BIOPHILIA HYPOTHESIS

The benefits of nature in the workplace

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1 Background

The term biophilia stems from Greek and translates as ‘love of nature’. It was initially used by social psychologist Erich Fromm (1973, p. 366) to depict “the passionate love of life and of all that is alive”. The definition has changed since then. At first biologist Edward O. Wilson (1984, p. 1) described in his book *Biophilia* the concept as “the innately emotional affiliation of human beings to other living organisms” and “the innate tendency to focus on life and life-like processes”. Some authors redefined the hypothesis later on. Kellert and Wilson (1993, p. 42) saw it as “the innate need to relate deeply and intimately with the vast spectrum of life about us”.

Biophilia and its interpretation is still in the process of development. It is therefore referred to as a hypothesis rather than a theory. As Joye and De Block (2011) rightly point out, some aspects of the interpretation of biophilia are problematic. Biophilia is embedded and overlaps with other fields of research. It is therefore difficult to define limitations to it. The limitation to “life and life-like processes” is in the light of many findings certainly inconclusive because of the positive effects of natural materials, water, scent etc. which are not alive.

We have therefore seen that the definition of biophilia has changed over time. Heerwagen (2008, p. 227) defined biophilia as the “human need to connect with nature”. This is a much sounder approach but also less specific. That can lead sometimes to a very broad interpretation of its meaning. Some authors see, for instance, a connection to sustainability and conservation of nature or even an ethical dimension (Benyus, 2008; Joye & De Block, 2011; Krčmářová, 2009). There is an obvious risk that biophilia loses its specific meaning if applied too widely. Certainly, the ethical interpretation is questionable. It is important to remain detached from judgments of value and morality in order not to get into naturalistic fallacy (Roberts & Van Vugt, 2012). In other words, nature is not positive or negative in absolutes. Nature just has settings that are positive relative to non-natural environments, as we will see. From an evolutionary perspective the ‘normal’ natural environment is just the better neural fit. Humans are a part of nature and therefore susceptible to it. A natural environment is our default situation.

The human body is in all its aspects biologically encoded and therefore suited to live in a certain range of natural habitats. “Nature is not merely ‘nice’. It is not just a matter of improving one’s mood, rather it is a vital ingredient in healthy human functioning” (Kaplan, 1992, p. 141). This is true despite the fact that humans can adapt to new circumstances. The quantity

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and quality of changes in the last 10,000 years are just too numerous for a sufficient adaption in a short time, in evolutionary terms (Buss, 2008). It is within this context not too far-fetched to assume that even the human brain is formed for a more natural context. It is therefore not surprising that biophilia provides a better mental fit to our predisposition than do environments without biophilia. The system of the human being as a whole has a predisposition for natural conditions. The underlying principles are beyond personal characteristics and cultural differences. They touch on the very nature of humankind. There is a coherence between environmental settings in nature and positive reactions of humans.

Biophilia can therefore be regarded as embedded in evolutionary psychology (see also Chapter 17 Evolutionary Psychology Theory). Both views share the assumption that evolutionary processes have shaped the human body and the brain and therefore even the psychological mechanisms and the behaviour associated with it. However, biophilia does not advocate biological determinism. The metaphor that compares the brain with a computer is too simplistic for a system of organic complexity (Epstein, 2016).

Biophilia is today influential in many fields, for instance in developmental psychology (Kahn, 1997), preventive medicine (Frumkin, 2001) and architectural theory (Hildebrand, 2008). The value of nature to humans is most obvious if there is a lack of it, like in urban settlements. Biophilia is a tool to dampen the neurological effects of nature deprivation and to calibrate our contact to nature. That it is necessary and valuable is undisputed and demonstrated by a large body of research.

2 Applicability to workplace studies

The extensive observation and testing of all kinds of human reactions to natural elements has led to recommendations on how to implement the findings to workplace design. Biophilic design is based on the understanding that the spatial conditions have a highly relevant influence on our mental state and that nature is important to human well-being, as we will see. Space can be described as a cluster of symbolic and sensual codes. The contextual sum of this 'neuronal landscape' has a profound, but mostly unconscious, influence on us. Kühn et al. (2017, p. 1) point out, "research on brain plasticity supports the notion that our environment can shape brain structures as well as function." It is therefore important to design the workplace environment in the best possible way for people's well-being and business objectives.

But, "current workplaces are designed to focus on efficiency rather than psychological well-fare" (Fitzgerald & Danner, 2012, p. 772). The mismatch between the human preconditioning and the novelty of our modern environment can be sometimes problematic. This clash of environmental settings, even referred to as the mismatch hypothesis (Cofnas, 2016; Lloyd, Sloan Wilson, & Sober, 2011), has countless consequences for our modern lives (Gluckman, Hanson, & Low, 2019), not least for the workplace (Norman, Van Vugt, & Colarelli, 2017). But the paradox offers even a great potential for architectural design, if we introduce elements of biophilia which are beneficial to us. That means, in consequence, that we need to enrich our built environment with conditions that meet our inherited spatial preferences. Biophilia can be a guideline to evaluate and enhance the settings of a workplace against our original natural habitat.

Browning, Ryan and Clancy (2014) describe biophilic settings in 14 different patterns (see Table 15.1)

The implementation of these biophilic patterns can be structured into three parts (Browning et al., 2014):

- 1 Incorporation of nature: Hereby 'real' nature is introduced into the office space with the help of *natural components* like water, sunlight, plants, animals and natural materials (see

Figure 15.1; applied principles: visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, biomorphic forms and patterns, material connection to nature, complexity and order, mystery).

- 2 Mimicking of nature: The next approach is to use *analogues and simulations of nature* represented in pattern, form, pictures, colour, light and scent (see Figure 15.2; applied principles: non-rhythmic sensory stimuli, biomorphic patterns, complexity and order).
- 3 Use of natural principles: A third way is to *design the space itself with abstract references to nature* and to use architectural composition and organisation, information richness and variability in order to facilitate biophilic effects (see Figure 15.3; applied principles: mystery, refuge, prospect, material, non-visual connection).

Table 15.1 Biophilic features

Biophilic features	Examples
Visual connection with nature	windows with a view to nature, in-house plants
Non-visual connection with nature	scent, sound, touch
Non-rhythmic sensory stimuli	natural pattern, plants, elements interacting with nature (e.g. wind and sun)
Thermal and airflow variability	openable windows, variation of indoor climate, access to the outside (balconies etc.)
Presence of water	outdoors or indoors (aquarium, fountains, water walls, etc.)
Dynamic and diffused light	daylight, human-centric lighting, flexible control, variation of light settings
Connection to natural systems	water cycle, access to green areas and gardens, experience of seasons
Biomorphic forms and patterns	organic shapes, natural colours, fractals
Material connection to nature	wooden surface, stone, leather, wool, etc.
Complexity and order	spatial composition and layout, workstation design, pattern on floors and walls, colour scheme
Prospect	views, elevated planes
Refuge	protection from behind (e.g. furniture) bay windows, arcades, elevated planes, canopies
Mystery	winding paths, partly concealed views
Risk and peril	heights, passing under a dominant object, slide or ramp

Source: (Browning et al., 2014)

Figure 15.1 WC-wall at House of Innovation, Stockholm School of Economics, Stockholm

Figure 15.2 Floor at Lufthansa's local HQ in Stockholm

Figure 15.3 Lounge and kitchenette at Stockholm School of Economics, Stockholm

The approach of biophilic design enables us to create space which causes less strain to the brain. The observed results range from reduced stress and increased well-being to better health and higher job satisfaction (Martyn & Brymer, 2014). As Ulrich puts it:

for stressed individuals, restorative influences of viewing nature involve, among other responses, a broad shift in feelings towards a more positively-toned feeling state, positive changes in activity levels in different physiological systems, and that these changes are accompanied by moderately high levels of sustained attention.

(Ulrich, 1997, p. 8)

The described and highly desirable mental state results even in a significantly higher level of productivity. Table 15.2 summarises some findings regarding the possible increase of productivity related to biophilic design. It is noteworthy that aspects like general acoustics, air quality, artificial light settings, thermal comfort, social context and colour all can influence productivity, but they are generally not regarded as part of a biophilic design approach and therefore not included in the table.

3 Methodology/research approach

Productivity in a workplace, as shown in Table 15.2, can be measured indirectly by the number of repetitive activities in a workplace within a certain time. It is also possible to record absentee rates, hours worked, safety rule violations, number of sick days, staff retention, employee turn-over, job performance (mental stress/fatigue) and learning rates. The results related to workplace design show a very positive and highly relevant role for biophilia regarding all measures

Table 15.2 Productivity gains with biophilic workplace design

<i>Effect on productivity</i>	<i>Biophilic design strategy</i>	<i>Source</i>
+6% to 12%	Indoor plants	Lohr, Pearson-Mims, and Goodwin (1996)
+15%	Daylight	Romm & Browning (1998)
+13.2%	Daylight	Romm & Browning (1998)
+15% to 23%	Daylight	Heschong Mahone Group (1999)
Increase	Leafy indoor plants	Shibata & Suzuki (2002)
+7% to 13%	Daylight and window views	Heschong Mahone Group (2003)
Increase	Right number of indoor plants in view	Bringslimark, Hartig, and Grindal Patil (2007)
+5%	Natural daylight	Painter & Goodman (2007)
Improved cognitive performance	Pictures of nature	Berman, Jonides, and Kaplan (2009)
+10% to 14%	Presence of plants	Daly, Burchett, and Torpy (2010)
Increase	Wooden surface	Fraser (2011)
Increase	Pleasant sounds from nature	Fitzgerald & Danner (2012)
+20% to 26%	Daylight	Terrapin Bright Green (2012)
+38%	Office plants	Knight (2013)
+15%	Enriched office with plants	Nieuwenhuis, Knight, Postmes, & Haslam (2014)
+6%	View of the outdoor environment	Cooper (2017)

(Romm & Browning, 1998, Thomson & Bruk-Lee, 2019). But in order to understand the reason why biophilia is so beneficial for office design, it is necessary to have a broader approach. Besides the indirect method to measure productivity, it is possible to research more direct physical reactions of participants.

Evidence for the viability of the biophilia hypothesis can be obtained in various ways. Besides employee surveys recording work satisfaction, employee comfort and mental well-being, there are controlled laboratory studies with focus on attention, vigilance, memory, creativity and comprehension or motivation. Participants are hereby exposed to elements of biophilic character, like plants, images or pets, and it is observed if there is a significant change in behaviour. There are also field experiments not only with questionnaires but also with physiological tests like blood samples, measures of the electrical activity of the heart with electrocardiography (EKG) and electroencephalography (EEG), heart rate variability (HRV), and heart rate or near-infrared spectroscopy (NIRS). There are furthermore surveys with neuroimaging with functional magnetic resonance imaging (fMRI). The latter shows that “different landscapes affected regional brain activity differently” (Jo, Song, & Miyazaki, 2019, p. 13), not only regarding urban and natural settings but even between various types of landscapes. Observed brain activity with this method is “indicating that a nature-oriented lifestyle is inherently preferred” (Jo et al., 2019, p. 13).

Most prominent are the significant health benefits systematically observed in hospitals (Ulrich, 1984). A variety of physical effects tend to be noted when patients were exposed to nature settings, in comparison to urban settings with a lack of nature: substantial decline in skin conductance response (SCR) and decline in muscle tension (measured using electromyography EMG) (Ulrich, 2008). These results are associated with lower stress levels and therefore conditions beneficial to health and regeneration. Patients with window views to nature and sunlight recovered much quicker, had lower pulse and blood pressure and needed even less medication (Malenbaum, Keefe, Williams, Ulrich, & Somers, 2007, Ulrich, 2008). In other words, the environment had mental and even physical effects on humans.

Another well-documented field of biophilic research is *Shinrin-yoku*, so-called forest bathing. Research shows that spending time in a forest can decrease blood glucose in diabetic patients by almost 40% in comparison to only 21% when walking indoors (Ohtsuka, Yabunaka, & Takayama, 1997). Even hormonal secretion and autonomic nervous function are stabilised (Morita et al., 2007), which can be related to a lower risk for stress-related disease.

It can be concluded that biophilia has indeed positive effects on humans. Effects besides the one mentioned earlier are lower concentration of cortisol, associated with a lower stress level; greater parasympathetic nerve activity, linked to relaxation; and lower sympathetic nerve activity, indicating decreased stress. Contact with nature is even beneficial for mental health because of improved mood; reduced psychological tension, depression, anger, fatigue and confusion; and moreover enhanced psychological robustness and energy (Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2009). Most relevant to work performance is the fact that biophilic design is associated with less stress, increased concentration, lower anxiety and an increase of prosocial behaviours (Fitzgerald & Danner, 2012).

However, it should be noted that the results for indoor plants are not always conclusive regarding the support of productivity (Shibata & Suzuki, 2002). The number and density of plants are relevant, as well as the size and even the shape, when measuring effects. Plants with rounded leaves are perceived as mentally more beneficial than leaves with sharp and narrow shape (Augustin, 2009). This is coherent with findings regarding the reactions to abstract art with sharp forms compared with the attitude towards art depicting natural motives: sharp and abstract shapes are perceived as negative (Ulrich, 2008). But even natural motives can have an ambivalent effect. In general, pictures of nature do have a positive effect on humans, but pictures

of a spatially enclosed and shadowy forest setting have no effect (Ulrich, 2008). There are furthermore proven mental benefits from the company of dogs, but the opposite is true for snakes (Joye & De Block, 2011). There is not just biophilia but also biophobia (Hinds & Sparks, 2011; Ulrich, 2008; Olivos-Jara, Segura-Fernández, Rubio-Pérez, & Felipe-Gracia, 2020). That does explain why views of landscapes with traces of human intervention are rated higher than pure nature (Augustin, 2009). Elements of human presence in nature can refer to a social aspect and imply a sense of comfort and control (Joye & De Block, 2011).

The effects of biophilia are mostly measured directly as previously shown. But it is also valuable to notice that a variety of indirect, more circumstantial facts strengthen the hypothesis. The degree of human adaption to nature is also reflected in other fields of research. Examples are that our metabolism and mental health are dependent on a certain degree of movement (Hansen, 2016), our microbiome is not suited for all modern food (Gundry, 2017; Price, 1939), we need exposure to sunlight in order to generate sufficient vitamin D (Spitz, 2018; Ulrich, 2008), and we are affected by a circadian rhythm (Zivkovic, 2012). One example, which is mainly overlooked, makes this point very clear, as Berg, Mahnert and Moissl-Eichinger (2014, p. 2) explain: “Plants provide beneficial bacteria for indoor rooms and therefore can positively influence human health.” Enclosed environments like offices have a reduced microbial diversity compared to the outdoor environment. “A reduction in microbial diversity is well known to facilitate dominant proliferations of certain strains, which might bear the risk to have a negative effect towards our health.”

These findings are only a few examples, but they show that very different fields of research like medicine, cognitive neuroscience, behavioural genetics, evolutionary biology, environmental science, biological anthropology and biochemistry are involved. They all contribute to a better understanding of the complex system that human beings are and show that biophilia is indeed only a part of a bigger picture, rather than a detached theoretical model. In any case, further research required. Partly because it is still unclear if, and in this case, to what extent the human body, including the brain, can adapt to novel environments. The current evidence of a civilisatory mismatch is indisputable, but anthropology tells us that the human body, at least in the Western world, has changed significantly within the very short time of the last 150 years because of novel food patterns (Vonderach, 2015). It can therefore not be ruled out that even the brain has changed during a shorter course of time than earlier anticipated, not only because of the well-established evolutionary mechanisms but also due to rapid epigenetically changes we do not yet fully understand (Kegel, 2009).

4 Limitations

Researching biophilia is complex and only understandable within a larger context. However, that context sometimes adds even further questions. First, there is a general uncertainty regarding all kinds of research observing preferences and behaviour. Preferences can vary depending on mood, age, culture, health, personality and experience. (Ulrich, 1993 p. 94; see also Chapter 10 Temperament Theory). Some findings, therefore, do sometimes have a lightly episodic character because of unclear contextual influences. For instance, “To the degree that workplace plants are psychologically beneficial because they promote restoration, they will be less potent if the workers in question generally have modest restoration needs” (Bringslimark et al., 2007, p. 5).

Kuo (2015, p. 6) points out that there are “a multiplicity of mechanisms by which contact with nature might promote health”, for example chemical and biological agents, negative air ions, microorganism, sights, sounds, moderate temperature and the absence of air pollution as well as physical activity, just to name a few. The choice of test environments or the kind of

visual images used also have a profound influence on the results. Associated with this problem is the indifferent use of the description ‘urban setting’, which can indeed be used for very diverse environments (Kuo, 2015; Sandal, Thorlund, Ulrich, Dieppe, & Roos, 2015). The human brain functions only contextually and it is therefore extremely difficult to identify scientific proof from the observation of isolated aspects. Even the findings on productivity gains are not entirely conclusive, partly because of the vague definition of productivity (Sullivan, Baird, & Donn, 2013) and partly because of the wide range of results for the same aspect. “Clearly, there may be other factors which are playing a role, and these are not fully understood” (Bell, Mabb, Garcia-Hansen, Bergman, & Morawska, 2003, p. 2).

The fact that observed outcomes can have multiple causes does not render the results of the research invalid. But it is beneficial to take into account a wider spectrum of related findings in order to understand how and why biophilia works. It requires an evaluation on a meta-level. It is therefore desirable to develop the hypothesis into a sound theory in conjunction with other fields of research concerning evolutionary conditioning. In this way could the large amount of significant evidence be better evaluated, and self-referencing avoided.

5 Theory relevance to practice

Nature has been shown to contribute to recovery from mental fatigue resulting from sustained directed attention.

“Mentally fatigued individuals suffer from (a) a lowered ability to concentrate, think clearly, and solve problems; (b) heightened irritability and a disinclination to be helpful or even civil; (c) an inability to get along in the world; and (d) a tendency to be accident-prone. Lowering levels of mental fatigue by exposing oneself to nature would thus be expected to reduce levels of frustration and anger.”

(Kweon, Ulrich, & Tassinary, 2008, p. 360)

Too much stress is not only a health risk, but it also reduces productivity and creativity. It hinders social interaction and communication. Health and well-being have therefore a role to play regarding engagement and innovation. The promotion of well-being with the help of biophilia makes it easier to accomplish common business objectives as required for office work. Berman et al. (2009, p. 6) state, “To consider the availability of nature as merely an amenity fails to recognize the vital importance of nature in effective cognitive functioning.”

Biophilia can be a potent strategy for human capital management. A biophilic human-centric workplace can increase job satisfaction and is therefore useful for attracting new and retaining existing employees (Thomson & Bruk-Lee, 2019; Walden, 2008). That in itself can represent a cost savings. Considering the share of salary payments on the overall budget of a company of about 80% (Walden, 2008), it becomes clear that a significant increase in productivity and efficiency, as demonstrated with biophilic concepts, are a very cost-efficient way to create monetary value that can be expressed in revenue, billable hours, net income or market share gained. “Disregarding human’s inclination towards nature is simultaneously denying potential for positive financial growth” (Terrapin Bright Green, 2012, p. 9). A biophilic office should therefore be part of a company’s business strategy. If optimised for its use with biophilic insights, office space can be regarded a business asset rather than a cost. Biophilia deserves to be considered as a valuable method to increase the employee’s well-being and business performance. It should even go hand in hand with business consulting. In contrast to intellectually framed business theories applied in order to improve a company’s operations, biophilic design is based on unconscious

affinity. It is therefore a much stronger stimulus, and its effects do not rely on explanations in order to show positive effects.

We need to calibrate our view and consider nature as the ‘old normal’. We describe biophilia as positive because we regard our urban environment as the default condition. It might be that the opposite is true.

6 Further reading

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