CHAPTER 2.1

Environmental psychology

Agnes E. van den Berg and Henk Staats

Environmental psychology in a health context

This chapter aims to give an overview of theories relevant to understanding positive impacts of nature on health. Most of these theories originate in the field of environmental psychology. Environmental psychology is a social science discipline concerned with the interplay between individuals and their physical environment (Steg *et al.*, 2012). The discipline has been recognized as a field of psychology since the late 1960s and is therefore a relatively young scientific area (Proshansky *et al.*, 1970).

As an applied science, environmental psychology has adapted and changed over time to address questions arising from the social and political context of the time. In the early years, when societies were facing the post-war challenges of providing decent housing and facilities for the general public, environmental psychology was primarily devoted to studying human interactions with the built environment, for example homes, offices, hospitals, and schools. In this period, natural environments were mostly investigated in the context of leisure and tourism, with a special interest in the assessment of visual quality or scenic beauty (Shafer and Mietz, 1969). The natural environment gained a more central focus in the 1990s, when it became clear that increasing urbanization and industrialization were rapidly taking their toll on nature and landscape, and thus on the quality of people's living environment. In response to these developments, modern environmental psychology now takes an active interest in studying people's interactions with natural environments in relation to their health and well-being. In particular, the restorative or stress-relieving functions of contact with nature have become a major topic for research and theorizing (Van den Berg *et al.*, 2007).

Our review of theories in this chapter follows the historical developments in the field of environmental psychology. The first sections give an overview of classic theories on environmental aesthetics, followed by a discussion of research and theorizing on restorative environments and the health benefits of nature. We then explore recent advances in environmental psychology, including theories on the basic visual processes that may underlie the restorative effects of natural environment experiences.

Environmental aesthetics and landscape preferences

The experience of beauty is an important dimension of people–environment interactions. In general, people will derive less benefit from contact with a setting if they experience it as aesthetically unpleasant. From this perspective, theories on environmental aesthetics and landscape preferences provide an important backdrop for understanding which environments are benign for human health and well-being. In this section, we give an overview of several influential theoretical frameworks: arousal theory, prospect-refuge theory, and information processing theory. What these theories have in common is that they assume a biological or evolutionary basis for aesthetics and environmental preferences.

Arousal theory

Daniel Berlyne (1924–1976) made important contributions to a number of areas in experimental psychology. Professor Berlyne was a motivational theorist who wanted to understand why people display curiosity and explore their environment. He developed a general theory on aesthetic pleasure and the properties of physical stimuli that optimize the aesthetic experience (Berlyne, 1960; 1971).

Stated simply, this theory postulates that people prefer stimuli which help them reach and maintain an optimal level of arousal (arousal being the general level of activation or excitement). The stimuli that bring about an optimal level of arousal typically contain a mixture of arousal-increasing properties (e.g. complexity, novelty, and ambiguity), and arousal-decreasing properties (e.g. familiarity and patterning). Such stimuli are much preferred, because they afford a pleasurable rise or 'boost' in arousal while at the same time ensuring that the arousal will stay in the intermediate range, or can be returned quickly to a comfortable level should it rise too high.

Berlyne's arousal theory provides a psychobiological underpinning of the age-old aesthetic principle of 'unity-in-variety', or order imposed on complexity, a principle that was already known to the early Greek philosophers and is still popular among architects and designers (Hekkert, 2006). Although the theory was originally developed to explain people's reactions to art, its relevance to environmental preferences has been widely acknowledged. In particular, Joachim (Jack) Wohlwill (1928–1987), one of the founding fathers of environmental psychology, underlined the relevance of Berlyne's work to understanding people's responses to nature and landscape. Among other things, Wohlwill noted that visual attributes of natural environments tend to converge to produce a desirable, intermediate level of complexity, characterized by 'irregular lines and curvilinear lines and edges, continuous gradations of shape and colour, and irregular, rough textures' (Wohlwill, 1983).

Prospect-refuge theory

British geographer Jay Appleton (1919–2015) stressed the evolutionary advantages of landscape views that simultaneously afford prospect (wide, open views from which approaching predators

could be seen) and refuge (protected settings that prevent the viewer from being seen or that protect the viewer's back) (1975). Landscapes that offer both prospect and refuge allowed our ancestors to 'see without being seen', which would have enabled them to safely explore and gather information and food while out of sight of predators. Environmental preferences are therefore, according to Appleton, directly linked with the potential of an environment or 'habitat' to satisfy a biologic drive.

Appleton (1975) illustrated his theory, which has been aptly named 'hide and seek aesthetics', mainly through an analysis of landscape paintings, poetry, and park designs. He concluded that prospect-refuge symbolism, as indicated by sign-stimuli like panoramas and shelters, is omnipresent in landscape art and design, and thus seems to represent a universal value. However, the few studies that have empirically verified the theory have often found ambiguous results, especially with respect to refuge (Stamps, 2008). It therefore seems wise to maintain some caution in assuming the utility of the theory.

Information processing theory

The scholarly work of Stephen and Rachel Kaplan, both professors at the University of Michigan, has profoundly influenced the field of human-environment studies. In 1989, the Kaplans published their influential book *The Experience of Nature*, in which they offer a research-based analysis of the vital psychological role that nature plays in people's lives. The Kaplans developed an information processing theory on landscape preferences that it is grounded in cognitive psychology (Kaplan and Kaplan, 1989; Kaplan, 1987). However, the theory also builds on evolutionary assumptions and predicts a preference for natural settings that impose order over complexity. Information processing theory assumes that selection pressures during human evolution in natural environments would have favoured a cognitive ability to quickly detect conditions for survival by gaining knowledge of the environment. More specifically, Kaplan and Kaplan (1989) predict that humans have acquired a positive response to four basic informational characteristics, two of which (coherence and legibility) help one understand the environment, and the other two (complexity and mystery) encourage its exploration.

Empirical research has shown that especially mystery is a powerful predictor of landscape preference (Kaplan *et al.*, 1989b). Mystery is the promise that more information could be gained by moving deeper into the setting, as indicated by, for example, a trail disappearing, a bend in a road, meandering streams, or a view that is partially blocked by a hill. However, like arousal theory and prospect-refuge theory, information processing theory assumes that informational characteristics must act in combination for an optimal aesthetic experience. A scene must have sufficient complexity and mystery to invite the individual to gather more information, but these characteristics must be based on enough coherence and legibility to keep the scene from becoming too overwhelming (Kaplan *et al.*, 1998, see also Fig. 2.1.1).

Variations: group differences

Consistent with evolutionary theories, empirical research has shown a high degree of consensus in landscape preferences (Tveit *et al.*, 2012). However, there also exist important variations between groups and subcultures, which relate primarily to the preferred balance between nature and human influences (Konijnendijk and Van den Berg, 2012). These variations between groups and subcultures

Fig. 2.1.1 A winding path adds mystery to a landscape. It makes you want to find out what is behind the bend.
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may at least partly reflect differences in the relative strength of understanding (or refuge) and exploration (or prospect) needs (Kaplan & Kaplan, 1989). For example, the need for understanding an environment may become more salient when other aspects of one's life are temporarily or chronically less orderly and controlled, resulting in a higher preference for settings with a high degree of coherence and legibility (Koole and Van den Berg, 2005).

These insights are also relevant to people's health responses. When designing natural environments for vulnerable populations with a high need for understanding, like older people or hospital patients with acute health problems, it may be better to keep to simple designs without too much complexity or ambiguity. More information about healthy and biophilic design can be found in Chapter 8.3, 'Nature in buildings and health design'.

Psychological restoration: classic theories

A main finding of research on environmental preferences is that natural environments elicit more positive responses than built environments (Wohlwill, 1983). This finding has stimulated environmental psychologists to go beyond aesthetics and formulate theories on the beneficial, restorative functions that people derive from interacting with nature. In this section we discuss two theories, Stress Reduction Theory (SRT) and Attention Restoration Theory (ART), which have become leading theoretical frameworks for research on restorative environments.

Stress Reduction Theory

Roger Ulrich is a professor of architecture who is renowned for his research on evidence-based design of healthcare environments. In 1983, he first published his psycho-evolutionary theory on aesthetic and affective responses to natural landscapes (Ulrich, 1983), which is more commonly known as Stress Reduction Theory (SRT, Ulrich *et al.*, 1991) The theory assumes that certain environmental features and patterns elicit rapid, affective reactions (i.e. like/dislike) which occur without conscious processing. These affective reactions very quickly initiate physiological mobilization and subsequent adaptive

or survival-enhancing behaviour. The environmental features or 'preferenda' that may automatically elicit positive affective reactions include the presence of natural content like vegetation and water, gross structure (e.g. symmetries), depth and spatial cues, smooth texture, a deflected vista, and the absence of threats.

What makes Ulrich's approach stand out from previously discussed evolutionary theories is that it explicitly acknowledges restoration as an adaptive need that provides a 'breather from stress', perhaps partly to restore energy to sustain behaviours to exploit food, water, or other advantages of the area (Ulrich *et al.*, 1991). SRT makes a number of testable predictions about the restorative response. For example, it is stated that restorative influences of unthreatening natural scenes following a stressor should be evident in a shift towards a more positively toned emotional state, and in decreased levels of physiological arousal. It is also predicted that such restoration should occur fairly quickly (i.e. often within minutes rather than hours, depending on the intensity of the stress response). Furthermore, SRT maintains that 'modern humans might have a biologically prepared readiness to quickly and readily acquire restorative responses with respect to many unthreatening natural settings, but have no such preparedness for most urban or built contents and configurations' (Ulrich *et al.*, 1991). Thus, the theory explicitly assigns a restorative advantage to natural environments over built environments.

Experiments guided by SRT have confirmed that viewing natural settings can provide more effective restoration from acute stress than viewing built scenes, as indicated by, for example, a stronger reduction in muscle tension, skin conduction, blood pressure, and heart rate, and more positive changes in self-reported affect (Laumann *et al.*, 2003;Van den Berg *et al.*, 2003). These restorative responses occur very quickly, usually within the first minutes after the start of exposure to nature. A prediction that has not been empirically confirmed is, however, that restorative responses are moderated by adaptive and aesthetically important features, such as a deflected vista or presence of water. Indeed, one of the first experiments (Ulrich *et al.*, 1991) already showed that natural scenes with water were not more effective in providing restoration from stress than natural scenes without water. In general, research suggests that nearly all kinds of nature are about equally restorative, apart from scenes that induce perceptions of danger, like unstructured, enclosed woods (Gatersleben and Andrews, 2013).

Attention Restoration Theory

While doing research among participants of wilderness programmes and members of gardening groups, Kaplan and Kaplan (1989) were struck by the general and universal positive value and meaning of nature to people. Or, in their own words (Kaplan & Kaplan, 1989): 'Trees and water, flowers and green things, the sense that the plants grow and that they will always be there—these indeed seem to be as close to universals as one can find.' The universal positive value of nature stimulated Kaplan and Kaplan to formulate a new theory on restorative experiences with nature, to complement and extend their theory on landscape preferences. Thus, Attention Restoration Theory (ART; Kaplan *et al.*, 1989a; Kaplan, 1995) has become the most influential theory on benefits of nature for health and well-being.

While SRT considers restoration as an affect-driven process, ART emphasizes the importance of cognitive mechanisms, referring to those as 'directed attention' and 'fascination'. A core assumption of ART is that people only have a limited capacity to direct their attention to something that is not in itself captivating. The mechanism necessary to focus on things that require cognitive effort, called the central executive function, becomes depleted with prolonged or intensive use according to the theory (Kaplan and Berman, 2010). Depletion of the central executive function could result in something called mental (or attentional) fatigue. Entering a situation that does not require cognitive efforts ('directed attention') permits a fatigued person to rest and replenish the central executive function.

ART identifies four qualities of environmental experiences that would help restore mental fatigue: *being away* from daily hassles and obligations; a sense of *extent* or connectedness; *fascination* or the capacity of an environment to automatically and effortlessly draw attention; and a *compatibility* between the individual's inclinations and the characteristics of the environment (see Fig. 2.1.2). Of these four qualities, fascination is thought to play a key role by

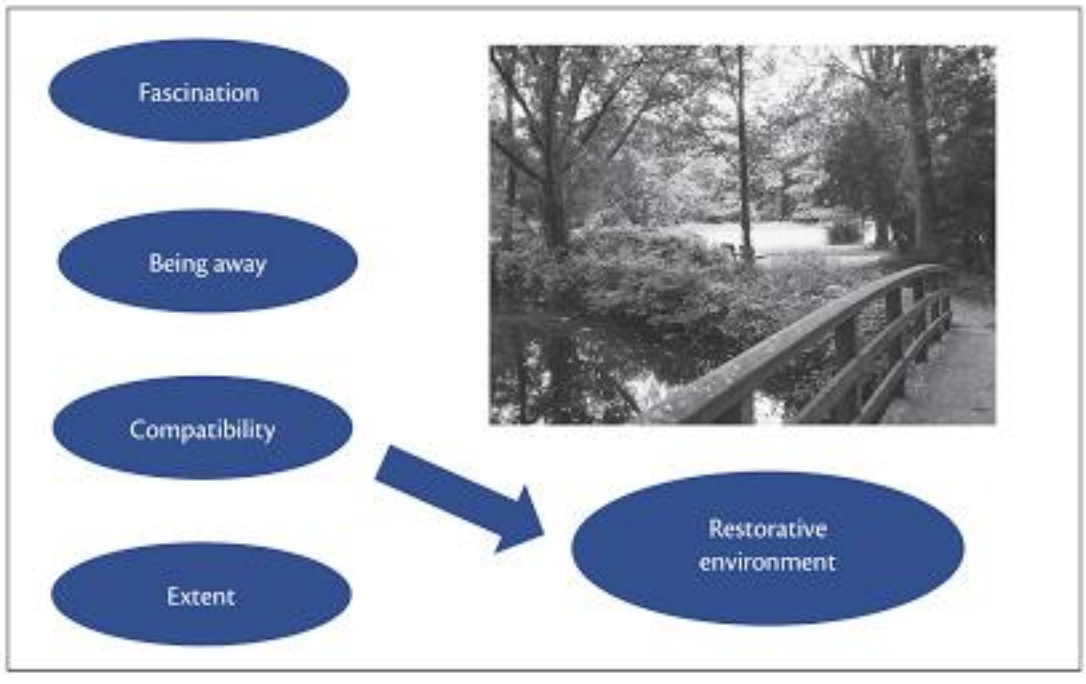

Fig. 2.1.2 The four components of Attention Restoration Theory.
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Box 2.1.1 Hard and soft fascination

Attention Restoration Theory makes a distinction between two types of fascination or involuntary attention (Herzog *et al.*, 1997; Kaplan, 1995):

- Hard fascination occurs when events or activities grab attention so fully that it is hard to think about anything else. Examples include watching sport, playing violent computer games, or visiting a nightclub.
- Soft fascination is a more moderate form of involuntary attention that leaves room for thought and self-reflection. Soft fascination seems to be especially, but not exclusively, evoked by natural events that are pleasant to watch, like sunsets, the play of light on foliage, a butterfly flapping its wings, or the motion of the leaves in a breeze.

While soft fascination is suggested to be highly supportive of restoration from mental fatigue and stress, hard fascination would provide only very limited space and time for reflection or recovery.

Source: data from Herzog TR *et al.*, Reflection and attentional recovery as distinctive benefits of restorative environments,' *Journal of Environmental Psychology*, Volume 17, Issue 2, pp. 165-170, Copyright ©1997 Academic Press; and Kaplan S, 'The restorative benefits of nature: Toward an integrative framework,' *Journal of Environmental Psychology*, Volume 15, Issue 3, pp. 169-182, Copyright © 1995, published by Elsevier Ltd.

alleviating demands on the central executive function, with the other three enhancing or sustaining fascination (see Box 2.1.1). Because a combination of these four qualities is more commonly found in natural environments than in most built settings, natural environments tend to be more effective in countering mental fatigue. However, some built environments, like museums or monasteries, could also be conducive to restoration, albeit mainly for selective groups (Staats, 2012).

ART posits that there are four successive and progressive stages of restoration (Kaplan and Kaplan, 1989). The first stage consists of the 'clearing the head' function, which frees the mind from residual clutter. The second stage is recharging directed attention capacity. The cognitive quiet and reduced 'internal noise' gained in these initial stages of restoration prepare the person to enter the third stage of restoration, during which one can more clearly hear unbidden thoughts or matters on one's mind. The final and deepest stage involves 'reflections on one's life, on one's priorities and possibilities, on one's actions and one's goals' (Kaplan and Kaplan, 1989). It should be mentioned, however, that the claims made regarding this sequence of restorative stages have not been critically examined through empirical research.

ART provides useful insights in what happens during a single restorative experience. However, one such experience will of itself do little to promote lasting good health and well-being. In recognition of this fact, ART has highlighted the importance of cumulative effects of repeated restorative experiences with nature in the living environment. For example, Rachel Kaplan (2001, Kaplan, 1993) has discussed the cumulative value of 'micro-restorative experiences' afforded by a window view onto trees and other natural features from the home or the workplace. Consistent with this line of reasoning, many studies have reported particularly strong relationships between green space in the living environment and public health and well-being (Groenewegen *et al.*, 2012; see also Section 3 'Public health impact by nature contact—pathways to health promotion and disease prevention' in this book).

Integration of theories

Although at first glance SRT and ART seem to offer competing theoretical perspectives, it has been argued that the theories complement, rather than speak against, each other. For example, Terry Hartig, an influential scholar who has from the outset been at the forefront of restorative environment research, has pointed out that psychophysiological stress and mental fatigue often occur independently of each other (Hartig *et al.*, 1991). Which theory is most predictive of the restoration process thus depends largely on the restorative needs of the person. If a person suffers from acute stress as indicated by elevated arousal and negative affect, exposure to nature would bring about quick psychophysiological recovery. If a person suffers from mental fatigue due to prolonged engagement in cognitively demanding activities, exposure to nature would initiate the more time-consuming process of attentional restoration. And should stress and mental fatigue coincide, which often is the case, the two theories may jointly predict the different dimensions and phases of a restorative process.

Attempts have also been made to link theories on environmental preferences with theories on restorative experiences. In particular, Henk Staats and colleagues (Hartig and Staats, 2006; Staats *et al.*, 2010) have shown that people who are in need of restoration, or imagine themselves to be so, express greater preferences for a walk in a forest or a park, over a walk in a built environment. Preferences for walking also correlated positively with ratings of the likelihood of experiencing attentional recovery during the walk. These findings have been interpreted as an indication that common preference for natural over urban environments is, at least in part, driven by the greater (perceived) restorative potential of natural environments (Van den Berg *et al.*, 2003).

Advances in environmental psychology

The area of environmental psychology has inspired much discussion and new theorizing. In this section we discuss several theoretical advancements in research on restorative environments and the health benefits of nature. Some of these have considered the basic neural mechanisms and visuospatial processes that lie behind the 'automatic affective response' and 'soft fascination'. Others have proposed alternative pathways to the restorative and health-promoting effects of nature.

Visuospatial mechanisms underlying restorative responses to nature

A common assumption of SRT and ART is that restorative responses to nature are driven by a bottom-up mechanism that is triggered by visual information. SRT proposes that there is an automatic affective response to viewing natural content based on millions of years of evolution; ART holds that natural scenes elicit soft fascination by automatically capturing attention without requiring any effort. However, both theories fall short in defining the basic neural mechanisms and visuospatial processes that lie behind the 'automatic affective response' and 'soft fascination'. Several theoretical

propositions have been advanced to try and find this missing piece of the puzzle.

The Perceptual Fluency Account (PFA, Joye, 2007; Joye and Van den Berg, 2011) proposes that natural scenes evoke more positive affect and capture attention more easily than built scenes, because the visual information contained in natural scenes is processed more fluently or easily than the visual information contained in built scenes. Specifically, PFA suggests that fluent processing of natural scenes is triggered by fractal patterns that are ubiquitous in nature, but mostly absent in built environments. See Chapter 2.5, 'Biological mechanisms and neurophysiological responses to sensory impact from nature' for further insights in this topic.

A related approach, referred to as Reward Restoration Theory (RRT, Valtchanov, 2013), has linked restorative responses to the activation of reward pathways in ventral areas of the brain. These pathways are thought to be activated by mid-to-high spatial frequencies (or wavelengths) that are common to non-threatening nature scenes. Notably, mid-to-high spatial frequencies are also common to fractals, making this account highly compatible with the PFA. The predictions made by RRT are supported by a number of experiments which have demonstrated positive links between mid-to-high spatial frequencies and various measures of restoration like blink-rates, number of fixations, self-reported stress and pleasantness (Valtchanov, 2013).

Connectedness to nature

A recent theoretical approach has argued that people derive a sense of meaning and emotional well-being from being connected to the natural world (Mayer and Frantz, 2004; Schultz, 2002). This approach draws on three lines of theorizing. First, in mainstream social psychology, the need to belong to human groups and to feel like a valued member of a community has been highlighted as a basic human need (Baumeister and Leary, 1995). Second, ecologists and ecopsychologists have proposed that a sense of belonging to the broader natural community is a prerequisite for environmental protection and human well-being (Roszak *et al.*, 1995). Third, the biophilia hypothesis (Kellert and Wilson, 1993) argues that people have a biologically based need to affiliate with and feel connected to the broader natural world.

Within this approach, several instruments have been developed to measure how connected an individual feels to nature, including the connectedness to nature scale (Mayer and Frantz, 2004), the nature relatedness scale (Nisbet and Zelenski, 2013), and the inclusion of self in nature scale (Schultz, 2002). Studies that have used these measures have shown that individuals who are highly connected to nature report higher well-being (e.g. Howell *et al.*, 2011). In addition, it has been found that a visit to nature can strengthen people's connectedness to nature (Schultz and Tabanico, 2007). Read more about these theories and their implications in Chapter 2.6. 'The role of nature and environment in behavioural medicine'.

Learned associations and positive beliefs

Finally, we want to draw attention to an alternative explanation of restorative effects of nature in terms of learned associations. This explanation is basically a logical argument that has been referred to as the 'cognitive perspective' (Valtchanov, 2013). The cognitive perspective has no formal citation, but is often brought up as an alternative explanation for the positive effects of nature by both scholars and non-scholars alike. The argument states that, during the lifespan, modern city dwellers experience natural and built environments in different contexts, which may shape their beliefs about the restorative and healthy effects of nature. Natural environments may be experienced while on holiday, during leisure time, and when spending time with family and friends, whereas built environments are mostly experienced while at work, doing chores, and generally in more stressful circumstances. To some extent these learned associations, including environment, behaviour, and social context, may affect beliefs about the health-related characteristics of these physical environments.

Consistent with these notions, surveys in different countries have shown that the majority of the population believes that being around nature will relieve stress. For example, 95% of the Dutch population agrees with the statement that visiting nature is a useful way of relieving stress (Van den Berg *et al.*, 2007). Thus, there exist pervasive beliefs on restorative and healthy effects of nature which may influence the way individuals respond to natural and built scenes. This explanation may be especially relevant to studies in which participants are asked to rate environments on the perceived likelihood of restoration as an alternative to assessing actual changes in restorative functioning. Such ratings are guided by beliefs, and may or may not be representative of the actual restorative potential of an environment at a given moment for a specific individual. However, they usually will give a fair approximation, because most people have experienced these outcomes on multiple occasions. Indeed, the present literature provides multiple examples of congruence between people's ratings of the restoration likelihood of natural versus built settings and outcomes of objective measures of attention and/or physiology while walking in or viewing these settings (Hartig, 2011). Moreover, positive beliefs about nature may also lead to real and measurable improvements in mental and physical health and well-being, even if they are unrealistic or illusory (Taylor *et al.*, 2000).

Conclusion

After more than 30 years of theorizing and experimentation, we have come to understand more about the drivers of people's positive and health-promoting responses to natural environments. In this chapter, we have not covered all available theories on human–nature interactions comprehensively, but instead have focused on those that are most relevant to understanding the benefits of nature for public health. It is clear from the work presented that much progress has been made, but the expectation remains that theorizing in this area can be enhanced, extended, and deepened. Among other things, this can be achieved by making connections with relevant domains of mainstream psychology, such as work and organizational psychology where stress is a major research topic, and research on emotion regulation, which has increasingly looked at environmental strategies. Much also remains to be done to inform organizations and authorities responsible for health promotion to make realistic assessments of what nature-based interventions can and cannot do and what would be cost-efficient or not. Part of this task involves explaining how different mechanisms or 'active ingredients' of 'nature as medicine' may be combined for optimal health promotion. These theoretical developments may inform and benefit many people as they seek better health and quality of life through contact with nature in their everyday living environment.

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