The Natural-Built Distinction in Environmental Preference and Restoration

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Chapter 3
The Natural-Built Distinction in Environmental Preference and Restoration: Bottom-Up and Top-Down Explanations

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3.1 Introduction

Humans have come a long way from living in places filled with animals, plants, and trees to living in a world dominated by cars, concrete, and buildings. Judging from the unstoppable trend of global urbanization, people appear to prefer built over natural settings. However, this preference seems based mostly on practical advantages offered by urban environments, such as safety from natural threats, comfortable living conditions, and job opportunities—to name only a few (Meyer, 2013; Purcell, Peron, & Berto, 2001). When it comes to environments that are most aesthically appealing and restorative, most people, including those living in cities, prefer natural over built settings (Van den Berg, Hartig, & Staats, 2007). Indeed, many of today's city dwellers long to escape from the urban asphalt jungle and spend time camping or hiking in nature areas. This "back-to-nature" sentiment has become an important complement and counter-tendency to urban living (Schmitt, 1990).

These days, however, busy urbanites no longer need to get out of the city to get a dose of nature. Across the world, a movement to reconnect people to nature by greening cities is rapidly gaining ground (Beatley, 2012). This "green urbanism" reflects a growing recognition of the vital importance of nature and green space for people's well-being and health (Twohig-Bennett & Jones, 2018). Yet, while the evidence for benefits of contact with nature is piling up, an important question appears to be overlooked: What is it exactly about natural environments that renders these environments more aesthetically appealing and restorative than human-made built environments? What are the essential (or as one might say, healing) aspects of nature that are not (or not as readily) available in built environments? As long as we remain in the dark about this matter, the argument for urban greening and other

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initiatives to reconnect people to nature remains incomplete because it leaves open the possibility that positive responses to nature reflect little more than a romantic ideal shaped by cultural and learned influences.

In what follows, I first reflect on the desirability and possibility of making a distinction between natural and built settings and discuss early findings demonstrating a natural-built distinction in environmental preferences. I then describe how the focus of research on positive responses to natural and built settings has shifted from visual preferences to restorative effects and health benefits of green space. These more personal observations are followed by a presentation of two alternative accounts for why more natural settings evoke more positive responses than built settings. The first is a bottom-up account in terms of intrinsic characteristics of natural environments that may have signaled adaptive values during human evolution. The second is a top-down account in terms of culturally transmitted views and personally learned positive experiences with nature. In subsequent sections, I critically review the empirical support for each account. I conclude the chapter with a discussion of non-visual bottom-up pathways and suggestions for future research into the direction of studying top-down resilience-building effects of experiences with nature.

3.2 The Distinction Between Natural and Built Environments

This chapter revolves around the distinction between natural and built environments. I have often noted that many people seem to have an intuitive aversion against such dichotomies, which are associated with rigid black-and-white thinking that is neglectful to instances that do not fall neatly into the dichotomous scheme. I agree there is a risk of oversimplification in looking at the world in terms of dichotomies. However, when I entered the field of environmental psychology as a PhD student in the early 1990s, I quickly became fascinated by the natural-built distinction in environmental perception and preference, as described by pioneering authors like Joachim Wohlwill (1983), Roger Ulrich (1983), and Steven and Rachel Kaplan (1982). They made me realize the profoundness and pervasiveness of this distinction, and its relevance for understanding effects of nature experiences on health and well-being (see also Hartig & Evans, 1993 for an excellent review and analysis of this early work).

The natural-built distinction may seem simple and crude because people make this distinction intuitively. From a more rational perspective, one might even question the distinction altogether because all built structures have to be manufactured from substances that are ultimately derived from natural matter (cf. Gibson, 1976, cited by Wohlwill, 1983, p. 12). Nevertheless, from a psychological point of view the distinction between natural and built is very real, and the principles that underlie it are far from easy to grasp. In fact, after decades of scientific inquiry, environmental

psychologists are just beginning to understand what may drive the natural-built distinction.

Most people will have a rough understanding of the concepts of natural and built environments or settings (I will use the latter two terms interchangeably). These concepts are, however, also quite broad and open to different interpretations. It, therefore, seems useful to clarify definitions before continuing with the main line of argument.

Within environmental psychology, the term "natural environment" (or setting) is broadly defined to include any outdoor or indoor place where vegetation and other organic or inorganic natural elements (such as water or rocks) are predominantly present (Van den Berg, Joye, & De Vries, 2019). Likewise, the term "built environment" broadly refers to any kind of outdoor or indoor place where human-made built structures and facilities devised for housing, transport, work, commerce, and other human needs are dominantly present (cf. Anderson, 2018). "Built environment" is sometimes used interchangeably with "urban environment." However, the term "urban" comprises not only geographical but also cultural and social aspects of living in cities and towns, and is therefore less appropriate as a counterpart of the term "natural."

As noted by Wohlwill (1983, p. 7), the distinction between natural and built environments is "far from iron-clad." Some places and settings seem to fall in between the two categories. For example, natural environments like the famous French gardens of the Palace of Versailles, or a row of neatly clipped animal shaped bushes, show such clear signs of human design and planning that they seem to lose their natural appearance. Within the built realm, organic buildings whose shapes and function mimic nature, such as Hunderwasser's tree tenant house in Vienna, or the nature-integrated structures built by Manrique on Lanzarote can also be considered boundary cases (see Fig. 3.1). Even in such cases, however, the setting will remain in its original category, no matter how much its natural appearance has decreased or increased. This suggests that there is something qualitatively different between natural and built settings that cannot easily be altered by human efforts.

Another type of boundary cases concerns natural settings that contain human artifacts, like buildings, roads and power lines, and built settings that contain natural elements, such as trees, plants, and water features. Regarding these mixed settings, Wohlwill (1983) proposed a predominance criterion, which states that a setting will be identified as natural or built as long as natural or built features remain the prevailing features. In addition, the categorization of a mixed setting as natural or built will depend on which setting it is compared to. Compared to grand, pristine nature scenes such as mountains, forests, and ocean beaches, a park surrounded by buildings will be classified as a built setting. However, the same park will be classified as natural when compared to a completely built area with no greenery. Responses to mixed urban-natural settings should thus be interpreted in relation to other settings in the stimulus set.

Fig. 3.1 Natural or built? Face fountain by César Manrique in the Jardin the Cactus at Lanzarote, photo by OxOx licensed under CC BY – SA 2.0

3.3 Preference for Natural over Built Settings

The first empirical evidence for a natural-built distinction in affective responses comes from visual preference studies. In this type of research, respondents are asked to rate a set of photos or slides of different environments on beauty, attractiveness, liking, pleasantness, and other affective dimensions (Ulrich, 1983). Using this approach, Kaplan, Kaplan, and Wendt (1972) found that natural scenes on average were rated one point higher than built scenes on a five-point like-dislike scale (see Fig. 3.2). The authors noted that "natural material was so vastly preferred over the urban slides that the two distributions hardly overlap" (p. 355). Furthermore, perceived complexity positively predicted preferences within the natural and built domains. Complexity could, however, not explain the greater preference for natural over built scenes—in fact, natural scenes were judged to be less complex than built scenes.

In the 1980s, it became clear that the natural versus built content of the scene was one of the strongest predictors of environmental preference (e.g., Bernaldez & Parra, 1979). In an early review of this research, Ulrich (1983, pp. 119–120) concluded that "one of the most clear-cut findings and potentially important findings to date is the consistent tendency for North-American and European groups to prefer

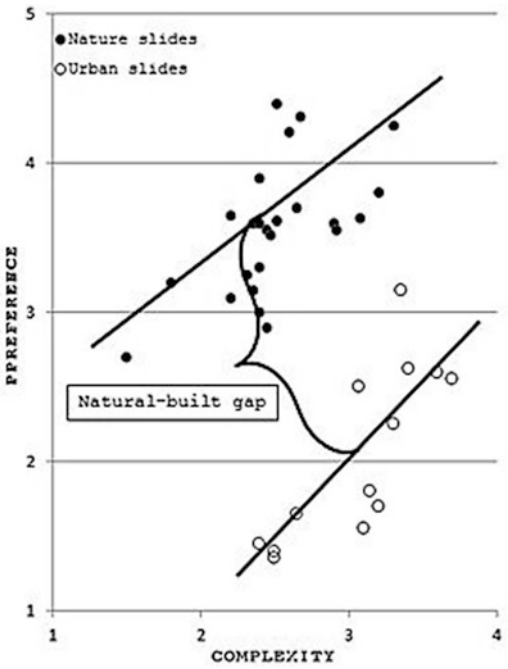

Fig. 3.2 The natural-built gap in environmental preferences. Figure adapted by the author from Kaplan et al. (1972)

even unspectacular natural scenes over the vast majority of urban views." In that same review, Ulrich proposed a tentative explanation of these findings. Building on emerging theories of emotions as innate phenomena that are inherently linked to actions, Ulrich suggested that preferences for natural over built environments might serve some deeper, adaptive function, in the sense that they serve as an action impulse, for behaviors that during human evolution in natural environments fostered well-being and functioning, and ultimately, the survival of the species. In particular, Ulrich proposed that preferences for natural environments, which are characterized by "mild-moderate interest, accompanied by preference/pleasantness, including calm and peacefulness," might signal opportunities for "psychophysiological restoration" (p. 94, Table 1)—an idea with a far-reaching impact.

3.4 From Beautiful to Restorative Nature

When I entered the field of environmental psychology as a PhD in the early 1990s, the focus of my research was on aesthetic preferences for natural landscapes (Van den Berg, 1999). Ecologists in the Netherlands were experimenting with a new nature management strategy, in which agricultural fields and other more cultivated nature areas were guided back into their more natural, wild state. Policy makers of the Dutch Ministry of Agriculture wanted to know more about public perceptions of

this new rewilding strategy. More specifically, they were interested in the aesthetic preferences of different user groups. This research question reflected the dominant focus of that time on visual quality and user values in the academic and policy discourse on nature experiences.

During my field work for the dissertation, I came to realize that the meaning of natural landscapes goes way beyond the aesthetic and the utilitarian. For one of the first studies, I had printed out large computer-simulated images of landscapes with varying degrees of naturalness and human influence (Van den Berg, Vlek, & Coeterier, 1998). When I asked farmers and other respondents, while sitting at their kitchen table, to rate the images for scenic beauty and other visual and user characteristics, they soon started to talk about their more personal experiences with the landscapes in which they lived, worked, or recreated. Respondents told me about how they recovered from burn-out by walking long hours with their dog through forests and fields. How they played as a child in the cornfields and how good it made them feel to think back to those days. Or how they found peace with the death of a loved one sitting on a bench listening to birds singing in trees. While listening to these stories, I felt that I fell short as a psychologist, not being able to capture the full meaning of nature for people with my visual preference research.

At the time, only some two decades ago, the idea that natural environments can promote health and well-being was not yet something most people would feel comfortable speaking about in public. In the Netherlands, one of the members of the Dutch royal family decided to cross the line and published a book in which she gave a very personal and intimate account of how she felt strengthened and comforted by her spiritual relationship with trees, plants, and animals (Lippe-Biesterfeld, 1995). The book was not received well in the media, and the princess was openly ridiculed for her confession that she communicated with trees. Politicians and other public figures were quick to distance themselves from her book. Indeed, during my interviews, respondents often felt the need to affirm, while they were describing their more personal experiences with nature, that "they are not the kind of person that talks to trees." However, it would not take long before the taboo on talking about health benefits of nature would be lifted.

Across the Atlantic, a new empirical line of research was rapidly gaining ground. In this research, people's affective, cognitive, and physiological responses were measured before and after real or simulated exposure to natural and built environments (Hartig, Book, Garvill, Olsson, & Garling, 1996; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Hartig, Mang, & Evans, 1991; Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998; Ulrich, 1979, 1981; Ulrich et al., 1991). Typically, participants in these studies suffered from experimentally induced or naturally occurring stress or mental fatigue and were in need of restoration from this depleted state. Hence why this line of research is commonly referred to as "restorative environments research." Results supported the greater restorative potential of natural, as compared to built, settings. A few years later, epidemiologists in the Netherlands and Japan began to document positive relationships between green

space in the living environment and health (De Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003; Takano, Nakamura, & Watanabe, 2002). New empirical evidence, as documented in a report by the highly respected Health Council of the Netherlands (2004), bolstered the idea that nature is important for people's health and well-being and rapidly became mainstream.

Looking back, I am still struck by how quickly the "nature is healthy" message found its way into modern society. Apparently, this message struck a chord because it resonated with people's deeply felt personal experiences and beliefs about nature. Yet, the eagerness with which people have embraced the "nature is healthy" message also suggests that momentary popularity of ideas on health functions of nature can quickly decline or even be reversed. Indeed, the history of psychology is rife with short-lived trends which were just as easily abandoned as they were adopted. To prevent this same thing from happening to nature–health research, it remains vital for the field to develop strong foundations in scientific theory and empirical research. This includes a healthy dose of self-criticism and a willingness to continually examine and critically test even cherished assumptions.

3.5 Bottom-Up or Top-Down?

A core assumption of nature–health research is that restorative and health benefits of nature stem to a large extent from bottom-up sensory processing of intrinsic characteristics that differentiate natural from built settings (Geisler, 2008; Ulrich, 1993). In other words, natural environments are assumed to contain some essential components which are lacking in built environments and that set in motion a train of positive affective and health responses. This assumption is by no means trivial—it is a necessary premise for evolutionary theories wherein restorative responses are postulated to be an innate, hardwired reaction to these intrinsic characteristics (Joye & Van den Berg, 2011). Moreover, the assumption that nature is a unique, irreplaceable source of health and well-being has motivated societal initiatives to connect people with nature. These initiatives include efforts to "bring nature to people" through the greening of cities, schoolyards, workplaces, and hospitals, as well as efforts to "bring people to nature" by means of community gardening, horticultural therapy, and other nature-based therapeutic interventions (Van den Berg, 2017).

Nature–health researchers have also acknowledged that responses to natural environments are partly shaped by top-down influences of culturally transmitted views and personally learned associations of nature as something positive and healthy. The potential influence of cultural views was discussed by Ulrich (1983, p. 107), who noted it can be argued that natural settings elicit more positive responses than built settings because "landscape painters have taught us that it is beautiful, or because society has conditioned us to revere wilderness and dislike cities." Such cultural views are likely passed on from parents to children—many readers will

have childhood memories of their mother or father urging them to go and play outside "because it is good for you." With regard to personally learned associations, it has long been recognized that natural environments are free from many of the cognitive, social, and physical demands of everyday built environments, and that merely the absence of these "stressors" can already explain why exposure to nature is pleasant, restorative, and healthy (Hartig et al., 2010; Kaplan & Kaplan, 1982; Knopf, 1987; Reser & Scherl, 1988). The consensual theoretical view is that "both unlearned and learned factors" play a role (Ulrich, 1983, p. 120). However, top-down explanations of restorative and health benefits of nature have received much less attention than bottom-up explanations, and researchers have been reluctant to consider the possibility that more positive responses to natural versus built settings might be fully accounted for by top-down cultural and learned influences.

3.6 The Persistence of Evolutionary Assumptions

Research on restorative environments and health benefits of nature has been dominated by two theories: Stress reduction theory (SRT; Ulrich, 1983; Ulrich et al., 1991) and attention restoration theory (ART; Kaplan & Kaplan, 1989; Kaplan, 1995). The details of these theories have been extensively described elsewhere, and are not relevant for the main line of argument in this chapter (Hartig et al., 2010; Staats, 2012). What is relevant here, is that both theories propose a bottom-up mechanism for restoration. ART recruits the concept of soft fascination, referring to patterns of visual and other sensory information that capture attention in an involuntary and effortless way. SRT proposes that there is an automatic positive affective response to non-threatening natural environments with survival-promoting qualities, such as the presence of water (cf. Valtchanov, 2013).

The principles of SRT and ART were laid out many decades ago, long before the surge in studies on restorative and health benefits of nature. The findings of this new body of research have generally not been held critically against evolutionary assumptions of the two theories. Rather these assumptions have been taken as an "article of faith" (Hartig et al., 2010). An exception is formed by a paper entitled "is love for green in our genes?" that I wrote together with Yannick Joye in 2011. In this chapter, we systematically examine the viability of the evolutionary claims of SRT as the theoretical framework that has most extensively elaborated on the supposed evolutionary origins of restoration. Our conclusion was that neither current empirical evidence nor conceptual arguments provide any strong support for an evolutionary account of restorative responses to nature. We did not go as far, however, as to suggest a top-down account of restoration. Instead, we put forward an alternative bottom-up account, in which we explained automatic positive affective responses to nature as by-products of fluent processing of specific informational patterns in nature rather than "obscure evolutionary factors" (p. 266).

3.7 Conditioned Restoration

A first attempt to formulate a top-down theoretical account of restorative responses to nature has recently been undertaken as part of a Norwegian master thesis (Egner, 2016). Drawing on principles of classical conditioning, the author argues that restorative effects of nature can be described by a two-step model in which exposure to nature first becomes associated, or paired, with leisure-time activities that elicit a positive restorative emotion, and later the same emotion is retrieved when the person is exposed to nature. This "conditioned restoration theory" as yet has to be empirically tested. Nevertheless, some basic assumptions of the model can be compared to existing findings.

According to the conditioned restoration account, leisure-time activities are in themselves more restorative than work or school activities, independent of where one spends the time. Consistent with this, experience-sampling studies have demonstrated that mood tends to improve over the weekend, and falls back on Mondays, and that such variations can be understood by the presence or absence of work-related activities (Ryan, Bernstein, & Brown, 2010). In a similar vein, mood has been found to improve during vacation time, independent of where the vacation is spent (Strauss-Blasche, Ekmekcioglu, & Marktl, 2000). Thus, more positive responses to natural versus built settings may reflect a conditioned association of nature-based activities with positive mood states during leisure time, provided, of course, that nature contact more commonly takes place during leisure time than during working hours.

While for most people the distinction between leisure and work time will covary with the amount of time spent in natural and built settings, this does not hold for people with outdoor, nature-based jobs, such as foresters. For these groups, natural environments constitute a workplace instead of a leisure environment. A cross-sectional study among a random sample of the Swiss working population found that having a profession related to forests was related to a decreased sense of being away, which in turn negatively influenced self-reported restoration when visiting forests (Von Lindern, Bauer, Frick, Hunziker, & Hartig, 2013). In a similar vein, a study among children living in agricultural areas in Spain shows that children who help out on their families' farm experience less restoration and a lower sense of being away when spending free time in agricultural natural areas than children whose relationship with these areas is merely recreational (Collado, Staats, & Sorrel, 2016). These studies are consistent with a conditioned restoration account. Both studies did not, however, measure respondents' responses to built settings. It therefore remains unknown whether experiencing the natural environment as a workplace may remove, or even reverse, the natural-built distinction in affective responses to nature.

Feeling a responsibility to support and encourage community-based and other initiatives to reconnect people with nature, many researchers may not be keen to discard the bottom-up account and thereby run the risk of having to communicate a more mundane picture of nature as something that is not so unique and special after

all. Nevertheless, it seems timely to reflect on the consistency of empirical findings of research on affective, restorative, and health responses to natural and built settings with a bottom-up, evolutionary account.

3.8 The Natural-Built Distinction in Preference Research

The presumed universality of the visual preference for natural over built settings constitutes a cornerstone of evolutionary theories. However, there is a lack of strong empirical data to support such universal claims. As in many other areas of psychology, most of the research on visual preferences has been conducted with student and convenience samples, instead of more representative population samples (for an exception, see Stamps, 1996). Moreover, very few studies have ventured out of the Western context, and the studies that have done so have mostly been conducted in western-oriented countries such as South Africa, Japan, or South Korea. Findings appear to be mixed—sometimes confirming a preference for natural over built scenes (Nasar, 1984), and other times going against such a preference (Zube & Pitt, 1981), or findings have been difficult to interpret along this dimension (Yu, 1995). Nowadays, research interest in cross-cultural comparisons of the preference for natural over built settings seems to have stopped almost completely, and the universal nature of this preference remains largely an assumption instead of an empirically established fact.

Another question that has received little attention is whether the preference for natural over built settings also applies to children. A thorough investigation of this question would seem highly relevant for an evolutionary account of positive responses to nature. If such positive responses reflect innate, biological mechanisms, they can be expected to decrease as the children increase in age, as children become more socialized and culturally educated. Many studies have documented children's affinity with nature (Kahn, 1997; Moore, 1986; Rice & Torquati, 2013), but few have compared children's affinity with nature settings to their affinity with built settings. In one of our own studies, we showed children (aged 8–10) pictures of attractive indoor/built and outdoor/natural play settings (Van der Waal, Van den Berg, & Van Koppen, 2008). About 60% of the children expressed a preference towards the indoor/built settings, and this preference did not change after the children had participated in a nature experience program.

A recently published study confirms and extends these findings (Meidenbauer et al., 2019). In this study, 4-to-11-year-old children and their parents rated their preferences for images of "nature and urban" scenes. Children demonstrated robust preferences for urban over natural environments, and the urban preferences significantly decreased with age. Nature exposure around the home and nature-related activities, as reported by parents, did not predict children's preferences (see also Rice & Torquati, 2013). Furthermore, children's preferences became more similar to their own parents' preferences with increasing age. As noted by the authors, these

findings "provide greater support for a learned affinity for nature, rather than an affinity that has been genetically programmed and present from birth" (p. 9).

3.9 The Natural-Built Distinction in Restorative Environments Research

Research on restorative environments has accumulated at such a rapid rate that it is now possible to conduct systematic reviews and meta-analyses. Unlike traditional narrative reviews, in which a content expert writes about a particular topic, systematic reviews, and meta-analyses use explicit and reproducible criteria designed to reduce bias, and the included studies are critically appraised in terms of methodological quality (Littell, Corcoran, & Pillai, 2008). A consistent finding from these reviews and meta-analyses is that the strength of the evidence for greater restorative effects of natural compared to built settings varies between outcome measures (Bowler, Buyung-Ali, Knight, & Pullin, 2010; Corazon, Sidenius, Poulsen, Gramkow, & Stigsdotter, 2019; McMahan & Estes, 2015; Mygind et al., 2019; Ohly et al., 2016; Stevenson, Schilhab, & Bentsen, 2018; Thompson Coon et al., 2011). In general, the strongest support is found for self-reported improvements in mood, while evidence for improved cognitive and physiological functioning is weak and inconsistent.

With regard to mood, a systematic review of 32 studies found that exposure to natural environments was associated with a moderate increase in positive affect and a smaller, yet consistent, decrease in negative affect relative to comparison conditions (McMahan & Estes, 2015). There is some support for improved cognitive functioning during exposure to natural versus built settings, but effects are weak and only found for a limited number of measures (Ohly et al., 2016; Stevenson et al., 2018). For example, a meta-analysis of 49 studies showed improvement in cognitive functioning after exposure to natural environments for only three out of eight cognitive domains, with low to moderate effect sizes (Stevenson et al., 2018). Support for improved physiological functioning in response to nature exposure is generally mixed and inconclusive (Corazon et al., 2019; Mygind et al., 2019). For example, a meta-analysis of 29 studies found that only studies of low or moderate quality reported some improved outcomes in the nature-exposure groups compared to control groups (Mygind et al., 2019). Studies of higher quality reported no differences. According to the authors, this indicates that the literature may be skewed towards positive findings being based on predominantly low to moderate quality studies.

In addition to these outcome-specific analyses, several systematic reviews on the added benefits of nature exposure to moderate forms of exercise (mostly walking) have taken a wider scope and included studies with different outcome measures (Bowler et al., 2010; Lahart, Darcy, Gidlow, & Calogiuri, 2019). Findings from these studies converge that acute bouts of outdoor green exercise are accompanied by somewhat more positive mood and feelings of enjoyment, but do not have any

measurable effect on biological markers. In a discussion of these findings, Bowler et al. (2010, p. 8) state that: "Given these [mood] data were self-reported, they were therefore potentially open to bias depending on prior beliefs of the participants. The blinding of participants to the research question in these studies is problematic as in many cases the hypothesis could be guessed by participants based on the study design. Thus, it cannot be ruled out that findings may have been affected by participants' pretest opinions/beliefs on the likely effects of a natural environment rather than any actual changes in their mental health or well-being."

Overall, the results of systematic reviews and meta-analyses provide only weak support for a natural-built distinction in restorative responses, and to the extent that they do, the findings are most pronounced for more cognitively elaborate outcome measures and therefore more supportive of a top-down than a bottom-up evolutionary account.

3.10 Scene Type Variations in Restorative Environments Research

In contrast to visual preference studies, which typically include multiple natural and built settings, most studies on restorative effects have compared only one type of natural to one type of built setting. This practice is partly due to the experimental setup of restorative environments research, which is much more time-consuming than simply asking people to rate their preference for a set of photos or slides. But one may wonder why so few studies have included multiple natural settings. This would seem a logical approach, that is necessary for identifying the components of natural settings that are responsible for their restorative potential. Identifying these components is not only practically useful to create optimal restorative environments. It is also vital for testing theoretical notions on bottom-up influences of evolutionary significant characteristics on restoration, such as the presence of water. The answer may lie in publication bias: studies with multiple natural environments tend to yield non-significant results, which are more difficult to publish than significant results.

Because there are so few studies with multiple natural (and built) environments, there are no systematic reviews or meta-analyses of these types of studies. However, a number of individual studies have reported no differences in restorative effects between different natural settings. Among these is one of the first and most widely cited studies by Ulrich et al. (1991) which revealed no differences in psychophysiological restoration between exposure to a video of a vegetated scene dominated by trees and other plants, and a video of a water setting dominated by a fast-moving stream. Another study by my own research group also found no differences in restorative effects between viewing videos of natural and built settings with and without a water feature (Van den Berg, Koole, & Van der Wulp, 2003).

In 2009, I was contacted by landscape architect Anna Jorgensen from Sheffield. She asked if I would be interested in participating in a project on the impact of perceived naturalness on restorativeness. The idea behind this study was to empirically demonstrate, using the method of the 2003 study, greater restorative impacts of viewing photo/video presentations of more natural wild woodland compared to tended woodland and parkland. Despite my gut feeling that such a study would not yield any differences between the different types of natural settings, we started the collaboration and carried out the study. The results, as published in the Journal of Landscape and Urban Planning in 2014, confirmed my expectations: Participants in the natural conditions showed stronger recovery on all self-reported measures than those in the urban street condition (Van den Berg, Jorgensen, & Wilson, 2014). Differences in recovery among the natural settings did not reach statistical significance.

A potential explanation for the non-significant findings is that in all these studies participants were passively viewing simulated nature, instead of being taken out to different types of real outdoor natural environments. Viewing nature may not be an ecologically valid method to study people's restorative responses as they actively engage with the environment (Heft, 2010, see also the concluding chapter of this volume). This does not, however, seem to be a viable explanation. Results of a well-controlled, randomized, cross-over, field experiment in which participants' mood, cognitive function, restoration experiences, salivary cortisol, and heart rate variability were measured before and after a walk in a pleasant residential environment and natural environments with and without water showed that mood and cortisol improved in all environments (Gidlow et al., 2016). There were no differences on any of the outcome measures between natural environments with and without water; both natural environments were associated with greater restoration experiences and cognitive function improvements than the built environment (see also Tyrväinen et al., 2014).

In general, both lab and field experiments on restorative effects of nature have thus far failed to uncover consistent differences between different types of natural settings in their effectiveness in supporting psychophysical restoration from stress or other detrimental conditions. These findings could indicate that the physical features responsible for nature's restorative powers are ubiquitous in nature. However, the findings may also point to the irrelevance of physical features to restorative effects of nature.

3.11 Preference and Restoration: (How) Are They Related?

Taken together, much of the available empirical evidence appears to favor top-down, rather than bottom-up, accounts of the natural-built distinction in both environmental preferences and restorative effects. As attentive readers may note, this goes against the findings of an early study of my own group in which we used mediational analyses to empirically demonstrate that aesthetic preferences for natural

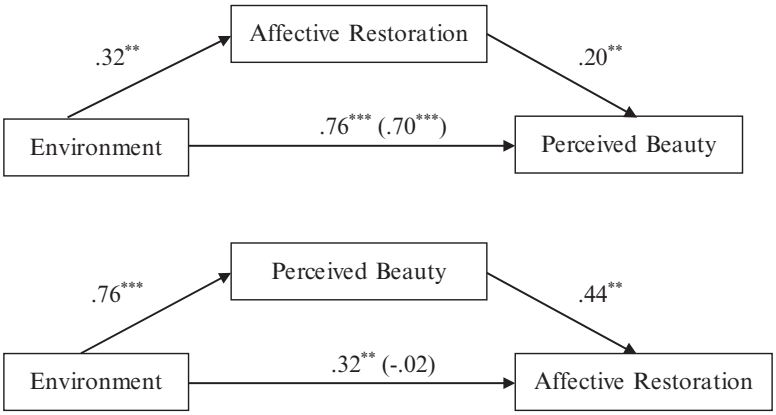

Fig. 3.3 Mediation test of the effect of environment (natural, built) on perceived beauty via affective restoration (top panel) and the reverse mediation test of the effect of environment on affective restoration via perceived beauty (bottom panel) based on data from the study by Van den Berg et al. (2003). Values represent standardized regression coefficients; the values in parentheses represent the direct (mediated) effects

over built settings can be partly explained by the greater, presumably bottom-up, mood-improving effects of the natural settings (Van den Berg et al., 2003). Within the dominant evolutionary theorizing of that time, this seemed the most logical way to interpret the interrelationships between preferences and restorative effects. It is important to point out, however, that mediational analysis cannot be used to determine causal direction, and the data may just as well be interpreted in terms of restorative effects being mediated or caused by (learned) aesthetic preferences (Lemmer & Gollwitzer, 2017). In fact, as shown in Fig. 3.3, a reverse mediation test of the data from that 2003 study shows full mediation of perceived beauty by affective restoration—which suggests that the alternative model, in which the independent variable X (natural versus built environment) influences the dependent variable Y (affective restoration), via a causal influence on variable M (perceived beauty) is the best-fitting model.

Within this reverse mediation model, it is still possible that perceived beauty as a causal mediating factor reflects a bottom-up influence of evolutionary-based intrinsic qualities of nature. However, an equally plausible interpretation of the findings is that mood-improving effects of nature are a by-product of culturally and personally learned aesthetic appreciation of natural environments.

3.12 Health Benefits of Green Space

In addition to experimental research on restorative effects of nature exposure, epidemiological studies have examined relationships between the amount of "green" and "blue" space in people's living environment and health outcomes, such as

perceived general health, perceived mental health, morbidity, and mortality. The number of studies investigating these relationships has also increased rapidly and has been summarized in systematic reviews and meta-analyses (Browning & Lee, 2017; Gascon et al., 2015, 2016; Gascon, Zijlema, Vert, White, & Nieuwenhuijsen, 2017; Kabisch, Van den Bosch, & Lafortezza, 2017; Van den Berg et al., 2015). Results generally support positive relationships between living in green environments and health, in particular mental health (e.g., a reduction of mood disorders and stress complaints), and mortality.

An inherent limitation of cross-sectional research is that relationships cannot be causally interpreted. People with lower incomes tend to have less healthy lifestyles and, as a consequence of more limited resources, will live in less green neighborhoods (see Wells, Chap. 7, this volume). It can therefore not be ruled out that the relationships reflect residential selection, a causal relationship in the opposite direction. Moreover, epidemiological studies typically do not include any measures of the amount of time spent in or near green space, thereby allowing for the possibility that the relationships reflect effects of confounding variables like diminished traffic noise and exhaust fumes that covary with amount of green space.

In the absence of solid support from studies in which people are directly exposed to natural and built environments, the epidemiological evidence for health effects of living in greener environments remains largely circumstantial. Nevertheless, assuming some form of causal relationship, these findings suggest that (mental) health benefits of nature are mostly realized through more chronic, long-term engagement with real outdoor natural settings. This might point towards the operation of non-visual pathways, such as the ingestion or inhalation of certain health-promoting substances in the air and soil of natural areas (cf. Franco, Shanahan, & Fuller, 2017). Before discussing research on such alternative non-visual pathways, I will first address research on positive responses to fractal patterns in nature as a potential visual pathway that has recently received growing attention in the field of nature–health research.

3.13 Visual Pathways: Fractals and Fluency

Research and theorizing on bottom-up processes underlying more positive responses to natural versus built settings has mostly focused on visual pathways (Hägerhäll et al., 2018; Kardan et al., 2015). In particular, it has been suggested that the greater aesthetic appeal and restorative potential of natural, as compared to built, settings, may derive from certain types of low-level "fractal-like" patterns that are ubiquitous in nature (Aks & Sprott, 1996; Hägerhäll et al., 2015; Joye, 2007; Patuano, 2018). These low-level patterns are characterized by the recurrence of broadly (but not exactly) similar patterns on finer scales, building shapes of immense complexity. Examples of such random (or statistical) fractal patterns can be observed in trees, whose fine-scale twigs approximately resemble the course-scale patterns created by thick branches (See Fig. 3.4). While fractal patterns are visually and geometrically

Fig. 3.4 Example of a random fractal-like pattern in a tree, with the branches of the tree looking like small-scale copies of the entire tree when zooming in (photo made by the author)

highly complex, the internal repetition of visual information in fractals creates higher levels of visual redundancy which makes such patterns relatively easy to process. According to the perceptual fluency account, as proposed by Yannick Joye and myself, this "easy processing" of fractals provides a possible explanation for the greater aesthetic appeal and restorative potential of natural versus built settings (Joye, 2007; Joye, Pals, Steg, & Lewis Evans, 2013; Joye, Steg, Ünal, & Pals, 2016; Joye & Van den Berg, 2011). In addition, it has been suggested that the human visual system itself operates according to fractal principles and during evolution in natural environments has become optimally adapted to processing scenes with fractal characteristics (Redies, 2008; Taylor, Spehar, Hägerhäll, & Van Donkelaar, 2011).

Using a stimulus set that included both natural and built scenes, Berman and colleagues have shown that low-level fractal-like image features, like a high density of curved and fragmented edges, positively predict perceived naturalness, and in turn, perceived beauty, especially when beauty ratings are made rapidly (Redies, 2008; Taylor et al., 2011). In one of our own studies, we took a more subjective, psychological approach by using perceived complexity of highly magnified parts of natural and built scenes as a subjective indicator of fractality (Van den Berg, Joye, & Koole, 2016). Results showed that greater perceived restorative quality and longer viewing times (as a measure of interest) of the unmagnified natural scenes, as compared to the unmagnified built scenes, were partly mediated by the higher perceived complexity of their magnified parts.

The research on fractals provides some first steps towards a better understanding of the critical low-level visual components that underlie the natural-built distinction in environmental perception (i.e., the basic visual cues that people use to discriminate between natural and built settings). Among other things, these findings strengthen the case for biophilic architecture, in which fractal patterns are integrated in buildings to create more natural-looking and beautiful cities (Joye, 2007; Kellert, Heerwagen, & Mador, 2011). But do fractals also have some inherent, restorative quality, as suggested by the perceptual fluency account?

Findings of a recent experiment speak against such a bottom-up pathway leading from low-level image features to restoration (Menzel & Reese, 2019). In this study, which followed a classic restorative environments research design with pre- and post-measures of self-reported restoration and cognitive functioning, participants were randomly assigned to viewing four types of images of natural and built settings

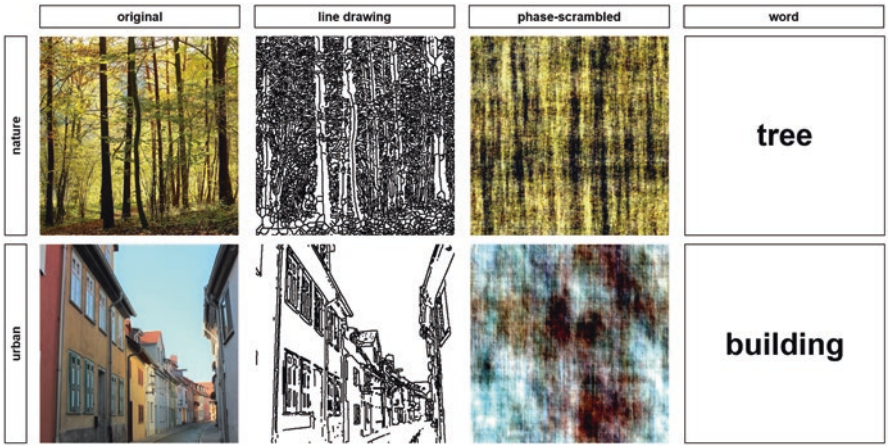

Fig. 3.5 Example of original and phase-scrambled images of natural and built scenes used in the study by Menzel and Reese (2019), unpublished materials reprinted with permission of the authors

(Fig. 3.5): original photos of natural and built settings, phase-scrambled versions of the same images, in which several low-level properties are kept constant while spatial information is randomized, line drawings of the settings, and a condition in which the settings were only described with words. Results show that self-reported restoration was different for natural versus built environments when confronted with original photographs, line drawings, and words. No differences between natural and built settings were found for the condition in which the environment could not be identified due to randomizing the spatial information. The authors conclude that they were unable to demonstrate a clear contribution of lower level processed image properties to restorative outcomes in natural versus built conditions. The results also suggest that the typical difference in restoration potential when comparing natural to built settings cannot occur without higher level processing.

3.14 Auditory Pathways: Nature Sounds

Humans are multisensory. It seems likely that many benefits are delivered through the non-visual senses (sound, smell, touch, and taste) and that these are potentially pathways through which bottom-up physiological influences of contact with nature on health may be obtained. With respect to the auditory pathway, several studies have shown that listening to bird song and other natural sounds can support restorative experiences (Alvarsson, Wiens, & Nilsson, 2010; Krzywicka & Byrka, 2017; Ratcliffe, Gatersleben, & Sowden, 2018). Natural sounds can provide information on species, season, and temporality, and it is conceivable that the human species has evolved to be attuned to such survival-relevant auditory cues (Franco et al., 2017). Findings of a recent study on restorative effects of listening to nature sounds are,

however, difficult to reconcile with such an account (Haga, Halin, Holmgren, & Sörqvist, 2016). In this study, participants conducted cognitively demanding tests prior to and after a brief pause. During the pause, participants were exposed to an ambiguous sound consisting of pink noise (a smooth and soothing form of white noise) with some static white noise interspersed. Participants were randomly assigned to different stimulus-source conditions in which they were either told that the sound originated from a nature scene with a waterfall, or that it originated from an industrial environment with machinery. Participants who were told that they were listening to a waterfall felt more restored after the pause, as indicated by a decrease in self-reported mental exhaustion. By contrast, participants who listened to the same sound thinking it was produced by industrial machinery showed a slight increase in mental exhaustion. These findings, which have been corroborated by other studies (Van Hedger et al., 2019), clearly sit uneasy with a bottom-up evolutionary account of restorative multisensory experiences with natural environments.

3.15 Olfactory Pathways: Phytoncides and Negative Air Ions

Human olfaction relies on old neural circuits in the brain stem, the reptilian part of the brain that developed first (Doty, 2015). These circuits have a direct link with the limbic system, which has allowed humans to rapidly assess, without much time for reasoning and reflection, whether something is edible or dangerous. In line with the evolutionary adaptive function of smells of nature, several studies have reported positive effects of inhaling smells of edible plants, like peppermint, rosemary, citrus, and vanilla on cognitive performance, psychophysiological stress and mood (for reviews see Franco et al., 2017; Hägerhäll et al., 2018). However, a number of systematic reviews of aromatherapy and essential oils, published in mainstream journals suggest that the evidence for health benefits of inhaling smells of nature so far remains inconclusive (Dimitriou, Mavridou, Manataki, & Damigos, 2017; Lee, Choi, Posadzki, & Ernst, 2012; Posadzki, Alotaibi, & Ernst, 2012).

Notably, it has been suggested that breathing in natural air may influence health without any conscious experience of smell (Franco et al., 2017; Kuo, 2015). When attacked by harmful insects and microbes, plants and trees give off certain antimicrobial organic compounds to protect themselves. A number of Japanese studies have shown that inhaling such “phytoncides” may strengthen human immune system function (Li, 2010). However, a closer look at these studies shows that participants were exposed to essential oils that were vaporized in the air through humidifiers. Essential oils are indeed a subclass of phytoncides, which themselves are a subcategory of a broad range of biochemical substances that are released by microorganisms and plants to attack other harmful plants and organisms, or warn other plants against such attacks (Rice, 2012). These biochemical substances are studied in a field called “allelopathy” (derived from the Greek “to suffer from each other”), and include antibiotics (substances used for interactions between microorganisms), kolines (used for plant to plant interactions), marasmins (used for

microorganism to plant interactions), and phytoncides (used for plant to microorganism interactions). While the antibacterial properties of these substances are well studied and have been successfully applied in medicine, the effects of inhaling these substances on humans remain largely unknown.

Negative air ions, which are formed when a gas molecule or atom gains enough energy to release an electron, are another type of odorless air-borne substances that have recently been linked to health benefits of exposure to natural environments (Kuo, 2015). Negative air ions can be found throughout nature, with particularly high concentrations in places that are traditionally prescribed for health treatments, such as mountainous areas and seashores. The presence of negative air ions has been associated with many health outcomes including improved mood (Goel & Etwaroo, 2006) and enhanced vaccine induced mucosal immune response (Grafetstätter et al., 2017). However, experimentation in this area has been hampered by serious methodological flaws (Yates, Gray, Misiaszek, & Wolman, 1986), and a recent systematic review showed no consistent or reliable evidence for therapeutic effects (Jiang, Ma, & Ramachandran, 2018).

In sum, the available evidence for bottom-up olfactory pathways from antibacterial compounds and negative air ions to health is mixed and inconclusive. Research in these areas has been plagued by a low quality of the studies and publication bias, which makes effects and interventions seem stronger than they actually are. Although there are enough positive findings to warrant further exploration, it seems unlikely that these pathways can account for the substantive and consistently positive relationships between green space and health.

3.16 Where to Go Next

So where do we go next—now that the case for bottom-up restorative effects of short-term exposure to natural over built environments is getting weaker with every new systematic review and critical experimental study being published? Is it time to abandon the whole idea that restorative and health effects of natural environments reflect evolutionary influences of some unique characteristics of these environments that cannot be found in built settings? I think it would be premature to draw such a drastic conclusion. After all, results of meta-analyses are only as strong as the studies they are based on, and the quality of the majority of studies in restorative environments research is still low or at best moderate. To me, the most reasonable next step would be to reassess the strength of the existing evidence base, by trying to replicate the findings of some of the most cited studies, preferably by means of large, well-powered multi-lab studies.

Recently, I participated in one of the first of such multi-lab replications of the seminal Ulrich et al. (1991) study, led by VU University of Amsterdam. This multi-lab study, which included 10 labs and almost a 1000 participants, failed to reproduce the impacts on physiological parameters as reported in the original study. Only if and when such replications and further critical experimental studies continue to

yield negative results, it would seem timely to let go of the now dominant view that restorative and health benefits of nature are guided by intrinsic visual and other sensory cues that signal information that was once important for human survival in natural environments. In the meantime, another possible non-sensory bottom-up pathway may be explored, which I will discuss in the next section.

3.17 Microbes and the Immune System: The Old Friends' Hypothesis

A different perspective on health benefits of nature is provided by the so-called old friends' hypothesis, formerly known as the "hygiene hypothesis," proposed by Graham Rook (Rook, 2013; Rook, Raison, & Lowry, 2014). The bottom line of this hypothesis is that some originally harmful microbes have co-evolved with human beings. To function correctly, the immune system needs "data inputs" from these "old friends." These inputs, which come from bodily exposure to natural environments and animals, are crucial in early life, but continue to be important in adulthood and old age. Without appropriate microbial inputs the regulation of the immune system is faulty, and the risk of chronic inflammatory disorders increases (Fig. 3.6).

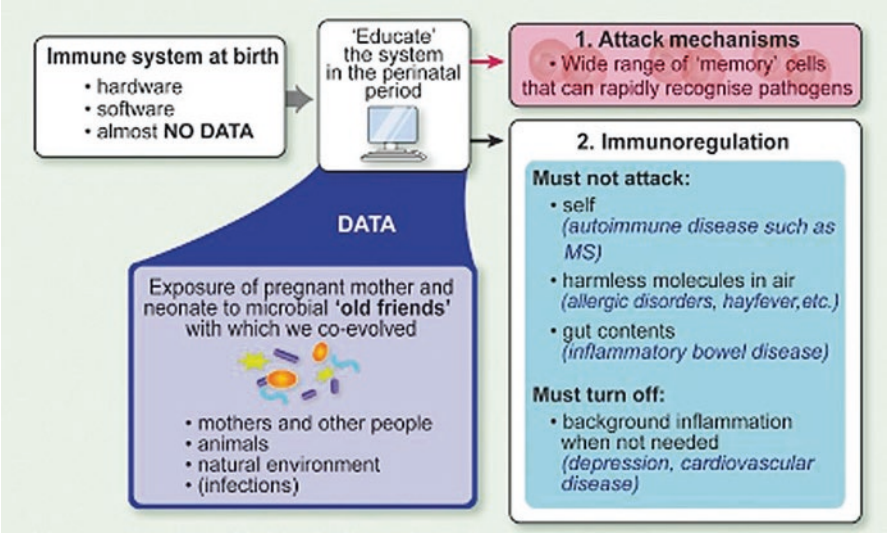

Fig. 3.6 Graphical illustration of the Old Friends Hypothesis (reproduced from Rook et al., 2014). According to this hypothesis, the immune system requires "educational" input. The microbiota of organisms from the natural environment and other tolerated organisms (such as helminths) with which humans co-evolved are required to expand the regulatory branches of the immune system to permit an appropriate immune response

The old friends' hypothesis fits in several ways with the findings from research on restorative environments and health benefits of green space. First, immune-regulating functions of microbial inputs only become effective with more prolonged exposure, which could explain why epidemiological studies have yielded more support for health benefits of nature than short-term experimental investigations. Second, chronic inflammatory disorder has been associated with lifestyle-related diseases, including anxiety and depression (Foster & McVey Neufeld, 2013), cardiovascular disease (Frostegård, 2013) and obesity and type 2 diabetes (Karlsson, Tremaroli, Nielsen, & Bäckhed, 2013) for which the strongest relationships between green space and health are found. Third, biodiversity is one of the few qualities of urban green space that predicts health outcomes and self-reported restoration (Aerts, Honnay, & Van Nieuwenhuyse, 2018; Wood et al., 2018).

Taken together, the old friends' hypothesis could be a bottom-up biological pathway through which nature benefits are delivered. It is a well-studied pathway that fits within a broader perspective of enhanced immune function as a central pathway in relationships between nature and health (Kuo, 2015).

3.18 Building Resilience: A New Focus for People-Nature Studies

Based on my analysis so far, it seems inevitable that nature–health research will move away from assessments of short-term restorative effects of visual exposure into the direction of benefits of more long-term direct exposure assessed with methods from epidemiology, immunology, ecology, and other natural and medical science fields. What could be the contribution of environmental psychology to this new perspective on nature–health relationships? A complementary contribution could be to show that embodied engagement with nature not only builds resilience at a biological/physical level, but also at a psychological level (see also Wells, Chap. 7, this volume). As described by the Dutch princess Irene, trees can be such good "old friends" in times of need and desperation. Every time people make a real, deeply felt connection with nature, their resilience to cope with adversities and to grow as a person is strengthened (Zelenski & Nisbet, 2014).

Thus far, research and theorizing on resilience-building experiences with nature has mostly been carried out in the context of wilderness programs and other organized nature-based therapeutic activities (Bettmann, Gillis, Speelman, Parry, & Case, 2016; De Pater, 2012; Russell, 2001). The positive outcomes of such programs on measures such as improved problem-solving ability, and positive changes in self-concept, self-esteem, and body image have been well documented (Bettmann et al., 2016; Driver, Nash, & Haas, 1987). A difficulty with this type of research is that effects of nature experience are confounded with effects of the therapeutic program and structured group activities carried out within the natural setting. Nevertheless, as pointed out by Hartig et al. (2010), there are reasons for assuming

that the natural environment itself contributes to resilience-building outcomes of wilderness programs and nature therapy. Besides a sense of "being away" from the cognitive, social, and physical demands posed by everyday urban settings (Kaplan & Kaplan, 1989), these reasons relate to more positive characteristics of natural settings, which include, but are not restricted to: the natural environment being impartial or indifferent, and giving little negative or judgmental feedback (Grahn, Tenngart Ivarsson, Stigsdotter, & Bengtsson, 2010; Wohlwill, 1983), the natural environment being a source of deeply rooted fears, which are often exaggerated in modern times and thus easy to overcome (Öhman & Mineka, 2003; Van den Berg & Ter Heijne, 2005), and the natural environment offering many affordances that promote acquisition of sensory-motor skills and mastery and a sense of competence (Fjørtoft, 2004). These characteristics may not be unique or intrinsic to natural environments. However, they are more abundant in natural than built settings, which makes natural settings effective places for resilience building.

It would seem timely for environmental psychologists to critically examine these resilience-building experiences with more rigorous empirical methods, in more varied natural settings. It is beyond the scope of this chapter to give a detailed outline of such a new approach. However, it is possible to list some topics worth examining with more controlled research designs that allow for comparison between natural and built settings, and shed more light on the possible conditions that facilitate connecting experiences that build resilience. These topics may include:

- Magical moments and other "peak experiences" with nature during childhood, which make children realize they are part of a larger universe and form the basis of a life-long affiliation with nature (Chawla, 2002; Van der Waal et al., 2008, see also the chapter by Chawla in this volume).
- Extreme experiences in wilderness settings that confront youth at risk, and other groups with their deepest fears, and helps them to overcome these fears (Bettmann et al., 2016; Lekies, Yost, & Rode, 2015).
- Hands-on experiences with nature during gardening and other tactile ("hands in the earth") contact with nature and animals (Buck, 2016; Gross & Lane, 2007).
- Episodes of heightened sensory experience, when the whole natural world seems to look new and different, as when people for the first time step out of a hospital after being treated for a life-threatened disease.
- Sublime encounters with nature which make people realize the power of nature and their own significance in the grander scheme of things (Joye & Bolderdijk, 2015; Van den Berg & Ter Heijne, 2005).

An important challenge for this experimental "resilience by nature" research is to study nature experiences in a systematic and controlled manner while preserving the authenticity of the experiences. One suitable approach is provided by ecological momentary assessment, which involves the repeated sampling of thoughts, feelings, or behaviors as close in time to the experience as possible in the naturalistic environment (Beute & de Kort, 2018; Moore, Depp, Wetherell, & Lenze, 2016).

3.19 Conclusion

Writing this chapter has turned out to be a journey through my career, reflecting on issues related to differential experiences with natural and built settings that have long since fascinated me, and finding out where we stand with these issues. While I used to think that experimental research on restorative environments provides more convincing evidence for health benefits of nature than epidemiological studies, I am now inclined to think that the reverse may be more true.

I would like to point out that my analysis does not contest the restorative qualities of contact with nature—they only open up the discussion on the origins of these qualities, which seem to be more top-down cognitively influenced than is generally assumed. There is no doubt that nature is a very powerful source of restoration and other health benefits. However, in terms of Kaplan and Kaplan's Attention Restoration Theory, much of the short-term benefits seem to be related to a sense of "being away" from the environmental and social pressures of living in urban environments, rather than a bottom-up "soft fascination" with intrinsic visual qualities.

Perhaps the most important lesson that I have learned is that we are still mostly in the dark about what it is that draws people to nature. Yes, countless people sense that making contact with nature is important and meaningful. But what makes experiences with nature so important and meaningful that we keep passing the message on to next generations? Can scientific methods help us to get to the heart of this experience? And if so, which methods are most useful for studying the deep affective affiliation we have with nature? A key challenge for future research is to develop an increasingly fine-grained understanding of these issues, with an open mind that is receptive to different—bottom-up and top-down—ideas and possibilities.

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