

Nature Connectedness and Biophilic Design

Evidence-based Commentary

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Abstract

Biophilic design involves creation of built environments that promote connection between humans and nature. While literature reviews show support for the psychological and health benefits of biophilic design, they note that the evidence base is heavily focused on the restorative efficacy of various natural elements (e.g., light, water, wood) and experiences (direct, indirect, space and place). There has been little consideration of Kellert and Calabrese's (2015) key principles of biophilic design and the holistic approach to design that has nature connection at its heart. This perspective article discusses the biophilic design principles in light of research on the psychological construct of nature connectedness. The research offers empirical support for the importance of key biophilic design principles – the need for repeated and sustained engagement with nature, for encouraging an emotional attachment to settings and places, and for promoting interactions between people and nature that foster a greater sense of relationship and responsibility for human and natural communities. An evidence-based framework for application of biophilic principles and experiences into the design process is proposed. Recommendations for optimising the application and evaluation of biophilic design principles and practices are made, in order to support the wellbeing of humans and nature.

Nature Connectedness and Biophilic Design

Introduction

The biophilia hypothesis holds that humans have an innate tendency to affiliate with other living organisms (Wilson, 1984; Kellert & Wilson, 1993). This in-built need to connect with the natural world is considered an adaptive mechanism that enabled humans to survive and thrive in our evolutionary past, and continues to play an integral role in human-nature relationships. Although often characterised as a 'love of nature', as a mechanism that includes survival, biophilia also includes human-nature relationships such as utility and dominion that can have a negative impact on the natural world (Kellert, 1993). There is growing evidence that nurturing positive connections with nature benefits people's wellbeing (Capaldi, 2014). This nurturing of the positive biophilic tendencies through direct and active engagement is more important than ever in a time when there is increasing disconnect between humans and the rest of the natural world.

A subset of sustainable design, biophilic design is the application of the concept of biophilia to the design of landscapes and the built environment, with the aim of fostering connections between humans and nature. It includes principles such as use of natural materials and provision of daylight which have previously been advocated in architecture and overlaps with design paradigms such as biomimicry (for review see Hes & Du Plessis 2014). Stephen Kellert, one of the pioneers of biophilic design, proposed a framework for the creation of landscapes and buildings that maximise opportunities for people to engage and connect with nature. Building on his earlier work on the dimensions, elements and attributes of biophilic design (Kellert, 2008), Kellert and Calabrese (2015) outline the fundamental principles necessary for effective biophilic design in *The Practice of Biophilic Design*. In this perspective article we discuss these principles of biophilic design in the context of recent research on the psychological construct of nature connectedness and propose a framework that returns biophilic design to focus on these principles for the good of both humans and nature.

Nature connectedness refers to the way we relate to and experience nature. A high level of nature connectedness means feeling a close relationship or an emotional attachment to our natural surroundings. The concept of nature connectedness is grounded in scientific study and measurable, which allows research to establish the benefits and the design of interventions to improve it. Greater nature connectedness delivers better mental health (Capaldi et al., 2015) and is key for both carbon-cutting pro-environmental behaviours (Mackay & Schmitt; 2019) and wildlife friendly pro-nature conservation behaviours – more so than passive exposure to nature (Richardson et al., 2020).

In order to understand the types of human-nature relationships that promote nature connectedness, Lumber et al (2017) used another aspect of Kellert's work, the nine values of biophilia (Kellert, 1993). These values identify nine types of human-nature relationships, and these were used as a framework to ascertain which types of human-nature relationship best explain nature connectedness. Lumber et al found five of these relationships were pathways to nature connectedness. These were activities involving engagement with nature through sensory contact, emotion, beauty, meaning and compassion. The pathways to nature connectedness provide a clear and empirically robust framework for interventions and applications aimed at helping people establish and develop deeper nature connections.

Integration of nature connectedness research into biophilic design can help in the realisation of the key aims of biophilic design: to foster and maximise connections between humans and nature to support the wellbeing of both. Further, incorporating the pathways to nature connectedness brings the original biophilic design principles of positive, meaningful and emotional engagement with nature back to the fore. In addition, incorporating recent research findings from nature connectedness increases the evidence base and justification for Biophilic Design. Finally, clarifying the nature of biophilia and approach to direct and active engagement with nature informs and contributes to green and sustainable design more generally.

Biophilic Design

Biophilic design offers a counterpoint to the tendency of the modern built environment to separate humans from the natural world. Kellert (2008, p.4) described biophilic design as part of a new paradigm of "restorative environmental design" that both minimises environmental impact and fosters "beneficial contact between people and nature". In 'The Practice of

Biophilic Design', Kellert and Calabrese (2015) state five basic principles essential for the successful application of biophilic design which fall around the themes of engagement, adaptation, attachment, interaction and interconnection. Three of these biophilic design principles are of particular relevance to the current discussion because of their relationship to the pathways to nature connectedness:

- Biophilic design requires repeated and sustained engagement with nature (maps onto the sensory engagement pathway).
- Biophilic design encourages an emotional attachment to particular settings and places (maps onto the emotion pathway).
- Biophilic design promotes positive interactions between people and nature that encourage an expanded sense of relationship and responsibility for the human and natural communities (maps onto the meaning and compassion pathway).

These principles emphasise the behavioural elements of the eventual users of a biophilic design, and their active engagement with nature in order to reap the benefits of spaces designed to foster human-nature relationships. What this highlights is that mere exposure to natural elements in the built environment is not sufficient – a relational approach is needed.

The Application of Biophilic Design

The practice of biophilic design, carried out in accordance with the key biophilic design principles, involves application of three main categories of experience, within which fall different attributes from the natural world:

1. Direct experience of nature – contact with natural environmental features such as natural light, air, plants, animals, water, landscapes, fire and ecosystems.
2. Indirect experience of nature – contact with images of nature, natural materials, colours, shapes and forms that evoke and mimic nature
3. Experience of space and place – providing spatial features characteristic of nature that have advanced human health and wellbeing, such as open views and places for retreat and refuge within organised diversity, clear pathways with natural waypoints and cultural and ecological elements that help develop attachment to place.

Kellert and Calabrese (2015) caution against the piecemeal application of these attributes, arguing that an interconnected approach is needed. Equally, considered alone and apart from the basic principles, the dimensions can be seen as material and physical elements for inclusion. If such a checklist approach becomes the focus, the need to foster engagement, emotional attachment and positive interactions to build a relationship with nature can be lost in the process of design and evaluation.

Research Evidence and Biophilic Design

Review articles (e.g., Gillis & Gatersleben, 2015; Hung & Chang, 2021; Peters & D’Penna, 2020; Ryan et al., 2014) have presented evidence of the wellbeing benefits of applying biophilic design. The reviews show that elements of biophilic design benefits humans in workplaces, homes, learning institutions, healthcare settings, and retail spaces. Features such as higher levels of daylight, views of nature, indoor plants, and natural building materials have been found to bring physiological and psychological benefits, with improvements in mental health, well-being, stress recovery, creativity, productivity, memory and cognition.

A main finding of the reviews is that the literature primarily focuses on specific natural elements and does not tend to refer explicitly to biophilia or biophilic design (Gillis & Gatersleben, 2015; Peters & D’Penna, 2020). Studies have focused on individual elements of nature (e.g., plants, water, wood) without broader consideration of holistic aspects of biophilic design or the foundational principles proposed by Kellert and Calabrese (2015). For example, in a review of research on office spaces and employee wellbeing, Colenberg et al. (2021) note that studies exploring the effect of contact with nature have focused exclusively on views of greenery. Gillis and Gatersleben’s (2015) narrative review of psychological literature on the benefits of biophilic design focuses primarily on the three types of experience with nature and spaces that Kellert and Calabrese propose: direct experience of nature, indirect experience of nature and experience of space and place. They review research that examines people’s perceptions and attitudes towards the natural and built environment, and their behaviours, feelings and experiences in such spaces. The focus is on specific natural elements within designs, for instance, natural light, water, plants, weather, landscapes and ecosystems. While the research shows the beneficial effect of various natural elements in design, for the most part the research evaluates individual features of environments and people rather than their combinations and interaction as highlighted by the biophilic design principles. There is also a focus on restoration as an outcome and measure of well-being.

Similarly, a recent literature review by Hung and Chang (2021) on the psychological and physiological health benefits of biophilic design is organised around 18 biophilic design patterns and elements, and the three types of experience. Descriptive and content analyses of the 45 papers revealed a research focus on the presence of natural images and plants, and visual, non-visual and material connections to nature. The review usefully consolidates the evidence base for the wide range of positive outcomes derived from components of biophilic

design, while further showing that research is primarily concerned with understanding the restorative effects of individual natural elements.

When considering empirical work on individual elements of biophilic design, the context of people's engagement with natural elements should be noted. For example, in research showing the benefits of touching, or viewing images of nature for managing emotions, people had to attend to the image or touch the material for a period of time, e.g., for several minutes (Ikei et al., 2017). To gain the benefits the natural element must be engaged with, which supports the key principle noted above: '*Biophilic design requires repeated and sustained engagement with nature*'.

As well as revealing the rather fragmented approach to studying the effects of natural elements on human wellbeing and functioning, the literature reviews show that there has been little attention to the human-nature relationship in biophilic design. As such, there is limited engagement with the issue at the heart of Kellert's biophilic design principles – people's engagement, interaction and emotional connection to nature. Peters and D'Penna (2020) also note that research is dominated by studies that present people with biophilic elements through images or virtual reality, and rarely studies people engaging with actual spaces. One exception to this is Gray's (2017) longitudinal qualitative study of the benefits of biophilic design within a site office (also see Gray & Birrell, 2014). As well as commenting on improved work performance, workers talked about appreciating the beauty of the office, and a developing emotional connection with the plants they shared the space with. By exploring people's actual experiences in a space designed holistically in line with biophilic principles and practices, the importance of the human-nature relationship is revealed. The limited consideration of the fundamental principles of biophilic design leaves a gap in the evidence

base, and subsequently in the application of biophilic design, in relation to fostering human-nature connection.

The Importance of Direct Active Engagement

Nature connectedness research offers a framework for reinvigorating empirical research and application in order to enhance understanding, evidence and recommendations for biophilic design. Research that bridges the gap between theory and practice by addressing the crucial need for humans to engage with nature in the everyday spaces they inhabit. By directly examining how different types of engagement with nature benefit people, the pathways to nature connectedness research shows which of the three categories of biophilic design are likely to provide most benefit, and importantly, the need for engagement and connection with the design elements. People's nature connectedness (emotional attachment), rather than contact with nature, best predicts wellbeing and pro-nature behaviours. When comparing the relationship between nature connectedness, time in nature, direct and indirect engagement with nature, nature connectedness and active engagement with nature consistently emerges as being the significant and prominent factors in explaining mental health and pro-nature behaviours (Richardson et al., 2020).

Active and direct engagement involved simple activities, noticing and engaging with nature. While indirect experience of nature through images can also bring benefits, they also need to be noticed and engaged with to bring benefits. When a natural element is provided (directly or indirect) in design there is a need to consider how will it be actively engaged with? Why will it be engaged with? How can the design prompt that engagement?

The power of prompting people to engage and notice nature can be seen through nature connectedness focused wellbeing interventions (Richardson et al., 2020). In one example people's smartphones were used to alert them when they were in a green space and asked them to record a 'good thing in nature'. Doing so and prompting emotional responses led to significant increases in nature connectedness and wellbeing. Simply noticing 'the good things in nature' brings sustained benefits to mental wellbeing, with clinically significant improvements for people with common mental health problems.

Active and direct engagement with nature is also needed for beneficial outcomes for nature. Simple direct engagement through actively tuning into nature best explains pro-nature behaviours. People's nature connectedness, rather than contact with nature, predicts pro-environmental and pro-nature conservation behaviours (Richardson et al., 2020).

In sum, while the three categories of biophilic design (direct, indirect, space and place) provide opportunities for contact, recent nature connectedness research shows that active direct engagement and, therefore, the principles of biophilic design are essential. The pathways to nature connectedness (Lumber et al. 2017) provide a framework for facilitating that active engagement and embedding the biophilic design principles.

Integrating the Pathways to Nature Connectedness

The principles of biophilic design are an essential element yet often seem to be overlooked in practise. Nature connectedness research provides evidence for the importance of these principles and supports their inclusion and use. The pathways to nature connectedness can be combined with the three categories of biophilic design application to create an extended biophilic design framework that operationalises the original biophilic design principles.

The pathways to nature connectedness focus on active engagement and have provided a new approach to nature engagement design in national programmes in the United Kingdom such as *30 Days Wild* from The Wildlife Trusts and *50 things to do before you're 11¾* from the National Trust, (Richardson et al., 2020). Rather than focus merely on design elements such as plants, wildlife and water, the pathways to nature connectedness outline the types of activity to prompt engagement with those natural elements. They provide a framework with great flexibility of application and case study guidance is available (National Trust, 2021).

For example:

- **Senses:** Provide opportunities and prompts to notice and actively engage with nature through the senses, e.g., simply listening to birdsong, smelling wildflowers, or watching the breeze in the trees.
- **Emotion:** Provide opportunities and prompts to engage emotionally with nature. Create spaces to notice and reflect on the good things in nature, to experience the joy and calm nature can bring. Offer opportunities to express and share feelings about nature with others.
- **Beauty:** Provide opportunities and prompts to find beauty in the natural world. Create spaces and moments to appreciate beauty in nature and to engage with it through art, music or in words.
- **Meaning:** Provide opportunities and prompts to celebrate and explore how nature brings meaning to life, how it appears in songs and stories, poems and art.
- **Compassion:** Provide opportunities and prompts to care for nature and encourage people to take action for nature, for example, by creating homes for nature or planting insect friendly plants.

Figure 1 below shows how the pathways and biophilic design categories can be combined to ensure interactions of different types across the three categories of application. For example, the direct experience of water provides an excellent opportunity for calm and a place of refuge. Further, pathways and design categories will interact and combine, a place to care for nature can facilitate direct and sensory experience through creating more nature. All the pathways do not need to be activated at every point; the matrix provides a prompt to design in the opportunity for interaction when the opportunity arises without becoming contrived.

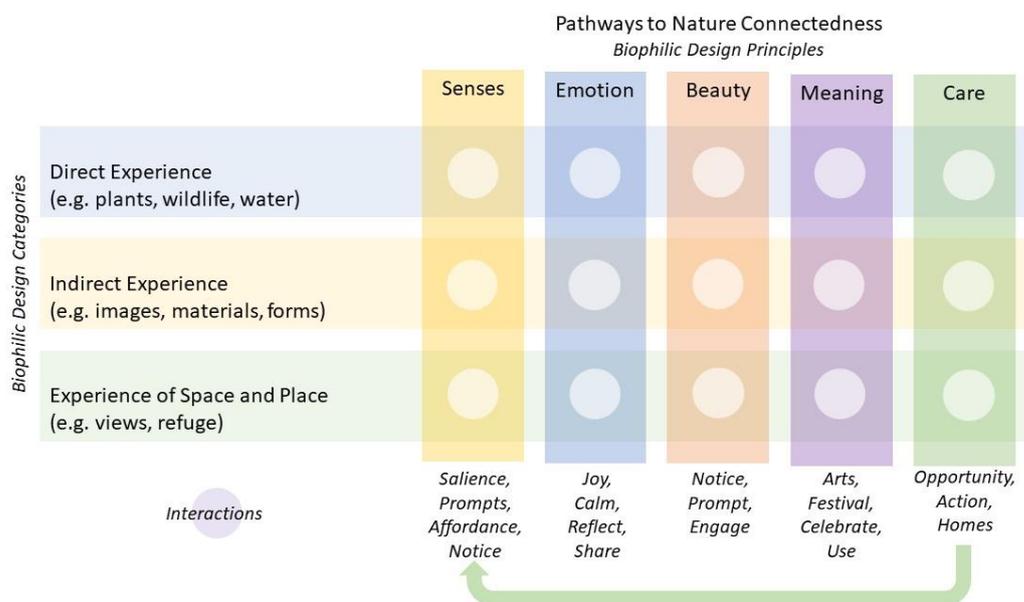


Figure 1. Biophilic Design & Nature Connectedness Framework

From Design to Use: The Need to Prompt Engagement

The research evidence, pathways and principles show that biophilic design cannot be passive. The space and features must be used and engaged with. Sadly, evidence shows that most people do not notice nature (National Trust, 2020). Therefore, there is a need make the natural elements salient, and to prompt and provoke people to notice. Design elements can be

used in ways that demand attention and the power of affordances used to encourage interaction.

Affordance theory (Gibson, 1979) highlights the many possibilities that a space or an object can offer – a tree can be a climbing frame or a place to rest (Laaksoharju & Rappe, 2017).

Affordances are possibilities for action suggested by the environment. They are direct perception-action processes and, therefore, affordances do not involve thinking or instruction as all of the information is available within the environment. That said, at times people might need inviting into activities in order to realise potential affordances the environment offers.

The more diverse the environment the more diverse the affordances and potential experiences. Biophilic design for nature connection could afford reflection – a space to pause and notice – close to features that engage the senses, or close to a place of beauty that evokes emotions. A place that then becomes meaningful with experiences one might wish to share.

Moving from the design of a physical space and features within it, to the behaviour of people occupying that space is a difficult process, especially when the principles require emotions to be fostered. So, although good design can influence behaviours, guidance on how users might enjoy and use biophilic landscapes and buildings should be considered. Especially as the research evidence often challenges common assumptions, such as the belief that nature connection comes from knowledge and identification or simply spending time in nature (Lumber et al, 2017; Otto & Pensini, 2017).

A biophilic workplace may need guidance on break taking and wellbeing programmes that facilitate sustained engagement with nature (such as activities used in *30 Days Wild* from The Wildlife Trusts). A biophilic school may need guidance on developing a biophilic curriculum

or developing extra curricula activities (such as the activities in *50 things to do before you're 11¾* from the National Trust). Otherwise, a biophilic space could soon become more of a background for work or learning rather than a place of positive interactions between people and nature. The interactions that encourage a close relationship and emotional attachment can help deliver wellbeing and a sustainable future.

Summary and Recommendations

Existing research supports the benefits of biophilic design elements for people's performance, health and wellbeing. However, the literature reviews reveal the dominance of research on individual elements and dimensions of experience, often studied out of context. Evaluations of biophilic design explore psychological, occupational and physical functioning, reflecting this focus on the services provided by specified natural elements to support human wellbeing, and overlooking what should be the key outcome for biophilic design – stronger relationships between humans and nature. The narrow scope of research and evaluation limits understanding and application of the core principles of Kellert's approach to biophilic design, and its fundamental aim to connect people to nature for human and nature's wellbeing.

Nature connectedness research offers additional – albeit indirect - evidence as to the benefits of biophilic design elements in everyday spaces, but more importantly it offers a framework for the application of both principles and experiences into the design process. The research provides empirical support for the importance of key biophilic design principles – the need for repeated and sustained engagement with nature, for encouraging an emotional attachment to settings and places, and for promoting interactions between people and nature that foster a greater sense of relationship and responsibility for human and natural communities. The nature connectedness measures used in this research (see Tam, 2013 for a review) offer a

means of evaluating the impact of biophilic design on people's relationship with nature, as do measures of pro-environmental and pro-nature conservation behaviours. On the basis of this evidence, the research identifies strategies for optimising the application of biophilic design principles and practices. Four key recommendations emerge: 1) Use the pathways to nature connectedness to enact the biophilic design principles; 2) Prompt direct engagement with natural elements rather than passive exposure to them; 3) Provide guidance and ideas for those using biophilic designs to support active engagement; 4) Include nature connectedness measures in evaluating biophilic design.

These recommendations put human-nature connection at the heart of biophilic design, addressing the limits of the human-centric focus of current research and application that explores the potential for nature-based design elements to help humans feel and function better. On the other hand, sustainable design paradigms focus on helping nature through designs that minimise the impact on earth's resources. Notwithstanding the immense value of design initiatives that support human well-being or reduce environmental impact, integration is needed. Optimised biophilic design has potential to deliver this integration by foregrounding the interdependence of human and nature's wellbeing and implementing practices that foster nature connection. True sustainability requires radical changes to the human-nature relationship. People need to feel and think differently about nature, moving beyond mere appreciation of the services nature can provide, and towards a reciprocal relationship in which the interconnections between humans and nature are recognised and valued. By designing opportunities for people to engage with nature in the spaces they live, work and play, nature connectedness focused biophilic design can support such a shift, creating environments that benefit people, the natural world, and their mutual futures.

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