimuli and scenes is thought to occur because the visual brain is more tuned in to the way in which visual information is structured in natural scenes than in built environments. Specifically, it is thought that owing to their so-called **fractal** or self-similar patterns, natural scenes contain much more redundant information than urban scenes, probably making the former more fluent to process than the latter (see Figure 6.1). Within the PFA, the greater stress-reducing capacity of nature, as predicted by SRT, may be explained by the greater safety or familiarity commonly associated with fluent versus disfluent stimulus organisations (Song & Schwarz, 2009). The greater attention-restoring potential of natural environments, as predicted by ART, may be explained by the fact that fluent stimuli are lower on cognitive resource demands than disfluent ones, which leaves more place for replenishing attentional resources.

### *Connectedness to nature*

Another recent theoretical approach to restoration starts from the observation that people gain purpose and meaning in life by feeling that they belong to the natural world. Based on this, it is predicted that feeling emotionally connected to nature is



**Figure 6.1** *The head of a Romanesco cauliflower provides a good example of a fractal pattern in nature.*  
 Photo by Vlad Tsirushkin (2010). Retrieved from <http://www.flickr.com/photos/dailyfood/4655214681/>.  
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an important mechanism underlying beneficial effects of nature. In a series of experiments, Mayer, Frantz, Bruehlman-Senecal and Dolliver (2009) established that the positive effects of exposure to nature on positive affect and the ability to reflect on an unresolved life-problem could partially be explained by increases in connectedness to nature. Exposure to nature also increased attentional capacity, but this could not explain participants' greater positive feelings and ability to reflect. These findings provide some of the first empirical evidence for the supposition that an experiential sense of belonging to the natural world plays a role in restorative environment experiences, besides more unconscious, automatic processes.

### ***Micro-restorative experiences and instorative effects***

A third approach has focused on **micro-restorative experiences** that result from brief sensory contact with nature, as through a window, in a book, on television or in a painting (Kaplan, 2001). Accumulated over time, such micro-restorative experiences may significantly improve people's sense of well-being and provide a buffer against the negative impacts of stressful events. A survey on nature-based coping strategies of elementary school teachers suggests that micro-restorative experiences are especially helpful when stress levels are low (Gulwadi, 2006). Teachers who frequently suffered from vocational stress (having to teach in overcrowded classrooms, poor working conditions) preferred to go out and be in nature (such as taking a walk in the woods), whereas those with low levels of vocational stress found sufficient merit

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in brief sensory interactions with nearby nature, such as listening to a birdsong. Consistent with these findings, there is increasing evidence that exposure to nature may not only have restorative, but also **instorative effects** in individuals who are not stressed or fatigued (Hartig, 2007). Recent studies among healthy, unstressed individuals have shown that exposure to nature may improve people's mood states and ability to reflect (Mayer et al., 2009), and increase subjective 'vitality' or energy levels (Ryan et al., 2010).

## 6.5 APPLICATIONS AND IMPLICATIONS

Findings from restorative environments research are increasingly being used to guide the design and management of natural and built environments. Given its emphasis on recovery, restorative design measures appear to be most suited for contexts in which stress and attentional fatigue are relatively acute and where such states hamper healing or developmental processes. This is probably one of the reasons why restorative elements have become an essential part of so-called **evidence-based design (EBD)** of healthcare settings (Ulrich et al., 2008; see also Chapter 9). However, as certain aspects of urban living constitute a significant and prolonged source of stress, a number of scholars have argued for integrating nature-based design measures on the scale of entire urban environments (Van den Berg, Hartig, & Staats, 2007). In particular, the findings on the micro-restorative and instorative effects of nature show that even in unstressed urbanites, green interventions may still have a vitalising role and improve the appeal of the environmental context.

One challenge for applying restorative design measures involves the optimal amount of exposure to nature. As discussed above, the available evidence suggests that one does not need to be deeply immersed in a vast natural environment to experience restoration. On the other hand, there are indications that 'more is better', especially in urban areas with little green space (Nordh, Hartig, Hägerhäll, & Fry, 2009). However, for some natural elements such as water there appears to be an upper limit to the amount that is effective for restoration (White et al., 2010). More research is needed to provide more detailed, evidence-based guidelines for designing optimal restorative environments for different groups, contexts and activities.

Another question relevant to nature-based interventions is which modality of nature needs to be implemented. Research shows that exposure not only to actual nature, but also to visual simulations (e.g. videos, paintings) and to olfactory (smells) or auditory components can have restorative effects (Eisenberger et al., 2010; Kjellgren & Buhrkall, 2010; Mayer et al., 2009; Mishima et al., 2004; Ulrich, Simons, & Miles, 2003). Preliminary investigations suggest that restorative responses might even extend to geometric properties of nature, such as the fractal repetition of patterns at many scale levels of natural scenes (Hägerhäll, Purcell, & Taylor, 2004). This extends the possible scope of restorative design measures from actual nature, to imitations of nature and nature's fractal geometry in architecture (Joye, 2007).

## 6.6 SUMMARY

There is increasing empirical evidence that contact with nature can provide restoration from stress and mental fatigue. Two theoretical perspectives for the restorative effects of nature have dominated the restorative environments research agenda, namely SRT and ART. While in both viewpoints it is commonly assumed that restorative responses are ancient relics of human evolution in natural environments, that view has become criticised. In recent years, theoretical developments relying on concepts such as ‘fluency’, ‘connectedness to nature’ and ‘micro-restorative experiences’ have aimed to further and deepen our understanding of restorative experiences. The empirical evidence for restorative effects of nature is increasingly applied in healthcare and in urban and landscape planning, but further research is needed to optimize these applications.

## GLOSSARY

**affective** refers to responses and mechanisms that involve feelings and emotions.

**arousal** a general state of psychological and/or physiological activation.

**attention** the cognitive process of selectively concentrating on certain aspects of the environment while ignoring other things.

**attention restoration theory (ART)** one of the main theories on restorative environments, according to which restoration implies the replenishment of attentional resources.

**being away** a quality of restorative environments, as described by ART, indicating an environment that is free from reminders of daily hassles and obligations that overtax the capacity for directed attention.

**central executive** a brain system associated with the prefrontal cortex which is responsible for the control and regulation of cognitive processes.

**cognitive** refers to responses and mechanisms that involve beliefs, thoughts, ideas, judgements, perceptions and other ‘higher’ mental processes.

**compatibility** a quality of restorative environments, as described by ART, indicating a good fit between the individual’s inclinations and the characteristics of the environment, so that no attentional resources need to be devoted to questioning how one should behave or act appropriately.

**directed attentional fatigue (DAF)** a neurological symptom, also referred to as ‘mental fatigue’, which occurs when parts of the central executive brain system become fatigued.

**evidence-based design (EBD)** an approach to designing buildings based on the best available evidence on the effectiveness of design measures.

**extent** a quality of restorative environments, as described by ART, which is a function of scope and coherence. Scope refers to the scale of the environment, including the immediate surroundings and the areas that are out of sight or imagined. Coherence refers to a degree of relatedness between perceived features or elements in the environment, and the contribution of these elements to a larger whole.

- fascination** a quality of restorative environments, as described by ART, indicating the capacity of an environment to automatically draw one's attention without cognitive effort, thereby relaxing the demand on the central executive and leaving room for the replenishment of directed attention.
- fractal** a rough or fragmented geometric shape of which the parts are each (at least approximately) reduced-size copies of the whole. Most natural structures are fractal in form.
- instorative effects** improvements in psychological and/or physiological functioning that are triggered by particular environments and environmental configurations.
- micro-restorative experiences** brief sensory interactions with nature that promote a sense of well-being.
- perceptual fluency** the subjective experience of the ease with which a certain stimulus is perceptually processed.
- preferenda** features of a setting or an object that are evaluated very rapidly on the basis of basic sensory information.
- restoration** the physiological and psychological process of recovery from stress and mental fatigue.
- restorative environment** an environment that promotes recovery from stress, mental fatigue or other psychologically or physiologically adverse conditions.
- stress** a real or perceived threat or challenge to the integrity of the organism, which is often accompanied by fear or anxiety.
- stress recovery theory (SRT)** one of the main theories on restorative environments, according to which restoration implies recovery from stress.

## SUGGESTIONS FOR FURTHER READING

- Kaplan, S. (1995). The restorative benefits of nature: Towards an integrative framework. *Journal of Environmental Psychology*, 15, 169–182.
- Roe, J. (2008). *The restorative power of natural and built environments*. Doctoral dissertation. Edinburgh: School of Built Environment, Heriot-Watt University. Retrieved from [http://www.ros.hw.ac.uk/bitstream/10399/2250/1/RoeJ\\_0908\\_sbe.pdf](http://www.ros.hw.ac.uk/bitstream/10399/2250/1/RoeJ_0908_sbe.pdf)

## REVIEW QUESTIONS

1. What are restorative environments and how can the restorativeness of an environment be measured?
2. Describe the four restorative qualities of people–environment interactions central to attention restoration theory.
3. Explain why natural environments tend to be more restorative than built environments.
4. What is the relationship between restorative effects of nature and health benefits of nature?
5. To what extent can the use of imitations of nature or geometrical properties of nature in urban design compensate for restorative experiences with real nature?