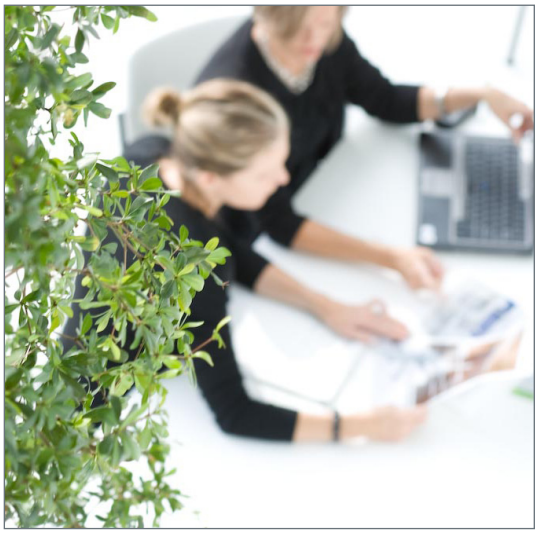

Environmental psychologist Judith Heerwagen's work focuses on the link between building design and psychosocial behavior and needs. She is a frequent speaker at conferences and is an editor of Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life, which won the 2008 Publishers Award for Professional and Scholarly Excellence in architecture and urban planning. She is a member of the New Ways of Working Network and the US Green Building Council. She served on the USGBC research committee for three years and as its vice-chair for two years. Before starting her own consulting and research business, Heerwagen was a staff scientist at the Pacific Northwest National Laboratory and a research faculty member in the University of Washington College of Architecture and Urban Planning. She currently works for GSA in Seattle and is a visiting scholar at Portland State University's Center for Sustainable Processes and Practices. She has conducted numerous postoccupancy building evaluations and works with interdisciplinary teams to evaluate the link between interior environmental conditions and occupant health and comfort. She has written widely on workplace design issues, biophilic design, and sustainability.

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Biophilia

by: Judith Heerwagen, PhD

Biophilia

E.O. Wilson, who popularized the term "biophilia," describes it as an "innately emotional affiliation of human beings to other living organisms" (Wilson, 1993, p. 31). In this paper, Judith Heerwagen explores biophilia and its implications for workplace design.

Two aspects of the biophilia definition are especially important. First, Wilson argues that biophilia is innate, and therefore part of our genetic heritage and evolved human nature. Second, biophilia is an emotional response that can be an end in itself (feeling a sense of pleasure and well being) or it can stimulate emotions that motivate behaviors (interest motivates exploration).

If biophilia is an innate characteristic of human nature, how did it evolve? There is general agreement among researchers that Homo sapiens' long history as hunters and gatherers, intimately involved with nature, has influenced how we perceive and respond to the physical environment. There are differences among researchers, however, in the nature of the adaptation and how it is manifested. Wilson (1986) describes biophilia as a complex of learning rules that guide adaptive response to natural stimuli. The rules are reinforced through cultural adaptations such as myths and stories. As Wilson notes, "When human beings remove themselves from the natural environment, the biophilic learning rules are not replaced by modern versions equally well adapted to artifacts" (1993: p 31). Thus, the learning rules are fragile and need to be reinforced through contact with nature.

Tooby and Cosmides (1992) take a different perspective. Rather than possessing weak learning rules, they see the brain as composed of thousands of modules that were designed to solve specific problems that occurred regularly over the course of human evolution. In their view, biophilia would consist of hundreds of modules designed to solve problems regularly encountered in ancestral habitats, such as avoiding predators, separating toxic from non-toxic foods, using clouds to predict weather patterns, and using flowers to signal future resource availability. Each module is content rich, with its own reasoning process and information gathering structure. For instance, rules about selecting nutritional plant resources would be different from rules about predators because the problems posed by these two situations are very different.

At this time, there is not enough research evidence to support one or the other perspective. However, there is good evidence from cross-cultural studies that the brain has a natural history intelligence that evolved from the need for detailed information about nature (Atran 1992; Mithen 1996). Mithen notes that all known cultures have notions of plant and animal "species," all cultures construct taxa based on morphological patterns, and all cultures have life form groupings for animals (fish, birds) and plants (trees, flowers, grass).

Further evidence of evolved responses to nature comes from controlled laboratory studies. A series of conditioning experiments by Öhman (1986) showed that physiological and emotional responses to fear-relevant stimuli (snakes and spiders) can occur subliminally with subjects having no conscious recognition of having seen the stimuli. Similar responses do not occur to modern threats such as guns.

More recent experiments by New, Cosmides, and Tooby (2007) found that subjects were more accurate at detecting small changes in animal location in complex scenes than changes in any other target elements (which included mountains, built elements, plants). They hypothesized that the visual attention system should show differences in monitoring of information based on its time sensitivity. Time-sensitive information requires rapid assessment and response, whereas time-insensitive information does not. They argue that animals and humans impart time-sensitive information that would need to be monitored regularly to assess the potential for threats or opportunities. The results also showed that subjects detected changes in animals more rapidly and accurately than changes in cars, which are modern mobile artifacts, often hazardous to pedestrians or other drivers. Their research does not directly address biophilia, but it does indicate that our mental mechanisms show adaptations to our evolutionary past.

The Savannah Hypothesis

Although humans eventually came to occupy many biomes and habitats across the globe, Gordon Orians argues that the long period of evolutionary development in the savannahs of Africa should have left a positive mark on the human psyche (Orians 1980, 1986; Orians and Heerwagen 1992; Heerwagen and Orians 1993). According to the "savannah hypothesis," people should prefer to be in savannah-like environments because in our evolutionary past they provided a superior resource base compared to the forest or desert biomes. Key characteristics of the savannah include:

- Scattered clusters of trees that provided shelter from the sun and for protection from terrestrial. predators
- Long-distance views that afforded surveillance for predator detection and avoidance
- Even ground cover for efficient movement across the terrain
- A rich diversity of plant and animal species
- Rock outcroppings for surveillance or sleeping
- Seasonal variation in fresh water availability due to rain patterns

What evidence exists for the savannah hypothesis? Do people prefer to be in landscapes that have these features?

Studies in landscape planning unrelated to biophilia have consistently shown that people prefer semi-open landscapes with large trees and water over either dense forest or desert (Ulrich 1993). Scruffy, dense habitats with rough ground texture are consistently disliked. Similar results are found cross culturally.

The strongest results relate to water. Coss (2003; Coss and Moore, 1990) argues that selective pressures to find sources of fresh water should have been particularly strong in the savannah habitats of Africa due to the strong seasonal variation in rain. Studies of water perception (summarized in Coss, 2003) show that people respond very positively to sparkle, reflections, and surface movements of water. Early humans may have used visual sparkle, in particular, as a cue to the location of water because it can be seen in the distance, whereas reflections and water surface movement could only be seen on closer inspection. Reflection and movement may have been used as indicators of water quality.

Benefits of Nature

Over the past several decades, research in a variety of fields shows that contact with nature generates emotional, physiological, and social benefits. Research on this topic has been conducted in workplaces, hospitals, urban environments, and experimental laboratories. Further, the findings point consistently to the value of particular nature features such as large trees, flowers, and water. Studies also show that benefits of nature occur in many ways—through direct contact (sitting in an outdoor garden), indirect contact (through a window view), and from simulations using nature decor (such as posters or paintings).

Nature through the Window

Ulrich's research (1984) was the first to focus on the links between nature, emotional functioning and health associated with window views. His study found that hospital patients in rooms with views of trees had a more positive recovery from surgery than a matched group of patients whose view was a brick wall. Patients with the nature view stayed in the hospital fewer days, took fewer strong medicines, and had more positive notes from nursing staff about their recovery process. Studies in office settings have also found reduced stress associated with window views of nature (Kaplan, 1992).

Simulated Nature

Ulrich's studies have included laboratory experiments using photos and videos in which he has consistently found that subjects recover from stress more quickly and are in more positive moods if they are shown nature scenes or urban scenes with nature rather than urban scenes devoid of natural elements (see reviews of this research in Ulrich, 1993).

Others have shown that nature contact can be beneficial, whether it is real or simulated. For instance, a study of windowed and windowless offices by Heerwagen and Orians (1986) found that people in windowless spaces used twice as many nature elements (posters and photos especially) to decorate their office walls than those who had views to natural areas outdoors. A laboratory study of "green exercise" tested the effects of projected scenes on physiological and psychological outcomes of subjects on a treadmill (Pretty et al, 2005). They found that all subjects benefited similarly in physiological outcomes, but that subjects who viewed pleasant nature scenes (both rural and urban) scored higher in measures of self esteem than those viewing totally urban scenes or "unpleasant" rural scenes with destroyed landscapes.

Outdoor Nature and Gardens

Urban nature also has benefits for health and well being. For instance, a study of public housing projects in Chicago found that large trees had a significant impact on residents' social behavior (Kweon et al, 1995; Sullivan et al, 2004). Using behavioral observations and interviews, the researchers found that housing developments with large trees attracted people to be outdoors and, once there, they talked to their neighbors and developed stronger social bonds than people in similar housing projects without green space and trees.

There is also growing evidence that both active and passive contact with gardens provides psychological, emotional and social benefits. Cooper-Marcus and Barnes (1995) found that benefits of gardens included recovery from stress, having a place to escape to, and improved moods. Benefits also occur with horticulture therapy, especially in clinical settings and nursing homes. Studies described in Morris (2003) show that dementia and stroke patients show improved mobility and dexterity, more confidence, and improved social skills as a result of gardening activities.

Indoor Vegetation

Indoor plants are common in many workplaces as aesthetic and psychological enhancers. Researchers in Norway found that plants also had physiological benefits. The field experiment in an office environment found that workers who had a cluster of

plants near their desk showed a decrease in neuro-physiological symptoms (with the greatest decrease in fatigue) and a decrease in mucous membrane symptoms when the plants were present (Fjeld et al. 1998).

Outdoor Green Space

Researchers in the Netherlands are conducting a nationwide study of the benefits of green space—which they call Vitamin G—at the household, community, and regional levels (Groenewegen et al, 2006). Using national health survey data arrayed on a geographical information system, the researchers have found preliminary evidence that residents who are closer to green spaces have better health profiles than residents who are farther away. The data analysis has controlled for socioeconomic factors which have known links to health outcomes.

Cognitive Benefits

In addition to the emotional and physiological benefits from nature contact, there is some evidence of a linkage to cognitive functioning. Lohr et al. (1996) found that subjects working in a windowless room with plants completed a series of computerized tasks faster, had lower blood pressure readings, and felt more attentive than subjects working in the same room without plants. In study of window views, Tennessen and Cimprich (1995) found that people whose view was predominantly natural (as opposed to built) had higher scores on a survey assessing directed attention and attentional recovery. Hartig et al (1991) report similar results in a field experiment. People who went for a walk in a predominantly natural setting performed better on an editing task than those who walked in a predominantly built setting or who quietly read a magazine indoors. Performance was assessed by number of errors found in the text and corrections implemented.

Although the mechanisms underling the links between nature and cognitive performance are not currently known, there are several hypotheses. The first, proposed by Kaplan (1995) focuses on attention. Kaplan argues that visual contact with everyday nature reduces fatigue associated with intense concentration, and thereby replenishes the attentional system enabling people to refocus easily after short nature breaks.

The other leading hypothesis, proposed by Ulrich (1993), argues that nature contact improves cognitive performance through impacts on mood. He draws heavily on research by Isen (1990). In numerous experiments, Isen's research shows that subjects in positive moods perform better on tests of creative problem solving than those who are in neutral or negative moods. Isen speculates that positive moods increase the tendency to "break set" and to see relatedness between divergent events or appearances. This is because feeling good promotes diffuse rather than focused attention and this leads people to see things differently (e.g. people notice more details) or to search more broadly for solutions and alternative interpretations. Joseph LeDoux (1996), one of the nation's leading brain researchers, cites neurological evidence to support this hypothesis. He has found that positive feelings lead to heightened activity of the right parietal brain region—the section of the brain that is associated with a more global, expansive cognitive style. Thus, positive feelings directly affect brain processes related to performance on tasks requiring creativity and novel problem solving.

Biophilia and Sustainability

The human desire for contact with pleasant natural settings has many benefits, as noted above, but also presents a potential dilemma for sustainable living and for urban spaces.

Our innate attraction to water, distant views, and lush vegetation often leads to unsustainable design practices. We create water features and lush gardens in the desert. We raze hilltop forests to build hotels and houses that take advantage of panoramic views. We build expensive houses and resorts along waterfronts rather than creating public access spaces or wildlife refuge. The desire to enhance biophilic experience is reinforced by the economic benefits of doing so. Houses and commercial buildings command higher purchase and rent values when they are located near water and green spaces and when they have lush landscaping (Heerwagen, 2006).

Urbanization also presents a dilemma for biophilia. Ironically, it is in just such places where contact with green spaces, trees, flowers and water would be most beneficial as an antidote to urban noise, pollution and other stressors. Yet, green spaces and vegetation are not equally distributed in urban neighborhoods. The economically advantaged live in houses and condominiums bordering parks or water's edge, whereas poorer neighborhoods often are devoid of such amenities. To overcome this deficit, planners, health practitioners, and landscape architects in New York City have banded together to promote the Restorative Commons (Meristem, 2006) to bring nature amenities to all neighborhoods. Researchers in Sweden propose a similar idea to "design communities that balance settlement density with satisfactory access to nature experience" (van den Berg et al, 2007).

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