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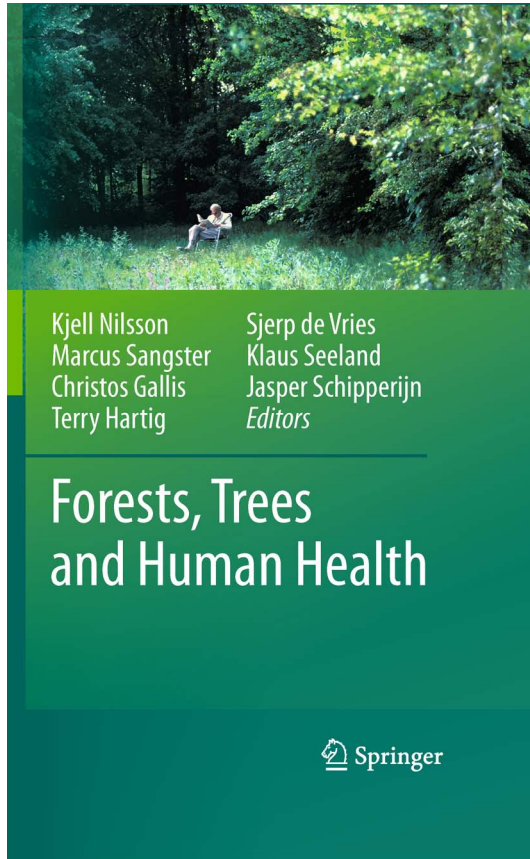
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## Chapter 5

# Health Benefits of Nature Experience: Psychological, Social and Cultural Processes

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**Abstract** In this chapter we consider how experiences of nature can affect human health and well-being. We first address the matter of ‘what has been’; that is, we sketch the development of theory and research concerned with health benefits

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of natural environments, from ancient times to the current situation. This shows the current research to be a recent expression of a number of long-running, intertwined, social and cultural processes. We then discuss 'where we are now'; that is, we overview current theories and related research concerning processes through which nature experience might provide health benefits. These processes concern environmental preferences, psychological restoration, and learning and personal development. Finally, we consider 'where we are going'; that is, we consider some additional directions for research and we identify some issues that research will have to address in the foreseeable future.

## 5.1 Introduction

Trees and forests affect human health in a variety of ways. They help to preserve people's health by maintaining air quality, by providing nutritious foods and medicinal substances, and by protecting homes, crops and vital infrastructure from intense sunlight, high winds, and flooding. They also challenge health by discharging pollen, harboring disease-bearing insects, and posing hazards from fire and falling objects. In addition to such physical and biochemical influences, discussed in Chapters 2, 3 and 4 of this book, trees and forests affect health in ways that primarily have to do with people's behavior and experiences. For example, surveys in numerous countries have found that many people like to visit natural areas such as forests, and that they do so to relax and ease feelings of tension. Behavioral and social scientists have taken interest in these common activities and valued experiences, and they have offered various explanations regarding their implications for health. These explanations have focused on phenomena such as environmental preferences, attention restoration, stress recovery, and personal development. The purpose of this chapter is to overview some of the most widely used of these theories and related empirical research.

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The ideas and theories discussed in this chapter differ in important respects from the explanations for benefits of trees and forests that are presented elsewhere in this book. For one, they do not focus only on trees and forests but also consider benefits for health related to the natural environment in general. Also, they consider other aspects of health; in addition to physical illness and wellness, they address various psychological and social aspects of health, such as emotional well-being and connectedness. Further, in explaining how the natural environment can benefit health, they invoke variables that have an abstract character. Much as 'intelligence' cannot be observed directly but is instead studied using tests on which people demonstrate their personal levels of intelligence, the phenomena discussed here, such as 'stress' and 'restoration', are studied indirectly with measures of cardiovascular activity, performance on standardized tests, statements about current feelings, and other indicators of psychological and physiological states.

In the following, we set the stage by providing some fundamental definitions. We then address the matter of 'what has been'; that is, we sketch the development of theory and research concerned with health benefits of natural environments, from ancient times to the current situation. We then discuss "where we are now"; that is, we overview current theories and related research concerning psychological processes through which natural environments might provide health benefits. In doing so, our aim is not to exhaustively review the literature but to give readers a sense of the field of inquiry as it looks today and some points of entry into the literature. Finally, we consider 'where we are going'; that is, we consider some additional directions for research and we identify some issues that research will have to address in the foreseeable future. Some of those issues are salient in policy, planning, and health care contexts in which ideas about health benefits of natural environments are put into practice. Our discussion of those issues will open for the discussion of relations between theory and practice in Chapters 6 and 7 of this book.

## 5.2 Fundamental Definitions

### 5.2.1 *From Trees and Forests to the Experience of Nature*

Most if not all of the theories covered here realistically assign importance to the objective physical environment, but they focus primarily on subjective aspects of the experience of the environment. People are continuously engaged in perceiving, evaluating, and assigning meaning to the events and conditions in the world around them. Their perceptions and evaluations, the meanings that they assign, and their actions can all be seen as contributors to processes through which the environment becomes linked with health. Without denying the importance of objective environmental features, we thus focus here on environments as people experience them. In particular, we focus here on the experience of 'nature'.

The concept of nature has a broad range of meanings, from the intrinsic character of things to the whole of the physical universe (Gurthrie 1965; Naddaf 2006).

In line with the ideas, theories and research that we will come to discuss, the focus here is on a relatively narrow band of meanings assigned to nature. We are particularly concerned with nature as the seemingly natural features and processes that people ordinarily can perceive without the use of specialized instruments or sensory aids. This is the nature of trees and forests, other kinds of vegetation, animals and their creations, wind, sunlight, clouds and rain, changes in the landscape with the seasons, the flow of water in rivers and streams, tidal and wave action at shorelines, and so on.

This meaning of 'nature' overlaps substantially but not exactly with the meaning of 'natural environment', which is commonly used to refer to a large outdoor area with little or no apparent evidence of human presence or intervention (Pitt and Zube 1987). The natural environment is commonly contrasted with the built environment, as comprised of houses, streets, squares and other artifacts. In the literature that we will discuss, the terms 'nature' and 'natural environment' get used somewhat interchangeably, although, in a seeming contradiction, the nature of interest here is not only found in natural environments, but also in otherwise built environments. In addition to the experience of a person walking along a path through an otherwise untouched forest, we also take interest here in the experiences of people who might see potted plants indoors, or who might look through a window at trees along the street outside. This is not the only seeming contradiction. Some environments that people might consider to be natural are in fact as thoroughly designed, shaped, and organized as any urban centre; however, because they consist of trees, other vegetation, and perhaps other natural-appearing features, and so appear distinct from the built environment of buildings, roadways, and other constructed features, they may be perceived as natural. People may enjoy urban parks, botanical gardens, and golf courses as representations of natural environments, while still knowing of their artificial character.

Despite the wide range of variation in the environments and environmental features of interest here, most of the research that we will discuss has concerned places that most people can ordinarily experience. Some kinds of natural environments are seldom visited. The experiences of people who venture into polar regions, deserts, high mountains, high seas, jungles, and other wild, little populated places are relevant here, but much of the literature that we will discuss concerns natural environments and features of nature that are benign, familiar, close to home, and shared with other people. At the same time, most if not all of the literature concerns the experiences of people in urbanized societies who may be less sensitive to subtle differences between the natural and artificial than, for example, indigenous people who live continuously in 'natural' environments.

Finally, the terms 'natural environment' and 'natural landscape' or simply 'landscape', also get used interchangeably in some of the literature we will cover. The word 'landscape' typically refers to a view over or into an area of land, or the area and landforms encompassed by a view (Daniel 2001). Unlike the definition of natural environment, which typically excludes apparent human artifacts, the definition of landscape is open to human involvement; this is reflected in designations such as 'cultural' and 'pastoral' that are often attached to landscape. Research and practical

efforts do however often focus on the visual aspect of a natural environment (i.e., the natural landscape) and in doing so they treat people as viewers who might appreciate natural scenery. In line with this emphasis on visual experience, we also take interest here in representations of natural environments and features in a wide range of visual media, including landscape paintings, photographs, films, video and virtual nature. With these representations, a person might have the sense of being within a natural environment or recall an experience in a natural environment, while in some objective sense being situated in a completely artificial environment.

This is hardly an exhaustive treatment of the complexities involved with the definition of nature, natural environment and landscape. Those who want to read further on these matters can turn to, for example, Wohlwill (1983), Evernden (1992), Mausner (1996), and Eder and Ritter (1996) For present purposes, it should be clear that we are concerned with environmental entities as they are perceived, evaluated, and invested with meaning by individuals who are embedded within a socio-cultural context.

### ***5.2.2 Health and Well-Being***

The World Health Organization (WHO) has defined health as ‘a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’. This definition has been disseminated widely, and it has had the support of the WHO since its publication in the organization’s Constitution in 1948. It has, however, also been criticized as utopic and unrealistic. For present purposes, this definition of health has several heuristic advantages. First, in that it calls attention to a person’s physical, mental, and social condition, it affirms a view of health as multi-dimensional. This implies that people can enjoy relatively good health or suffer relatively poor health in different ways at the same time (cf. Antonovsky 1979). For example, a person who is physically and mentally fit may still have relatively poor health because he or she is socially isolated or the target of discrimination. A view of health as multi-dimensional invites consideration of how it arises from the interplay of physical, psychological, social and environmental factors.

Second, the WHO definition calls attention to subjective aspects of health, since well-being has a crucial subjective aspect. The level of subjective well-being can be seen as an aggregate of psychological sentiments and evaluations of one’s own life (Kahneman et al. 1999). As such it has emotional and cognitive components that relate to affective features and evaluations of the person’s circumstances (Diener 2000; Diener and Lucas 2000). Some of these components may be trait-like in that they remain steady over time and situations, while other components of subjective well-being may change as the immediate situation changes (Becker 1994). Attention to subjective aspects of health helps one to appreciate how psychological, social and cultural factors can come to work in chronic ill health as well as the maintenance of good health under trying circumstances.

Third, by defining health with regard to well-being rather than an absence of symptoms, the WHO definition affirms the importance of preventive as well as curative measures. This, together with its acknowledgement of the multi-dimensional character and subjective aspects of health, implies the need for a greater variety of actors in the health enterprise than does a definition that frames health in terms of symptoms in need of treatment. Medical professionals will continue to play a key role in caring for the sick, but additional actors can come to share with them responsibility for preventing illness and promoting well-being in individuals and populations. The preventive work can aim at positive as well as negative aspects of human-environment relations. For example, environmental health professionals can promote health not only by identifying and removing toxic agents, but also by identifying salutogenic features of environments, including possibilities for experiences of nature (Frumkin 2001). This said, disease prevention and health promotion should not only be delegated to professionals. A definition of health that acknowledges its subjective aspects implicitly places some responsibility on the individual (see WHO 1986). Individuals are expected to do more than simply turn up at the doctor's office in the hope of a cure when things turn bad. Aside from acquiring knowledge about endogenous determinants of health such as personal genetic attributes, the individual assumes some responsibility for exogenous determinants such as life-style (e.g., diet, smoking, exercise), social environment (e.g., friends and family ties), and physical environment (e.g., housing, proximity to natural areas) (de Hollander and Staatsen 2003). Not all of these things are under the control of the individual, of course, and different professionals working on disease prevention and health promotion will continue in their effort to establish and maintain social and environmental preconditions for mental, social and physical well-being. These issues will be addressed at greater length in Chapters 6 and 7 of this book.

### ***5.2.3 On Processes that Link Nature with Health and Theories About Them***

People commonly are not satisfied with the simple fact of a relationship among things; they want to know how that relationship became established. A theory offers an explanation. Most if not all of the theories of interest here describe some process, which we take to mean a sequence of changes in the attributes of a system. At the same time, a theory offers a basis for predictions that relate causes and consequences; if in the future one should change some attribute of the system, then one has a basis for expecting that another change will follow in a prescribed manner. Because knowledge of the causes and consequences may have practical value, a theory may come to have practical value if predictions based on it are accurate.

The theories of primary interest in this chapter concern psychological processes. For example, we will overview theories that concern processes through which a person restores a resource that is needed to meet the demands of everyday life, such as the ability to direct attention. Such theories may stand on less solid ground than physical or biochemical explanations for health effects of trees and forests because



the variables thought to mediate or transmit environmental effects must be inferred from observations of people's behavior. Nonetheless, the further development and use of such theories is justified by their potential practical value, not to mention satisfaction of the desire to understand the phenomena.

The processes of interest here engender benefits that can be described as preventive or therapeutic, depending on whether the people who realize those benefits already enjoy relatively good health or are recovering from some illness. The preventive benefits are typically intermediate to later outcomes; that is, when a person realizes those benefits repeatedly over time, those benefits may cumulatively come to decrease the likelihood that a person will suffer some form of ill health. For example, if psychological stress goes uninterrupted and becomes chronic, then it may contribute to a variety of health problems in the long run, such as depression or cardiovascular disease. A person who walks in a forest may experience psychological restoration and so for a short time alleviate the experience of stress. One walk in a forest may do little for health in the long run, but regular walks in a forest, and so regular psychological restoration, may cumulatively reduce the odds of becoming clinically depressed or developing cardiovascular disease. Therapeutic benefits of nature experience are also intermediate to 'harder' health outcomes, though typically over a shorter span of time; they may cumulatively help a person to recover from illness more quickly or completely.

All of the processes of interest here occur within the course of some activity. Some activities, and in particular physical activities, are of themselves thought to promote health, and it may be difficult to separate their effects from the effects of the environment. For example, people commonly walk or run to reduce stress, and they commonly choose relatively natural settings with high restorative quality in which to perform those activities. With their choice, eventual stress reduction attributable to the experience of the environment joins with stress reduction attributable to the physical activity. If they were to run or walk along a street with sometimes heavy car traffic, then their experience might be one of irritation and displeasure rather than reduced stress, and the benefit of the physical activity would be questionable, exposure to polluted air aside (see e.g., Bodin and Hartig 2003; Hartig et al. 2003; Pretty et al. 2005). We will not say more on this point here, as the health benefits of physical activity in natural areas are in focus in Chapters 8, 9 and 10 of this book. In the present chapter we will not focus on specific types of activity, but rather on the psychological process carried within different activities through which a person comes into an experience of nature. We thus treat beneficial processes as independent of specific forms of activity.

### 5.3 Historical Background

Scientific research explicitly concerned with nature experience and health may have a relatively short history, but the idea that the experience of nature is beneficial for health has deep roots in diverse intellectual and professional traditions. In this section we consider those roots; we address the matter of 'what has been' by looking

at the development of thinking on the topic, particularly in Europe and North America. That development has been underway since ancient times and has many complexities, so we cannot do more here than superficially sketch some of its significant aspects and milestones. This sketch will nonetheless suffice as background for the current situation, in which societal trends have converged with developments in diverse scientific and professional fields to stimulate and enable more systematic study of nature experience and health.

### 5.3.1 *The Evolution of the Health Sciences*

To begin with, we can place the development of research on nature and health partly within the more general evolution of the health sciences. An early milestone is *Airs, waters, places*, a text traditionally attributed to the physician Hippocrates of Cos (460–370 BC). This seminal work in epidemiology explained that the diseases which afflict the population of a city can be understood through reference to the city's environmental circumstances, such as proximity to stagnant water and exposure to harsh winds. It also called for attention to the particulars of the locations being considered in the planning of a new city, so that the living conditions of future residents would be salubrious rather than harmful. The author of *Airs, waters, places* did not address the processes of particular interest here, but he did emphasize that particular natural conditions were conducive to population health, and he acknowledged the relevance for individual as well as population health of lifestyle factors such as diet, work, and recreation (for further discussion, see Buck et al. 1989).

The health sciences developed through several eras, each with characteristic notions of disease and approaches to prevention (see e.g., Catalano 1979; Rosen 1993; Susser and Susser 1996). The conception of physical and mental disorder as an expression of imbalance among the four humors (blood, black bile, phlegm, and yellow bile) may have predated Hippocrates, but it was still in use into the nineteenth century, perhaps because it entailed recommendations for moderation in lifestyle practices and attention to environmental causes of humoral imbalance that seemed to be effective. A successor, miasma theory, attributed epidemic diseases such as cholera to bad air emanating from sources such as foul water. This motivated sanitary reform measures such as sewage systems and protected water supplies. These were successful, albeit for reasons other than dispelling bad air. Scientists eventually caught on (in the case of cholera, Filippo Pacini in 1854, Robert Koch in 1884), and the germ theory they advanced proved a successful approach to understanding infectious illnesses. Germ theory did not however provide an adequate explanation for the chronic illnesses, such as cardiovascular disease, that came to replace infectious illnesses as the major causes of death in many countries. Instead of searching for a single necessary exposure, health scientists had to disentangle the complex interplay of lifestyle, genetic, and environmental factors during the life course. Psychological and social aspects of health and illness, such as stress and social support, received

increasing amounts of attention, and new concepts and methods became available for the study of nature experience and health.

### ***5.3.2 Intellectual, Economic, and Demographic Trends***

The development of ideas about nature experience and health also aligns with a number of long-running, intertwined societal trends. During the time that humoralism was the dominant account of personality, health and disease, changes were underway in Europe that would come to profoundly affect conceptions of human-nature relations. The Enlightenment brought not only advances in the application of reason and scientific method, but also a shift toward appreciation of wild nature and the belief that the thoughts and intentions of God could be discerned in natural phenomena (Garraty and Gay 1972). The scientific advances supported industrialization, and industrialization stimulated urbanization, which brought ever more people from rural agricultural work into urban factories. People who had worked outdoors and structured their time around the diurnal and seasonal cycles left their villages, fields and forests for towns and factories in which work was less tightly coupled to natural *zeitgeibers*. The contrasts between rural and urban life intensified in the process. The increasingly stark contrasts helped to feed the Romantic Movement in philosophy, music, the visual arts and literature. Wild nature was exalted, at first by the kind of literate tourists who could afford to leave their urban homes for rambles in the Lake District or the Haslital, then later by a broader band of the general public. At the same time that it stoked appreciation of the natural, the Romantic Movement advanced a critique of the city and urban life, not only with regard to its negative somatic effects but also with regard to mental, social, and moral harm. The advantages and disadvantages of life in a city versus a suburb or the countryside remain a staple of scientific as well as popular literature today, and distinctions between the natural and urban constitute a major theme in current discussions of nature and health. For discussions of historical shifts in attitudes toward nature per se, and of the contrasts in attitudes toward the urban and natural environment, see, for example, Ekman (2007), Nash (1982), Schama (1995), Stremlow and Sidler (2002), and Thomas (1983).

### ***5.3.3 The Development of Approaches to Health Care Involving the Natural Environment***

The contrast between urban and rural conditions figured in the development of approaches to care for diverse mental and physical disorders. Common to these was the idea that time in nature, away from the usual urban setting, would facilitate a therapeutic process. For example, in many European countries, people of means could from the 1600s onward go to a spa and take the waters, to soothe their nerves,

alleviate hysteria, or ameliorate some somatic illness (e.g., Fuchs 2003; Mansén 1998). The experience of nature was meant to play a role in the healing effects of visiting the spa. At the Ronneby Brunnspark in Sweden, for example, the overall design was meant to support the experience of nature as an adjunct to the other components of the spa program, namely, drinking the mineral water and physical activity (Jakobsson 2004). Another example, moral therapy, proved at the time to be a relatively successful and humane (thus moral) approach to caring for the mentally ill, who to that time had received harsh treatment. As described by Edginton (1997) with regard to the Retreat in York, England, which opened in 1796, moral treatment involved ‘the removal of a lunatic from all associations in home or community influencing his or her condition’, as well as ‘the use of nature as a means of calming insanity’ (p. 95). A more recent example is the sanatorium-based treatment for people with tuberculosis. The disease afflicted many people in densely built cities. The sanatoria were meant to isolate infected people from the rest of the population and provide them with good air, sunlight and pleasant views of nature as a possible cure (e.g., Bonney 1901; Gardiner 1901; Anderson 2009; von Engelhardt 1997). The first sanatorium opened in 1859 in Görbersdorf (presently Sokolowsko), Poland, and others sprang up in scenic countryside locations in Finland, Switzerland, California, and other places, where they were used until the discovery of an antibiotic cure for the disease.

Although the tuberculosis sanatoria gave way in the face of medical advances, other historical uses of natural surroundings for health care facilities and programs have persisted to the present day, such as therapeutic camping for children with emotional disorders (e.g., Levitt 1988). Recent decades have seen a surge of interest in therapeutic values of nature experience, in connection with perceived shortcomings of conventional medical approaches that, while effective by some criteria, have seemed insensitive to the needs of the whole person. A growing openness to alternative and complementary therapies has entailed increased attention to nature-based interventions such as therapeutic horticulture (e.g., Irvine and Warber 2002; Sempik et al. 2003; Townsend 2006; Gonzalez et al. *in press*). In a related development, dissatisfaction with sterile, intimidating, high-tech environments has prompted the creation of ‘healing gardens’ at many hospitals and clinics (e.g., Cooper Marcus and Barnes 1999; Hartig and Cooper Marcus 2006). With both of these developments, proponents have acknowledged that sound scientific evidence regarding therapeutic values of nature experience is needed to convince a professionally skeptical medical community of the worth of their proposals (see Chapter 11 of this book).

### ***5.3.4 The Development of Environmental Design Professions Concerned with Access to Nature***

Urbanization also stimulated the development of environmental professions that came to assume responsibility for providing access to nature for people living in cities. The work of some of the early proponents was grounded on the conviction

that nature experience would be beneficial to the health of an urban public. One notable early proponent was the landscape architect Frederick Law Olmsted, whose plans for urban parks in major North American cities reflected an awareness of the somatic and psychiatric medical theories of his time (Hewitt 2006). The open spaces and trees of public parks were to provide for clean air and sunlight, in line with miasma theory (see also Szczygiel and Hewitt 2000), while other features of the design, such as the screening of buildings just outside the park, were intended to help the visitor achieve greater psychological distance from everyday cares, in line with moral therapy.

Town planners also have made assumptions regarding beneficial effects of contact with nature in promoting particular planning strategies. One notable example in this regard is Ebenezer Howard. The central idea in Howard's (1902/1946) book *Garden Cities of To-morrow* was that the advantages of the town and countryside should be joined in the Garden City: 'Human society and the beauty of nature are meant to be enjoyed together. The two must be made one' (p. 48). Howard's garden city idea inspired the founding of the Letchworth and Welwyn garden cities in England as well as the design of neighborhoods in cities around the world (Meacham 1999). As with landscape architecture, attention to nature in the urban context remains a staple of urban planning today, though the concerns extend beyond the health values afforded by experiences of urban nature (see e.g., Whiston Spirn 1985).

### 5.3.5 *The Development of the Environmental Movement*

Besides the efforts to bring nature into cities, the nineteenth century was also marked by a movement in some countries to create large national parks, national forests, and wildlife preserves outside of cities as a reaction against the large-scale exploitation of natural resources. This environmental movement was motivated not only by concern for the well-being of nature, but also by concern for the well-being of people (e.g., Grundsten 2009; Runte 1979). For example, the aforementioned landscape architect Olmsted addressed health-promoting functions of nature in an 1865 text that has been described as the philosophic basis for the creation of national parks (see Olmsted 1865/1952). The text comes from a report intended to provide guidance for the governor of California in managing a major transfer of land from the US federal government for the purpose of preserving scenic resources for the benefit of the public. This land transfer included what is now Yosemite National Park. Olmsted's guiding rationale for protecting the scenic values of the park land resembles current formulations concerning stress, mental fatigue, and restoration:

It is a scientific fact that the occasional contemplation of natural scenes of an impressive character, particularly if this contemplation occurs in connection with relief from ordinary cares, change of air and change of habits, is favorable to the health and vigor of men and especially to the health and vigor of their intellect beyond any other condition which can be offered them, that it not only gives pleasure for the time being but increases the subsequent capacity for happiness and the means of securing happiness. The want of such occasional

recreation where men and women are habitually pressed by their business or household cares often results in a class of disorders the characteristic quality of which is mental disability, sometimes taking the severe forms of softening of the brain, paralysis, palsy, monomania, or insanity, but more frequently of mental and nervous excitability, moroseness, melancholy or irascibility, incapacitating the subject for the proper exercise of the intellectual and moral forces (p. 17).

Nature protection already had long-standing utilitarian motives. For example, the emergence of scientific forestry in Germany in the late eighteenth century was a reaction to wasteful use of forest trees, and reflected the belief that societies should be as rational in managing natural resources as they should be in other forms of public administration (Ciancio and Nocentini, 2000). The establishment of national parks, in the USA (1872) and then in Europe (e.g., Sweden in 1909), appears however to have gone beyond earlier forms of nature protection in its scope, degree of institutionalization, centralized versus local control, and apparent diversity of motives. The parks protected species and habitats, as well as opportunities for studying them. They protected watersheds. Not least, they protected possibilities for beneficial experiences of wild nature and culturally significant landscapes. For example, Wodziczko (1930), an important Polish proponent of the health values of nature experience, argued that even the most beautifully arranged parks, public gardens, and other green spaces in a city were not sufficient to maintain the body in full health. He claimed that people who become fatigued by life in a large urban agglomeration 'need at least periodically a complete recreation in nature, among green forests, rivers, and lakes'; they should, he argued, '... whenever it is possible, even for a few moments, ... escape from among city walls and go to places where nature has preserved its primeval beauty' (p. 40). Wodziczko saw his ideas implemented with Wielkopolski National Park, near Poznan, as well as with public green spaces inside that city (Wodziczko 1928).

Nowadays, concerns of the environmental movement have extended well beyond protecting nature's beauty; pollution, rapid population growth, nuclear energy, nuclear weapons, unsustainable transportation and agricultural practices, environmental justice, and many other issues have come onto the agenda. It is worth noting, however, that many of the prominent figures in the broad environmental movement have expressed their appreciation of nature and outdoor life in their ecological and activist writing (e.g., Brower 1990; Carson 1962; Leopold 1949); the motivation to engage in environmental activism may be rooted in positive experiences in nature.

### ***5.3.6 The Development of Multiple Use Management of Land***

Different actors have long had different motives for pursuing environmental protection and conservation, and some of those motives have been at odds. The need to resolve the conflicts that stemmed from different motives provided an impetus for some of the lines of scientific inquiry that have come together in the nature-and-health research field. A prominent example is the conflict in the USA between the

conservationists and the preservationists around the turn of the twentieth century. The conservationist Gifford Pinchot studied scientific forestry in France and Germany, and then went on to become the first chief of the US Forest Service. He thought that national forests should be established and managed for the sustainable production of resources. He placed aesthetic and recreational values outside of the concerns of forestry (see for example p. 71 of his autobiography 1947/1987).

Though a better alternative than unrestrained exploitation, Pinchot's utilitarian view was disliked by the preservationist John Muir. The Scottish-born naturalist and co-founder of the Sierra Club acknowledged the utilitarian values of the American wild lands, but he emphasized their aesthetic, recreational and spiritual values

The tendency nowadays to wander in wildernesses is delightful to see. Thousands of tired, nerve-shaken, over-civilized people are beginning to find out that going to the mountains is going home; that wildness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life. Awakening from the stupefying effects of the vice of over-industry and the deadly apathy of luxury, they are trying as best they can to mix and enrich their own little ongoings with those of nature, and to get rid of rust and disease (Muir 1901/1981, pp. 1–2).

The conflict between the conservation and preservation motives – sustainable exploitation of natural resources versus appreciation of the ecological and experiential values of nature – eventually led to the development of a multiple use management strategy for public wild lands in the USA (see Pitt and Zube 1987). Public opinion encouraged elected officials to pass legislation that compelled land managers to manage for cultural, recreational and aesthetic values as well as for the consumption of natural resources. This in turn created a demand for knowledge about public preferences regarding different management alternatives. Social and behavioral scientists were recruited to address this demand. For example, at the urging of environmental organizations (see e.g., Brower 1990), the Outdoor Recreation Resources Review Commission was created in 1958 to gather information about, among other things, the values that people assigned to recreational activities in wilderness areas (1962). The work of the ORRRC is an early example of government-commissioned research done to guide protection of experiential values of nature. Since the early 1960s, American social and behavioral scientists in governmental employ or funded by federal land management agencies have continued to study topics related to the health values of nature experience, such as scenic preferences and the benefits of outdoor recreation (for reviews of the earlier work, see e.g., Driver et al. 1987; Ewert and McAvoy 2000; Knopf 1987; Roggenbuck and Lucas 1987; Stankey and Schreyer 1987; Zube et al. 1982).

Conflicts among different uses of natural environments have also stimulated demand for research on nature experience in many European countries. The particulars of the research needs have varied across countries, in line with variations in the environments of concern, the circumstances of the populations wanting to use those environments (e.g., degree of urbanization), and the consumptive and recreational activities pursued in those environments. The conditions for responding to research needs have also varied, given the variations in, for example, environmental legislation and the delegation of responsibility for commissioning and performing such



research. It is beyond the scope of this chapter to outline these variations. Simply put, as in the USA, research on topics such as landscape preferences and the benefits of outdoor recreation has been pursued in many European countries over several decades, with the intention of feeding results into policy, planning and land management processes (recent examples include Bell 2001; Bauer et al. 2009; Hunziker 1995; Jensen and Koch 2004; Konijnendijk 2003; Lindhagen and Hörnsten 2000; Scott 2003; Van den Berg et al., 1998; Van Herzele and Wiedemann 2003). This work has helped to prepare the way for the recent intensification of research more explicitly concerned with relations between nature experience and health.

### 5.3.7 *Summary*

To this point we have situated the development of thinking about nature experience and health in a context of intellectual and societal developments. These developments have involved the health sciences and conceptions of health; sources of ideas about human-nature relations and approaches to studying them; patterns of production and settlement that affected demand for experiences of nature as well as opportunities for such experiences; approaches to health care which accorded a role to nature experience; environmental design professions; the environmental movement; and the role of government and research in resolving conflicts between competing uses of natural environments. We have also pointed to relations among these different developments.

In closing this section, we want to emphasize that we have sketched only some of the origins of the research area here. We have said nothing, for example, about the development of evolutionary thought, which has opened for a view of health values of nature experience as grounded in adaptations to the environmental conditions of early human evolution. Nor have we discussed the emergence of academic disciplines, such as environmental psychology, that have made significant contributions to research concerning nature experience and health. Those developments will be acknowledged in the next section, in that several of the theories that we will discuss are direct expressions of those developments. Omissions here notwithstanding, we trust that our sketch has sufficed to show that the scientific study of nature experience and health is, like the phenomena under study, situated in long-running social and cultural processes. Today's research does not so much describe novel phenomena as approach familiar phenomena with current scientific concepts and methods.

## 5.4 **Current Theoretical Perspectives**

Having discussed 'what has been', we turn to discuss 'where we are now'. In the present section we overview current theories and research concerning psychological processes through which natural environments might provide health benefits.



The presentation here is meant to give a sense of the field of inquiry as it looks today as well as points of entry into the literature. We cover work in three areas: environmental preferences, psychological restoration, and learning and personal development.

The theories to be covered vary in the emphasis placed on three different kinds of influence on behavior: innate, cultural, and personal. Put simply, the common denominator of evolutionary assumptions is that people today retain adaptations to the environments of human evolution. It is therefore beneficial for people today to encounter conditions to which they remain innately adapted (cf. Parsons 1991). An alternative line of reasoning emphasizes the cultural forces that have shaped both the nature that people have available to experience and their shared beliefs about how nature experience affects health. According to this perspective, a person's response to a particular environment at a particular time varies as a function of attitudes, beliefs, and values shaped through learning within a particular socio-cultural context (e.g., Tuan 1974). Within that socio-cultural context, unique individual experiences further shape personal beliefs about whether and how nature is beneficial as well as the choices of activities through which the person comes into contact with nature. Further efforts to understand health in relation to nature will presumably follow the example of Bourassa (Bourassa 1988, 1990), who worked toward the theoretical synthesis of the personal, cultural and innate determinants of aesthetic responses to landscapes. We will return to this issue in the next major section. In the meantime, we wish to emphasize that while the different theories covered here may seem to emphasize one kind of influence, they do not necessarily disallow the others.

### ***5.4.1 Environmental Preference***

That people seem to like nature is not a trivial matter. Liking or preferring one alternative over another often influences the choice among courses of action – of which path to take, of where to go during leisure time, of which hotel room to take for the weekend, of where to locate one's home, and so on. Environmental preferences can be said to reflect a functional aesthetic; they signal conditions relevant to well-being. From this perspective, preference for natural environments over other environments is a sign that they are taken to serve well-being. In the following, we overview several theoretical formulations concerned with environmental preferences. All of them assume a basis for preferences in adaptations to the environment that occurred during human evolution. They thus emphasize uniformity or consensus in preferences across cultures, individuals, and time (cf. Purcell and Lamb, 1984).

#### **5.4.1.1 Biophilia**

The word 'biophilia' was first introduced by Erich Fromm (1964) to describe attraction to the various spheres of life, the process of life, and all that is alive and

vital. The term was subsequently popularized by Edward O. Wilson (1984), who defines biophilia with regard to 'the connections that human beings subconsciously seek with the rest of life' (p. 350). The idea or hypothesis that all people have some innate drive to affiliate with other forms of life has since attracted considerable attention from researchers (e.g., Kahn 1997; Kellert 1993a, b; 1996).

The leading conception of the biophilia hypothesis is that humans have an affinity for life and life-like processes that motivates contacts with plants, animals, and natural landscapes. This orientation to affiliate with other forms of life has genetic determinants. Biological evolution as a process of continuous genetic adaptation of organisms or species to the environment integrates the results of environmentally advantageous genetic changes. Organisms that are better adapted to particular environmental conditions have a higher survival rate and attain greater reproductive success. Accordingly, they have a better chance to contribute their genetic material to the population's genetic pool and, in the long run, to increase the environmental fitness of the whole population.

According to this view, the process of species evolution by natural selection is slow and individual adaptive changes may take hundreds of thousands of years. The biophilia hypothesis thus relies on the observation that for most of the millions of years during which our species evolved, humans coexisted in a close relationship with the natural environment. Therefore, most adaptations in the human organism, including those of the brain and related behavioral reactions, developed as an evolutionary response to needs imposed by this environment. In contrast, the history of human civilization is relatively short. People have gathered in agricultural settlements for around 10,000 years, and in urban areas for a much shorter period. It is considered unlikely that evolution could change existing adaptations during the period that people have occupied such relatively artificial settings. Therefore, according to the biophilia hypothesis, humans still tend to express inherited earlier adaptations and so to like or prefer natural environments where they can function well. According to Wilson (1984), the biophilic instinct emerges unconsciously and 'cascades into repetitive patterns of culture across most or all societies' (p. 85).

The biophilia hypothesis emphasizes people's positive responses to nature. However, nature can also prompt negative, fearful – biophobic – responses (Öhman and Mineka 2001; Van den Berg and Ter Heijne 2005). Some researchers consider the extensive body of findings concerning biophobia to provide support for the biophilia hypothesis (e.g., Ulrich 1993). The ability to respond to positive environmental cues (e.g. potential food and water sources, shelter) as well as to negative ones (e.g. danger from predators, venomous snakes or poisonous plants) could have had adaptive significance during human evolution. Biophilia and biophobia can be viewed as examples of prepared learning (Seligman 1970), reflecting a predisposition 'to easily and quickly learn, and persistently retain, those associations or responses that foster survival when certain objects or situations are encountered' (Ulrich 1993, p. 76). Biting and stinging insects, snakes, bats, and other animals elicit strong aversion or fear in many people. This holds even for people who have not previously had contacts with those animals, perhaps as a result of vicarious learning by observation of the reactions of other people (Lichtenstein and Annas 2000).

Since its original presentation, the biophilia hypothesis has been the subject of numerous critical commentaries. Kahn (1997) provides a thoughtful summary that focuses on three major concerns: (1) the degree to which biophilia is genetically determined; (2) whether negative affiliations with nature contradict the biophilia hypothesis, and (3) how well biophilia withstands scrutiny, if experience and culture are admitted to influence the content, direction, and intensity of biological tendencies. Despite much circumstantial evidence, the biophilia hypothesis seems to be lacking in convincing support, in contrast to biophobia, for which support comes from many well-controlled experiments (see Ulrich 1993; Öhman and Mineka 2001; for a more critical view, see Coelho and Purkis, 2009). Criticisms and evidential shortcomings notwithstanding, the notion of biophilia has been a valuable stimulus for recent research and debate on human-nature relations.

#### 5.4.1.2 Savannah Theory

Another evolutionary theory, which was introduced by Gordon Orians in 1980, seeks to explain environmental preferences through reference to underlying behavioral choice mechanisms that an animal would deploy in the search for suitable habitat. In Orians' view, these mechanisms were shaped in the course of evolution by temporal and spatial variability in habitat suitability. He analyzes factors operating in the choice process that animals might go through in a search for suitable habitat, including the available knowledge about habitat alternatives, time available for selecting among alternatives, and variability in relevant environmental features. Assuming that the selection of habitat typically takes place under conditions of ignorance, Orians argues for the utility of strong, spontaneous emotional responses toward suitable and unsuitable habitats. 'Good habitats should evoke strong positive responses and poorer habitats should evoke weaker or negative responses' (p. 55). At the same time, he proposes that the responses vary as a function of immediate needs. For example, he writes, 'a hungry animal may accept a second-rate site more readily than a well-fed one, since hunger is a signal that good habitats have not been encountered' (p. 55).

Orians groups factors that influenced the suitability of early human habitats into categories of resource availability and protection from predators. His analysis leads to the conclusion that 'tropical savannahs, particularly those with irregular relief providing cliffs and caves, should have been the optimal environment for early man' (p. 57). Thus, strong positive responses to savannah settings should have been selected for in the evolution of human habitat choice mechanisms. He supports his hypothesis through reference to several lines of evidence: emotion-laden landscape descriptions of early explorers in the American Great Plains, which at that time had little of the apparent human presence that would have strongly signaled habitability; spending for homes and for recreation access in places with characteristics of suitable habitat, such as proximity to water; and common practices in the choice and arrangement of aesthetic vegetation so that parks and other spaces resemble savannah environments. In a subsequent text, Orians (1986) marshals additional support for

his position, citing among others the findings of Balling and Falk (1982). Those researchers found that, of the people in their sample from the American Northeast, children preferred scenes of tropical savannah over the kinds of natural scenes that would have been familiar to them in their own locale. For the older members of their sample, the more familiar scenes were as well liked as the savannah scenes. Later work with Judith Heerwagen (Orians and Heerwagen 1992; Heerwagen and Orians 1993) further elaborates the analysis as well as the evidential base, including findings of greater preference for tree shapes characteristic of suitable habitat.

The savannah theory is distinctive in linking the emotional response to landscapes with the resolution of the problems associated with identifying suitable habitat. Some independent research has addressed the theoretical claims, as with particular tree forms as cues of suitable habitat (e.g., Summit and Sommer 1999; Lohr and Pearson-Mims 2006). A recent study by Falk and Balling (2009) among students and school children from the rain forest belt in Nigeria provides further support for an innate preference for savannah-like settings. Despite the fact that 80% of the participants had never been outside their own area, both groups expressed a preference for savanna scenes as compared to other biomes, including the familiar rainforest biome. Other scholars have, however, cast doubt on the idea that the savannah should be regarded as the relevant, stable setting for early human evolution, and their arguments and findings present challenges to the theory (e.g., Potts 1998; Han 2007).

#### 5.4.1.3 Prospect-Refuge Theory

A third evolutionary approach also considers the suitability of habitat with regard to a problem that would frequently have confronted proto-humans. In his presentation of prospect-refuge theory, however, Appleton (1975) defines the problem more narrowly than Orians (1980). Assuming that the ability to move toward a goal while out of the sight of predators would have been of primary importance to survival, he asserts that the environment's potential for supporting this ability should have evoked affective responses before other indicators of survival potential. Accordingly, he is more specific in his treatment of symbolic aspects of the human-landscape interchange and in setting out the characteristics of landscapes that should influence preference.

The idea of seeing without being seen motivates Appleton's (1975) analysis of landscape into prospects, refuges, and hazards. Prospects, or views outward, are of two general types. Direct prospects are the views available from the presently occupied place, or primary vantage point. Examples include panoramas and vistas, with panoramas not being bounded by objects in the landscape as are vistas. Indirect prospects, such as deflected vistas, imply views that might be attained if one could reach points farther off in the landscape, referred to as secondary vantage points. A refuge may serve as a shelter or as a hiding place. It may be that it does not serve both functions simultaneously; a refuge might offer shelter from a storm yet not hide the occupant from the sight of a predator. Thus, the distinction between shelter and hide assumes importance relevant to the type of hazard. Aside from function,

refuges can also be characterized by their accessibility, efficacy, origin (natural versus artificial), and substance (earth refuges such as caves, vegetation refuges such as trees or grass, and nebulous refuges such as fog). Hazard is important to the analysis as the justification of the need for refuge and for seeing without being seen. A hazard can be animate (e.g., a predator) or inanimate (e.g., weather). It can also be seen in an obstacle to free movement (impediment hazard) or in the absence of a requirement for survival, such as water (deficiency hazard).

Although many hazards may no longer be salient, Appleton (1975) maintains that human response to landscape is still determined to some extent by prospect and refuge values. The aesthetic experience of landscape is thought to be influenced by variation in the objects that symbolize prospects and refuges, the spatial arrangement of symbols, and the equilibrium between prospect and refuge symbols, among other factors. Furthermore, prospect-refuge symbolism is seen to hold on more than one level. It derives from the imagination and experience of the observer as well as from the physical characteristics of landscape objects.

Prospect-refuge theory can in some respects be described as Gibsonian in that it entails the description of landscapes in terms of prospect and refuge affordances. Affordances are functional values inherent in physical characteristics of the environment. In his account of ecological perception, Gibson (1979) argued that people immediately apprehend the functionality of the surfaces that they see, as when a surface is perceived to afford walking or sitting. Appleton (1996) acknowledges this characterization in his retrospective look at the original presentation of the theory.

He also takes the opportunity to address two criticisms of the earlier work. First, he emphasizes that 'there is no significance in the comparative paucity of reference in the book to the cultural case', as one should not 'expect the case for the prosecution to incorporate also the case for the defense' (p. 236). Second, he emphasizes that, '... while cultural, social and historical influences are of great importance, they do not operate in a vacuum'; to the extent that such influences shape landscape tastes, '... they shape it, not out of nothing, but out of something which is already there' (p. 236), namely, an innate component.

Prospect-refuge theory has apparently inspired a substantial amount of discussion, but relatively little focused empirical research. Stamps (2006) identified 214 works that made some reference to the theory, but he could only classify 11% of them as empirical. Recent empirical work by Stamps (2008a, b) provides support for some claims (i.e., preference for views out onto mountains) but not for others, and he recommends caution in assuming the utility of the theory.

#### **5.4.1.4 An Informational Perspective on Environmental Preferences**

A fourth approach to understanding environmental preferences differs from the previous three in that it is grounded in cognitive psychology; however, it also builds on evolutionary assumptions and takes interest in the needs of pre-humans. Stephen and Rachel Kaplan offer a view of human evolution as responsive to ongoing demands

for the acquisition and rapid processing of information from the environment (Kaplan and Kaplan 1978, 1982, 1989). On descending from the trees for savannah ground well-populated with predators, pre-humans came under selective pressure to build on their perceptual capabilities in the development of an ability to quickly anticipate and respond to events in the environment. For continued survival, sustained in large part by hunting, selection would have favored abilities to comprehend extended spatial areas and to plan.

According to this account, environmental preferences reflect an innate sensitivity to informational requirements of survival. Pre-humans are assumed to have been motivated to expand upon the cognitive maps that they relied upon for their survival. Their success would have been determined to some degree by their responsiveness to conditions which affected way-finding. Aside from ready comprehension of the environment being explored, the possibilities for exploring further would also have shaped preferences. Thus, informational qualities of the visual array that supported needs for both understanding and exploration would have been influential in instituting preferences. The desire to maintain cognitive clarity is assumed to still undergird aesthetic responses. The aesthetic response, though unconscious, is cognitive in character, and guides affect (Kaplan 1987).

Informational qualities are ordered with respect to two dimensions in the Kaplans' (1982, 1989) preference matrix. One dimension is temporal, spanning from what is in front of the person at the moment to what could be in front of the person as he or she proceeds further into the environment. The other dimension refers to what the person is doing with regard to information at the time; the person is seen as engaged in making sense of the information available as well as proceeding to acquire new information. Thus, (1) an immediate need for understanding is supported by the coherence of the perceived environmental elements; (2) the potential for understanding in the future is in the legibility of what lies ahead; a legible view suggests that one can continue moving and not get lost; (3) exploration of what lies in front of one is encouraged by the complexity within the given set of elements; (4) further exploration is stimulated by the promise of additional information with a change in vantage point, or mystery.

With this arrangement, a tension between order and uncertainty is implicated in aesthetic response; sufficient coherence and legibility are needed to make sense of the environment, but their action must be balanced by enough complexity and mystery to entice the individual to gather more information. In addition to the informational qualities, the theory sees particular contents signaling survival values (Kaplan and Kaplan 1982). In modeling preference, natural elements such as trees and water are designated as primary landscape factors because their very presence appears to have a positive impact. Here the preference framework has common ground with habitat theory.

Numerous empirical studies have reported the influences of contents and informational factors on preferences for photographic scenes (e.g., Herzog 1985, 1989 reviewed in Kaplan and Kaplan 1989). On the basis of a meta-analysis, however, Stamps (2004) concludes that the relationships between the four informational factors and preference are far from consistent. One possible explanation for this is that the strength of the relationships may be contingent on the kind of scenes (e.g., of built

versus natural environments; cf. Herzog and Leverich 2003). Stamps (2004) offers some specific recommendations for further work with this theory.

#### 5.4.1.5 Fractal Geometry and the Fractal Dimension

The term fractal is used to describe fractured shapes, which possess repeating patterns when viewed at increasingly fine magnifications. This quality of scale invariance can be identified and quantified with a parameter called the fractal dimension,  $D$ . The fractal dimension can be defined as a measure of the extent to which a structure exceeds its base dimension to fill the next dimension. Thus, for a fractal line,  $D$  will be greater than one and up to two. Similarly for a fractal surface  $D$  will have a value between two and three.

From the start, the development of fractal geometry was strongly linked to issues relating to the mathematical description of forms and shapes that are found in nature, such as mountain ranges and coastlines (Mandelbrot 1983). The ubiquity of fractals in the natural environment (Barnsley 1993; Barnsley et al. 1988; Gouyet 1996) has motivated a number of theories concerning the relationship between the pattern's fractal character and the corresponding perceived visual qualities. The ability of observers to discriminate between fractal images based on their  $D$  value has been shown to be maximal for fractal images with  $D$  values corresponding to those of natural scenes (Knill et al. 1990; Geake and Landini 1997), triggering discussions as to whether the sensitivity of the visual system is adapted to the fractal statistics of natural environments (Knill et al. 1990; Gilden et al. 1993). Observers who displayed a superior ability to distinguish between different  $D$  values were also found to excel in cognitive tasks involving 'simultaneous synthesis' (the ability to combine current perceptual information with information from long term memory), with the authors speculating that natural fractal imagery resides in the long-term memory (Geake and Landini 1997). Furthermore, Aks and Sprott (1996) noted that the aesthetically-preferred  $D$  value of 1.3 revealed in their studies corresponds to fractals frequently found in natural environments. They speculated that this 'may point to an abstract form that may be shared by nature and human preference' (p. 12). This kind of speculation follows lines of thought similar to those which attribute environmental preference and aesthetic appraisal of particular landscape elements to evolutionary factors.

A more general theory discusses fractal aesthetics in terms of the condition experienced when the fractal structure of the observed environment matches the fractal structures that underlie cognition and perception (see, for example, Briggs 1992). For example, the spatial information in a scene is thought to be processed within a 'multi-resolution' framework where the cells in the visual cortex are grouped into so-called 'channels' according to the spatial frequency they detect. The way these 'channels' are distributed in spatial frequency parallels the scaling relationship of the fractal patterns in the observed scenery (Field 1989; Knill et al. 1990; Rogowitz and Voss 1990). Thus, an aesthetic experience might be expected if, for example, an artwork or a view from a window matches this scaling relationship of the channels.



The number of empirical studies concerning how aesthetic experiences relate to fractals is small, and the visual stimuli used have been very different. Some studies have shown that people prefer fractal patterns over non-fractal patterns (Taylor 1998, 2003), but a question of particular interest has been whether particular fractal dimensions are preferred more than others. The studies initially led to very different results, with preference shown for both higher  $D$  (Pickover 1995) and lower  $D$  values (Aks and Sprott 1996). The inconsistency suggests that there is no universally preferred fractal dimension, and it was suggested that the aesthetic qualities might instead be dependent on how the pattern was generated (Taylor 2001). This hypothesis was tested using natural, man-made and computer-generated fractals, but surprisingly it was found that fractal dimensions in the range of 1.3–1.5 were most preferred, irrespective of the pattern's origin (Taylor et al. 2001; Spehar et al. 2003). The result pointing to preference for mid-range  $D$  values has since been supported by studies on landscape silhouettes extracted from photographs (Hagerhall et al. 2004; Hagerhall 2005), where mid-range fractal dimensions seemed to be most preferred and also had the highest score on perceived naturalness.

#### **5.4.1.6 Closing Comments on Environmental Preference**

We have given considerable attention to environmental preference here because a preference can be taken as an indication of conditions relevant to well-being. A preference for one environment over another might lead a person into relatively beneficial circumstances. This does not mean, however, that an expression of preference itself constitutes an improvement in well-being. In the following, we review theories that more directly address the issue of how the experience of nature can serve health. We do not leave preferences behind, however, in that some of the research to be covered in the following considers the correspondence between preferences and benefits of nature experience relevant for health.

### **5.4.2 *Theories About Psychological Restoration***

The theories just overviewed all assume that environmental preferences have some innate basis. To justify the assumption, they refer to various challenges faced by pre-humans in the environments of their time. Even though people today may no longer face those challenges, it is argued that they retain a disposition to respond positively to environmental features that would have been conducive to the survival of their ancestors. Those ancient tendencies may serve people today by guiding them into opportunities for restoration.

The term 'restoration' covers processes through which people recover resources that they have diminished in their efforts to meet the demands of everyday life. Those resources vary in kind. Physiological resources include the ability to mobilize energy for action aimed at some demand, whether acute, as when running



to catch a train, or persistent, as when working hard for many days to meet a deadline. Psychological resources include the ability to focus attention on a task, even when noise or other distractions make it hard to concentrate. Social resources include the willingness of family and friends to provide help. Because a person depletes various resources in meeting everyday demands, a potential or need for restoration arises regularly. New demands will come along, so the person must restore the depleted resources or risk not being able to meet the new demands. Over time, inadequate restoration can translate into problems with mental and physical health (Hartig 2007).

With populations today concentrated in urban environments, the need for restoration ordinarily arises with activities in an artificial or built environment. Because nature experiences often involve getting away from those places where restoration needs arise, they may permit restoration of depleted resources. Nature experiences may at the same time promote restoration in that they have features that a person may find engaging and pleasant, for reasons like those described in theories about environmental preferences. Thus, the restorative effects of nature experiences may have some evolutionary basis, but the dynamic that is commonly of interest – induction of restoration needs with activities situated in built environments followed by movement into a more natural one to address those needs with other activities – has a fundamentally cultural character.

Theories about restorative environments must specify the antecedent condition of resource depletion from which a person needs restoration; describe the process of restoring the given resources, and; characterize the environments that promote that process, as compared to merely permitting it (Hartig 2004). Two theories have guided much of the recent research on restorative effects of nature experiences. Although they both emphasize the restorative qualities of nature, they differ in their specifications of antecedent condition and restorative process.

#### 5.4.2.1 Psychoevolutionary Theory

Roger Ulrich's psycho-evolutionary theory (Ulrich et al. 1991; see also Ulrich 1983) is concerned with recovery from psychophysiological stress. Stress is defined as a process of responding to a situation perceived as demanding or threatening to well-being. Ulrich assumes the operation of an evolved system for directing behavior in situations that are relevant to continued survival and could be experienced as stressful. That adaptive system involves 'hard-wired' affective responding in the selection of a behavioral strategy (i.e., approach or avoidance) and the simultaneous mobilization of physiological resources needed to execute that strategy. Stress, in this work as elsewhere, becomes manifest in increased negative emotion and heightened autonomic arousal, among other changes.

The theory proposes that restoration can occur when a scene elicits feelings of mild to moderate interest, pleasantness, and calm. For someone experiencing stress and needing to renew resources for further activity, it could be adaptive to continue viewing the scene in a non-vigilant manner. This initially depends on

visual characteristics of the scene that can rapidly evoke an affective response of a general character, including interest. This response is thought to be 'hard-wired'; it does not require a conscious judgment about the scene, and indeed it can occur before a person can formulate such a judgment. The characteristics of the scene that elicit the response include gross structure, gross depth properties, and some general classes of environmental content. In this regard, Ulrich (1999) maintains that '... modern humans, as a partly genetic remnant of evolution, have a biologically prepared capacity for acquiring and retaining restorative responses to certain nature settings and content (vegetation, flowers, water), but have no such disposition for most built environments and their materials' (p. 52). Thus, the theory assigns a restorative advantage to natural environments and features of nature over artificial environments.

The process of restoration would go something like this, then: a scene with moderate and ordered complexity, moderate depth, a focal point, and natural contents such as vegetation and water would rapidly evoke interest and positive affect, hold attention, and thereby displace or restrict negative thoughts and allow autonomic arousal heightened by stress to drop to a more moderate level. Restoration would become manifest in, for example, more positively toned emotions and lower levels of physiological parameters such as blood pressure, heart rate, and muscle tension.

Experiments guided by this theory have documented differential change in emotional and physiological outcomes measured during or immediately after viewing actual or simulated natural and urban environments. For example, Ulrich et al. (1991) had university students view a stressful industrial accident film and then a 10-min video of a natural setting, urban traffic, or an outdoor pedestrian mall. After the stressor, the downward trajectories for *frontalis* muscle tension, skin conductance, heart period, and pulse transit time were steepest with the nature simulations. Changes in self-reported affect converged with the physiological results in showing a greater degree of restoration with the nature videos (see also, e.g., Chang and Chen 2005; Parsons et al. 1998; Park et al. 2007).

#### 5.4.2.2 Attention Restoration Theory

Stephen and Rachel Kaplan's attention restoration theory (Kaplan and Kaplan 1989; Kaplan 1995) is concerned with restoration from attentional fatigue. They assume that a person's ability to direct attention depends on a central inhibitory capacity or mechanism. To focus on something that is not of itself interesting, the person must inhibit competing stimuli that are more interesting. It takes effort to do this, and the person's ability to inhibit competing stimuli will become fatigued with prolonged or intensive use. Loss of the inhibitory capacity has a variety of negative consequences. Those consequences include irritability, failure to recognize interpersonal cues, reduced self-control, and increased error in performance of tasks that require directed attention.

A person can restore a diminished capacity for voluntarily directing attention when he or she experiences *fascination*, a mode of attention which the Kaplans' assume to have an involuntary quality, not require effort, and not have capacity limitations. When a person can rely on fascination in ongoing activity, demands on the central inhibitory capacity are relaxed and a capacity for directing attention can be renewed. As described by the Kaplans, fascination is engaged by objects or events, or by processes of exploring and making sense of an environment. Yet fascination is not sufficient for restoration. The theory also refers to the importance of gaining psychological distance from tasks, the pursuit of goals, and the like, in which he or she routinely must direct attention (being away). Further, fascination can be sustained if the person experiences the environment as coherently ordered and of substantial scope (extent). Finally, the theory acknowledges the importance of the match between the person's inclinations at the time, the demands imposed by the environment, and the environmental supports for intended activities (compatibility).

According to ART there are four progressive stages of restoration (Kaplan and Kaplan 1989). The first stage is referred to as 'clearing the head', which allows random thoughts to wander through the mind and gradually fade away. The second stage of restoration is recharging directed attention capacity. At the third stage, one can clearly hear unbidden thoughts or matters on one's mind, due to reduced internal noise and enhanced cognitive quiet which are facilitated by soft fascination. 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, p. 197). Although it may be assumed that restoration progresses with increasing involvement and time spent in nature, it is not clear how much exposure to nature or time is required for this process under optimal conditions.

Although many environments might afford the experience of being away, fascination, extent, and compatibility, the Kaplans (1989) have argued that natural environments should more readily do so than other environments. For example, natural environments may more readily afford being away because there are few reminders about work demands and a relative absence of people, interactions with whom may require paying attention to one's own and the others' behavior. The Kaplans also assert that natural environments are rich in aesthetically pleasing features, such as scenery and sunsets, which evoke moderate, or 'soft', fascination that permits a more reflective mode. In this regard, they suggest that there may be an evolutionary basis for finding particular natural features to be appealing, as they have done in their informational perspective on environmental preference.

Quasi – and true experiments have tested the proposition that experiences of natural environments promote directed attention restoration better than experiences of other environments. In these studies, the researchers have operationalized directed attention capacity in terms of performance on tasks that require a subject to focus attention. For example, Hartig et al. (1991) report a field experiment in which proofreading performance was measured after 40 min spent in a nature reserve, city center, or a passive relaxation condition. On average, the university students who were randomly assigned to the natural environment condition showed better posttest proofreading performance than that of the subjects assigned to the other two groups.

### 5.4.2.3 Extensions of Research Concerned with Restorative Environments

The restorative environments topic has inspired much discussion and research in recent years. Some work has considered whether the processes described in psychoevolutionary theory and attention restoration theory might run concurrently (Hartig et al. 2003). More recent work has appropriately sought to address shortcomings with sampling in the early experiments, most of which involved university students in just a few environmental conditions. Some studies have sought to assess the restorative effects of a broader range of environments (e.g., Berto 2005), while others have taken an interest in special populations other than students (e.g., Ottosson and Grahn 2005). Aside from sampling, recent work with attention restoration theory in particular has sought to use performance measures that more precisely capture the operation of the inhibitory mechanism on which the capacity to direct attention is assumed to depend (e.g., Berman et al. 2008; Laumann et al. 2003). Still other research has sought to develop measures of the components of restorative experience described in attention restoration theory, for use in tests of the theory as well as for practical purposes (e.g., Hartig et al. 1997; Laumann et al. 2001; Herzog et al. 2003; Pals et al. 2009). These different kinds of studies have in various ways affirmed the earlier findings of a restorative advantage of nature, and they have raised still other methodological issues. The extension of the research area with the use of additional environmental comparisons, study populations, measures, and research designs is enriching the body of findings. At the same time, it is creating challenges for eventual meta-analytic research that will try to summarize the available findings in quantitative terms.

Another way in which the research area is being extended has to do with the links between environmental preferences and restorative experiences. For example, investigators have measured skin conductance (Taylor et al. 2005; Taylor 2006) and brain wave activity (Hagerhall et al. 2008) in response to fractal images, and obtained results which suggest that fractal dimensions in the preferred mid-range may contribute to stress reduction. Hagerhall (2005) has proposed that fractal geometry in natural scenery combines complexity and new information with order and predictability due to the self-similarity between scales, and this may engage interest in ways that promote restorative soft fascination (cf. Joye 2007). Van den Berg and colleagues (2003) could in an experiment show that a video of a walk through a natural environment promoted greater post-stressor improvement in emotion than a video of a walk through a built environment, and that this difference partially mediated the difference found in preferences expressed (as beauty ratings) for the environments. Nordh and colleagues (2009) found that average ratings of preference for 74 small urban parks, given by one group of people, correlated strongly ( $r = 0.88$ ) with average ratings of the likelihood of being able to restore in those parks, as given by a separate group of raters. Links between environmental preferences and possibilities for restoration have important practical implications. Knowing that preference reliably indicates the possibility of restoration, at least for some categories of environments, supports the use of the extensive literature on specific physical environmental predictors of preference in the effort to design

settings that will serve restoration. As noted by Velarde et al. (2007), the empirical literature on restorative environments so far provides little specific guidance on how landscape architects and others might design restorative environments, as most studies have had very limited environmental sampling.

With regard to the relationship between nature experience and health, perhaps the most significant issue of extension has to do with cumulative effects. The research mentioned so far has had to do with what can be called discrete restorative experiences, in which, on a given occasion, isolated in time, a person in need of restoration enters a situation that allows for it, as with a visit to a park after a hard day at work (Hartig 2007). It is important to know just what happens in a discrete restorative experience, and the available evidence does speak of a restorative advantage of nature for such experiences (Health Council of the Netherlands 2004); however, one such experience of itself will probably do little to promote lasting good health. Rather, a basic assumption underlying research on restorative environments concerns their cumulative effects: access to environments with relatively high restorative quality during periods available for restoration will cumulatively promote greater health benefits than access to environments of lesser restorative quality. Note that this assumption has three components. One involves the environments to which a person has visual or physical access. The second involves the periods or respites in which restoration can occur, whether brief and in passing or of substantial duration and dedicated to the purpose of restoration. The third involves the span of time over which repeated restorative experiences can generate cumulative effects. Taken together, these components of the 'cumulative effects assumption' have encouraged attention to people in their everyday contexts, where they would ordinarily and regularly seek out or otherwise find possibilities for restoration on a regular basis over an extended span of time (Hartig 2007). Many studies have built on this line of reasoning, and many of them have reported associations between nature experience and variables relevant to health and well-being. They have done so for diverse populations and circumstances, referring to therapeutic as well as preventive benefits. Some examples are hospital patients recovering from surgery (Ulrich 1984), women receiving treatment for breast cancer (Cimprich and Ronis 2003), people with clinical depression (Gonzalez et al. *in press*), residents of urban public housing (Kuo and Sullivan 2001), children living in rural poverty (Wells and Evans 2003), urban office workers (Bringslimark et al. 2007; Shin 2007), leisure home owners (Hartig and Fransson 2009), people who have recently experienced a stressful life event (Van den Berg et al. 2010), the Dutch general population (de Vries et al. 2003; Maas et al. 2006), and the English general population (Mitchell and Popham 2007, 2008).

A final set of studies should be mentioned here, as it shows how environmental preferences can work in support of restorative experiences. Staats et al. (2003), (Staats and Hartig 2004; Hartig and Staats 2006) found in a series of experiments that the difference in preference expressed for a forest walk over a walk in a city was larger when there was a greater need for restoration. This was the case with subjects who were simply asked to imagine themselves as either fatigued or fresh as well as with subjects who were actually relatively fresh at the beginning of the day versus fatigued

after an afternoon lecture. Moreover, the subjects' ratings of preference for the different walks correlated strongly with their ratings of the likelihood that they would experience attentional recovery during the given walk. This pattern of results speaks to two important points: people come to learn that some places are more likely to support restoration than others, and they may be able to deliberately apply that knowledge in managing their energy, attentional capacity, and other adaptive resources (see also Korpela and Hartig 1996; Korpela and Ylén 2009).

#### **5.4.2.4 Closing Comments on Psychological Restoration**

Preference for a natural environment might lead a person into circumstances that are beneficial because they support restoration. The experience of restoration can help the person to perform more effectively, feel better, get along better with others, and so on. In the long run, recurrent restorative experiences can help the person to enjoy better health. Restorative experiences in nature can occur as part of a deliberate strategy for managing adaptive resources, as well as incidentally, in the course of living in an area with nature nearby. All of this said, experiences in natural environments do not only serve health through processes of restoration. They also serve health through processes in which people learn new skills, come to better understand their own capabilities, and otherwise develop in positive ways. We now turn to discuss such processes.

#### **5.4.3 *Learning and Personal Development***

Of particular interest here is a class of models for benefits of nature experience that focus on the way that behavior is shaped by the perceived contingencies of actions performed in natural environments. Such models build on the idea that the reinforcement or feedback that shapes a person's behavior in a natural environment differs from that which he or she receives in everyday environments. The net effect of the difference is a change in patterns of behavior and views of the self. In general, these models look to the natural environment as a setting for personal growth and the correction of maladaptive practices through the confrontation of problems or challenges as well as through opportunities for reflection. More specific outcomes mentioned in this literature include improved problem-solving ability, greater self-reliance, and changes in self-concept, self-esteem, body image, and perceived locus of control (for reviews, see e.g., Driver et al. 1987; Levitt 1988). Effects typically unfold over the course of days or weeks, with some persisting well beyond the time actually in the environment.

Discussions of learning and personal development as beneficial aspects of nature experience often refer to a person or group acting within a program that is implemented in a wilderness environment (e.g., Russell 2000; Ewert and McAvoy 2000). Moreover, the participants in such programs are often young people with

special needs. The combination of the therapeutic program with the environmental experience presents problems for those wanting to understand the beneficial effects of nature experience per se. The structure, staffing, and activities of the program may be more salutary for participants than the environment in which the program is being conducted. The natural environment may facilitate the conduct of program activities, but that does not mean that particular features of the natural environment itself are essential to the success of the program. Studies of the benefits of such therapeutic camping and outdoor challenge programs have been troubled by methodological problems such as a lack of comparison groups, and this has prevented a clearer view of the role of the environment. These points and the details of various programs are discussed in a number of reviews (e.g., Driver et al. 1987; Levitt 1988; Ewert and McAvoy 2000).

There are reasons to believe, however, that the environment of itself supports beneficial change. In a review of related literature, Knopf (1987) lists five ways in which natural environments have been differentiated from everyday environments as settings for behavior. First, a natural environment, and wilderness in particular, challenges 'accustomed behavior patterns, resources, and problem-solving styles' (p. 787). Second, a natural environment is impartial or indifferent, and gives little negative or judgmental feedback (see also Wohlwill 1983). Third, the relative manipulability and predictability of a natural environment means that the person need not be consumed with defensive, coping behaviors (after Bernstein 1972). Fourth, it permits a greater degree of self-expression. Finally, natural settings allow a greater sense of personal control. This last hypothesis has however been challenged by Kaplan and Talbot (1983). They maintain that the relaxation of efforts to control the environment was important to the participants in their wilderness program.

Newman's (1980) model for the amelioration of learned helplessness through structured wilderness programs also offers insights on what might prove beneficial for people acting outside of a program context. Learned helplessness follows from an inability to perceive contingency between one's efforts toward a desired outcome and the outcome that actually follows. A person learns to believe that he or she cannot influence outcomes more generally (Seligman 1975). The condition is attended by emotional, cognitive, motivational, and possibly self-concept deficits, such as impaired problem-solving ability, an inability to persist at a task in the face of failure, low self-esteem, and depression (e.g., Abramson et al. 1978). People who are suffering from learned helplessness tend to attribute their failures to stable, global, internal causes, such as a persistent, pervasive lack of ability. Conversely, they tend to attribute their successes to external, specific, and possibly unstable causes, such as good luck in the particular instance (Abramson et al. 1978).

According to Newman (1980) the structure of Outward Bound-style programs and the characteristics of their wilderness settings help a person to develop clear and realistic patterns of causal attributions and expectations. They also promote acquisition of skills and mastery, encourage a sense of competence or controllability, and help direct perceptions of competence in order to positively influence



self-concept and self-esteem. Several wilderness characteristics are thought to be instrumental in this. First, in wilderness there are lessened demands on information-processing capabilities. A person who is freed from having to deal with the usual mental noise may be able to gain needed insight into their attribution patterns. Second, stressful conditions in everyday environments (e.g., noise, crowding, stimulus ambiguity) are not present or they are more easily seen as being under one's control. Conditions that are not under one's control, such as the weather, are readily seen as impartial and out of the control of all people. Third, the novelty and threat values of wilderness evoke close attention and coping efforts. Dealing with manageable doses of confusion and anxiety provides an opportunity to develop a sense of competence in dealing with unexpected situations. Finally, being in a wilderness environment means engaging in basic survival activities that promote competence building and provide opportunities for making more accurate attributions about success and failure.

Reser and Scherl (1988) make similar observations about ways in which wilderness encounters encourage adaptiveness and personal development, but without placing the encounter in the context of a structured program or referring to the correction of pathological conditions. They present a model for person-environment transactions that occur in intrinsically motivating activities such as running or wilderness trekking. They argue that the person-environment transactions which occur during these activities involve feedback that is clear and unambiguous. Because of these qualities, the information has a reward value proportional to the ambiguity and lack of clarity in information that the person draws from the environment in general. Reser and Scherl further assume that the feedback which the person receives from the everyday physical and social environment is typically indirect, ambiguous, routinized, and role-prescribed. Their model is also interesting because it integrates aspects of a learning approach with attentional and information processing considerations from evolutionary models such as that of the Kaplans. Clear and unambiguous feedback has reward value in part because of its utility in optimal functioning for a biological information-processing system.

#### **5.4.3.1 Closing Comments on Learning and Personal Development**

Theories about learning and personal development provide an important complement to theories about psychological restoration in the effort to understand how nature experience serves health. People may benefit from experiences in natural environments not only by restoring depleted resources, but also by acquiring new capabilities. With activity in a natural environment, a person may correct a mundane deficit, such as directed attention fatigue, or a more serious one, such as learned helplessness. In either case, the activity may segue into a process of development and growth that does far more than simply correct the deficit. The natural environment as a setting for therapy and education receives more attention in Chapters 11 and 12 of this book.



## 5.5 Issues for Future Research

Having discussed ‘what has been’ and ‘where we are now’, we turn finally to discuss ‘where we are going’. In the present section, we first consider some additional directions for research. We then identify some general issues for research to address in the foreseeable future. These include challenges to the evolutionary assumptions that are made by some theories concerned with nature experience and health, as well as individual differences in responses to nature.

### 5.5.1 *Additional Topics for Research*

In the foregoing section we discussed a number of psychological processes that have implications for well-being and health. There is too little space here to go into the many possible directions for further research concerning those and other processes, but two other topics deserve at least brief mention here. They are self-regulation and place attachment.

In our discussion of restoration and restorative environments we mentioned that people come to learn that some places are more likely to support restoration than others, and that they may be able to apply that knowledge in managing their adaptive resources. This kind of behavior is integral to self-regulation as described by Korpela (1989); the person acts to maintain a favorable pleasure-pain balance, assimilate the data of reality into a coherent conceptual system, maintain a favorable level of self-esteem, and maintain relatedness to others (Korpela et al. 2001, p. 574). The person attends to these functional principles with the use of a variety of strategies, such as the selection of a place in which he or she can feel a particular way, be alone or with others, and so on, as desired. Self-regulation will periodically involve restoration (Korpela and Hartig 1996), and some people may on a given occasion prefer to go to a natural environment for that purpose, but they may turn to nature for other reasons as well (see also Scopelliti and Giuliani 2004). They may, for example, want to experience a feeling of vitality (Ryan et al. 2010). Whether for vitalization or restoration, the use of environments for self-regulation is seen as having clear relevance for health. Further research might fruitfully study a broader range of complementary processes within a self-regulation framework, including restoration and vitalization with nature experience.

A second topic that deserves mention here is the feeling of a connection to nature. Several researchers have in recent years proposed concepts that relate to this general theme, which involves the feelings that people have when they are in nature as well as the feelings that they have toward nature. These concepts include emotional affinity with nature (Kals et al. 1999), inclusion of nature in the self (Schultz 2002), environmental identity (Clayton 2003), and connectedness to nature (Mayer and Frantz 2004). Recent empirical work confirms the impression that these concepts overlap to a large degree (Brügger et al. *in press*). Nonetheless, it is of interest that these expressions of an emo-

tionally laden bond with the natural environment appear to motivate behaviors intended to reduce harmful impacts on the environment. In a similar vein, research has found that people who endorse the use of natural environments for psychological restoration perform more behaviors that could be considered environmentally friendly (Hartig et al. 2007). Research can thus consider a dynamic in which health promotion and protection of the environment are mutually reinforcing. This is not a new idea; we alluded to it in our discussion of the development of the environmental movement. It remains however for researchers to further study its practical potential.

### 5.5.2 *Challenges to Evolutionary Assumptions*

We suggested earlier that efforts to understand health in relation to nature will increasingly try to account for the combined contributions of innate, cultural and personal determinants of aesthetic responses to nature. To do this will require, among other things, attention to developments in evolutionary theory and related research. The evolutionary assumptions that underlie much of the current thinking about nature experience and health apparently have undergone little review since their formulation in the 1960s and 1970s. Consequently, some researchers still take it as an article of faith that too few generations can have passed for humans to have acquired biological adaptations to built, especially urban environments. The validity of this belief ought to be assessed in light of current research (Joye 2007). For one, paleoanthropologists have questioned the idea that the savannah was the unique environment of evolutionary relevance (Potts 1998). For another, 'humans spread out of Africa's savannas at least 1 million years ago', and 'we have had plenty of time since then – tens of thousands of generations – to replace any original innate responses to savanna with innate responses to the new habitats encountered' (Diamond 1993, pp. 253–254; cited in Kahn 1997).

Aside from work in paleoanthropology, recent decades have witnessed a sustained challenge to the orthodoxy that the environment does not affect genes as they pass from one generation to the next; the environment has been accorded a role in the generation of heritable genetic variation, in addition to its role in the selection of adaptive variants (Jablonka and Lamb 1998). This may open for more rapid change in ecologically relevant traits in natural populations. While geneticists and molecular biologists are busily investigating the processes of epigenetic variation and inheritance, ecologists are working to get a grasp on their real-world causes and consequences (Bossdorf et al. 2008). Their work may enable a more precise description of the relationship between health and nature as part of a process, long since recognized, in which biological selection and culture have come to play mutualistic roles; people shape the environment which then shapes them (cf. Dobzhansky 1962; Dubos 1965; Hartig 1993). In this process we can understand individuals not only as carriers and reproducers of genes, but also as carriers of meaning who reproduce something of the meaning structure of the culture in which they are embedded. If a particular culture maintains that a strong link holds between nature

and health, individuals within that culture may act on the environment in a way that both reinforces those meanings and affects the environment which generates and selects genetic variation.

### ***5.5.3 Individual Differences in Responses to Nature***

Perhaps in keeping with evolutionary conceptions that emphasize uniformity in response to nature, the research on nature and health has not yet seen a sustained effort to address the possibility that there are systematic differences across individuals in responses to nature. There are several types of personal variables that may account for differences in the strength and/or direction of nature-health relations in the short or long-term. These include socio-demographic variables such as gender, age, income, education, and socio-economic status; personality traits such as sensation-seeking (Zuckerman, 1994); motivational orientations and needs such as the need for autonomy (Deci and Ryan 2000) and the need for structure (Van Den Berg and Van Winsum-Westra *in press*); knowledge-related variables such as images of nature (De Groot and Van den Born 2003); personal experience with certain types of environments, including regional or local familiarity, childhood experiences (Ewert et al. 2005), and place attachments; and, finally, phases across the life span, including the various developmental stages of children (Kellert 2002).

Traditionally, research on individual differences in response to nature has focused mainly on the socio-demographic correlates of visual preferences for landscapes with varying degrees of human influence (e.g., Strumse 1996; Simoni 2003; Van den Berg et al. 1998). Other research on visual preferences has looked beyond socio-demographics to consider personality variables. For example, Abello and Bernaldez (1986) found that those of their subjects classified as less 'emotionally stable' preferred landscapes containing structural rhythms and recurrent 'patterns', while those with high scores on 'sense of responsibility' tended to reject hostile, defoliated or wintery landscapes, despite their greater legibility.

Personal variables may not only moderate visual preferences for nature, but are also highly relevant to people's health responses. In health psychology it is commonly acknowledged that people cope very differently with health threats (Leventhal et al. 1984). These differences are not only related to personal variables (e.g., neuroticism), but also to the availability of social and environmental resources that may be used to deal with health threats (Stockdale et al. 2007). Consistent with this latter notion, recent epidemiological research in the Netherlands has found that relations between green space in the living environment and self-reported health are stronger for groups who are more home-bound, and thus more dependent on the supply of green space in their neighborhood, such as children, housewives, and the elderly (De Vries et al. 2003; Maas et al. 2006). Other recent research suggests that gender as a marker of social roles and behavioral norms may also condition the health benefits that adults realize from opportunities for experiencing nature. For example, in a longitudinal population study of urban residents in Sweden, ownership of a leisure

home was prospectively associated with a lower likelihood of early retirement for health reasons among men (Hartig and Fransson 2009). Among women, highly educated ones in particular, the likelihood of early retirement was greater with leisure home ownership, possibly because the leisure home imposed additional domestic work that outweighed the benefits of contact with nature. In addition to their implications for further research, such facts deserve consideration in the policy, planning, and health care contexts in which ideas about health benefits of natural environments are put into practice.

## 5.6 Conclusions

Ideas about health in relation to the experience of nature have a long history. The current research on the topic can be seen as a recent expression of a number of long-running, intertwined, social and cultural processes. Those processes have converged with developments in scientific and professional fields to provide compelling reasons for systematically studying nature experience and health and relatively good scientific capabilities for doing so. In challenging 'common sense' views about nature and health, researchers today are using those methods and theories now viewed as scientifically credible, but researchers in the future will undoubtedly, in line with their professional responsibility, find fault with some of the methods and formulations used today. Nonetheless, there is good reason to think that our understanding of these phenomena is improving, as are the capabilities for putting them to use. Issues at the interface of research and application are addressed in the next two chapters.

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