

Biophilic Design: Nine Ways to Enhance Physical and Psychological Health and Wellbeing in Our Built Environments



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1 Introduction

Biophilic Design is an applied science, aimed at planning artificial spaces that reflect the innate tendency of human beings to seek connections with Nature. It is well known that the application of Biophilic Design reduces stress, stimulates creativity and clear thinking, improves physical and psychological wellbeing and accelerates healing (for a review, see [3]).

2 Biophilia

Biophilia is “the innately emotional affiliation of human beings to other living organisms” [34]. It covers a variety of attitudes [27], emotions [6] and values [22] which, collectively, constitute our relationship with Nature.

2.1 *Biophilia and Biophobia*

According to E.O. Wilson, “biophilia is not a single instinct but a complex of learning rules that can be teased apart and analyzed individually. The feelings molded by the learning rules fall along several emotional spectra: from attraction to aversion” [34]. Attraction is biophilia, aversion is biophobia [32]. During evolution, humankind had

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to face the hostile forces of Nature in wilderness environments. The learning rules of biophilia and biophobia rooted themselves in the genetic heritage of our species, according to the contribution they made to improving human efficiency in seeking resources and refuges. Wilderness environments trigger two types of physiological reaction: (1) the ‘fight-or-flight’ response, which translates into a hyperactivity of one of the branches of the autonomic nervous system, usually the over-expression of the sympathetic nervous system [30], which was linked to the concept of biophobia (e.g. [32]) and (2) the ‘rest-and-digest’ response, which manifests as the cooperation of both branches of the autonomic nervous system, with a prevalent influence of the parasympathetic nervous system. This assures better long-term resilience of the individual [19], as it reduces stress [32] and enhances cognitive functions [21]. Although various scholars consider biophobia to be part of the biophilic system (e.g. [32, 33]), for the purposes of studying Biophilic Design, it would be more convenient to maintain a distinction between the two concepts of biophobia and biophilia [4]. A reasonable objective of Biophilic Design could be to construct environments that can stimulate biophilia [2] and reduce the stress induced by bio-phobia: in other words, environments that can sustain and improve the equilibrium of the autonomic nervous system.

2.2 *An Evolutionary History of Biophilia*

Biophilia developed in the Palaeolithic period. For approximately 95% of their evolutionary history, human beings survived by adopting a nomadic hunter-gatherer lifestyle. Humans have thus perfected a set of responses adapted to the various wilderness environments—mainly the savannah [29]—aimed at recognizing the quality of an environment in terms of resources and refuges. Some of the environmental preferences which incorporated into Biophilic Design are based on innate learning rules derived from our ancestors’ survival, and even today they form the primary, deepest core of our biophilia [13]. After farming was invented, approximately 14,000 years ago [1], most of the human population became sedentary. Human beings started to distinguish the domestic from the wilderness environment. Their refuges became permanent, and the first human clusters were formed: villages and then towns and cities [18]. In this period, which covers approximately 5% of the evolutionary history of humankind, the biophilia structured in the Palaeolithic period was adapted to the new cultural requirements. One example is proxemics. In the Palaeolithic period, groups of *Homo sapiens* were few, and meetings between humans were rare, outside of their own clan. During the Neolithic period, village life required a level of socialization that imposed a hitherto unknown physical proximity, to which we have never fully adapted. This explains, for example, why many people seek outdoor spaces in Nature in which the human presence is rare. Finally, over the past 250 years—an irrelevant period from an evolutionary point of view: less than 0.2% of the evolutionary history of humankind—human beings developed their inclination to transform their environment permanently and irreversibly [17]. During this period, human clusters

gradually became larger and denser. Compared to the wilderness environments in which humans evolved, towns and cities—now home to 53% of the world’s population [35]—are characterized by a lack of green spaces, large crowds, and artificial lighting [7]. The lack of natural stimuli atrophied biophilia [12, 35]. After the industrial revolution, detachment from Nature became even more pronounced. This detachment was so hard that many people feel the need to restore their biophilia by immersing themselves in Nature during their free time.

3 From Biophilia to Biophilic Design

“Biophilic Design is the deliberate attempt to translate an understanding of the inherent human affinity to affiliate with natural systems and processes—known as biophilia—into the design of the built environment” [23]. “Biophilic Design is not about greening our buildings or simply increasing their aesthetic appeal through inserting trees and shrubs. Much more, it is about humanity’s place in nature, and the natural world’s place in human society, a space where mutuality, respect, and enriching relation can and should exist at all levels and emerge as a norm rather than the exception” [25]. These definitions come from Stephen R. Kellert (1943–2016), Tweedy/Ordway Professor of Social Ecology at Yale University. Kellert, together with E.O. Wilson, is the author of *Biophilia Hypothesis* [27]. Like Wilson, Kellert is also an ecologist, who gradually developed an interest in artificial environments, culminating in the book *Biophilic Design* in which [26] collected the experiences of biologists, psychologists and architects joined by their common interest in artificial environments that respect human biophilia. The first chapter of this book [23] continues to be a reference work for studies on Biophilic Design even today [31].

3.1 *Design by Nature: The Legacy of Stephen Kellert*

The goal of Biophilic Design is only apparently simple. Kellert saw two limitations that hamper the introduction of effective Biophilic Design: “the limitations of our understanding of the biology of the human inclination to attach value to Nature, and the limitations of our ability to transfer this understanding into specific approaches for designing the built environment” [23]. Therefore, Kellert recognized two dimensions of Biophilic Design. The first was an *organic* or *naturalistic dimension*, inspired by biophilia that established itself genetically during the Palaeolithic period. The second was a *vernacular dimension*, which developed after the Neolithic period. Kellert correlated these two dimensions to 72 ‘attributes’ of Biophilic Design and systematized them according to six ‘elements’: Environmental features, Natural shapes and forms, Natural patterns and processes, Light and space, Place-based relationships, and Evolved human-nature relationships [23]. The 72 attributes provided a foundation for the *Biophilic Quality Index* by Berto and Barbiero [13].

Kellert's research was interrupted prematurely in 2016. In the book *Nature by Design* [24], published posthumously by his wife Cilla, Kellert sought to systematize Biophilic Design according to three categories: Direct Experience of Nature; Indirect Experience of Nature, and Experience of Space and Place, which led to a series of suggestions aimed at helping designers to incorporate the human affinity with Nature into the built environment. If used appropriately and specifically, instead of as a checklist applied indiscriminately, these suggestions, or alternatively the 72 attributes published in [23], offer a series of options for using Biophilic Design in an effective way [24].

3.2 The 15 Patterns of Biophilic Design by Terrapin Bright Green

A pragmatic approach to Biophilic Design has been proposed by the consulting firm Terrapin Bright Green (TBG), founded by Bill Browning and Cook&Fox Architects. TBG's proposal is based on a systematic collation of environmental psychology literature, concerning the effects of the built environment on human beings. TBG's aim was to identify patterns which have both a scientific foundation and a feasible application by architects in Biophilic Design [14, 15]. Particularly significant is the fact that the entire 'Nature of the space' dimension—which includes patterns 11 to 15—raises the issue of considering, within Biophilic Design, environments that can support and improve the equilibrium of the autonomic nervous system which, as we have seen, is the biological root of biophilia. The 15th "awe" pattern was recently added by [15] to the original 14 models [14]. 'Awe' can be traced back to the penultimate of Kellert's 72 attributes, 'Fear and awe' [23]. This is an item that still need to be improved, including the related Immanuel Kant's meaning of 'sublime' ("das Erhabene" [20]).

3.3 Thirteen Years of Biophilic Design Theories: A Comparative Analysis

We compared the features of Biophilic Design described in the most scientifically relevant publications [14, 15, 23, 24] in order to identify the issues that the authors unanimously considered to be basic to Biophilic Design (Table 1). We noted that the first four attributes (Light; Protection and Control; Air; Views) are considered in Evolutionary Psychology to be essential in the search for refuge, while the next three (Greenery; Curiosity; Biophilic Materials) are essential in the search for resources. It is not surprising that the characteristics of Biophilic Design considered to be universal follow the adaptive models that were developed by our species in its search for a habitat with reliable refuges and resources. It is also unsurprising that the top places

Table 1 Comparison of the most important features of Biophilic Design according to the most relevant studies. The final column on the right contains a summary of our proposal

Kellert [8]	Browning et al. [12]	Kellert [8]	Our summary
Natural light	Dynamic and diffuse light	Natural light	Light
Prospect and refuge	Prospect and refuge	Prospect and refuge	Protection and Control
Air	Thermal and airflow variability	Air	Air
Views and vistas	Visual connection with nature	Views	Views
Plants	Visual connection with nature	Plants	Greenery
Curiosity and enticement	Mystery	–	Curiosity
Natural materials	Material connection with nature	Materials	Biophilic Materials
–	–	–	Sounds
–	–	–	Smells

are held by the issues most closely linked to our biology (the senses), and the cultural, experiential issues are lower down. Finally, we were quite amazed to note that issue of ‘Quiet’ is never considered. In our view, this issue would deserve greater attention [5, 8]. Since biophilia depends on the balance of the autonomic nervous system, we believe it is important to add two categories related to the ‘Quiet’ issue: Sounds and Smells. Sounds and Smells seem to be good indicators of a rest-and-digest state [28] and can be part of both finding refuge and seeking resources [16].

4 The Future of the Biophilic Design

In the future, empirical attempts to test Biophilic Design ‘in the field’, as has happened in recent years, will no longer be sufficient (for a review, see [24]). We think that there is a need to go beyond the list of ‘suggestions for designers’ on what is important for proper Biophilic Design [24]. The aim of Biophilic Design is to design artificial environments that have a positive effect on individual health and wellbeing. These positive effects need to be measurable. To guarantee that the biophilic quality

of projects continues to improve, in the future we will need to establish guidelines derived directly from the results of appropriate tests, conducted according to scientific criteria. In the next phase, these guidelines could then be converted into a handbook to assist designers in ensuring the success of their work, and this could be personalized and optimized for each specific case. Finally, in our view it is important to reconnect human beings with Nature [24] rather than “bringing nature into the built space” [14]. The practice of Biophilic Design touches on very deep parts of the human psyche, which are linked to the need, felt by many people, to rediscover an affinity with Nature and feel at one with it again [4]. This also entails an acceptance of the dangerous side of Nature, which arouses biophobic reactions in us. Reconnecting with Nature does not mean re-turning to the Palaeolithic hunter-gatherer lifestyle but knowing and valuing those aspects that allow us to recover our physical and mental equilibrium more quickly and efficiently. This will be the test bench for Biophilic Design.

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