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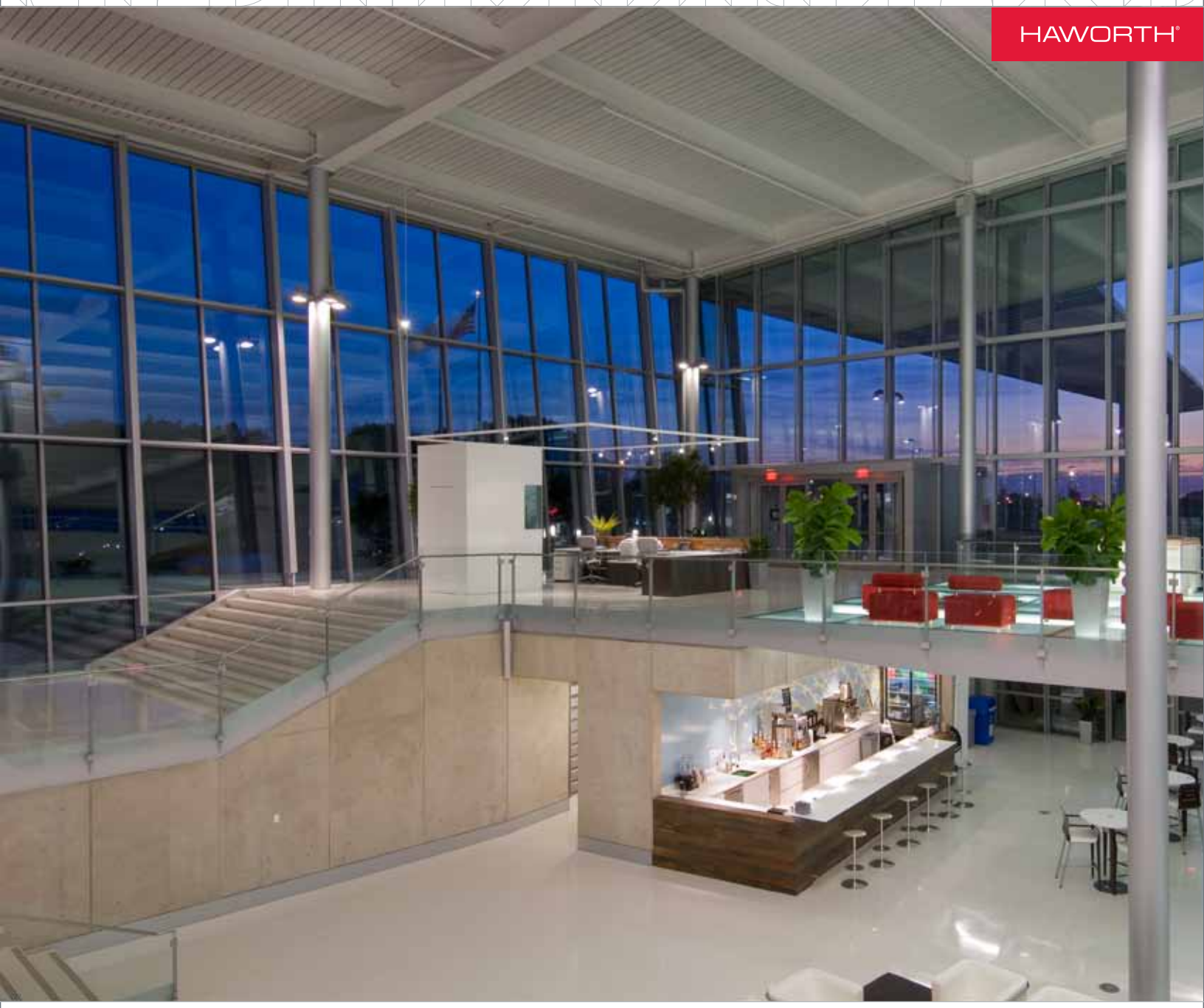

How Our Prehistoric Past Influences Modern Office Environments

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Indoor working environments are a relatively recent development in human history. Most people now rely on interior environments for the resources and support we once received in the natural environment. Still, our lighting preferences, preferred workplace layouts, and responses to visual and other patterns, for example, all reflect our evolutionary past. What's more, a growing body of theory and research from evolutionary psychology suggest a connection between aspects of the physical work environment and the work performance and quality of life experienced by employees. The theoretical constructs and practical applications that tie preferred workplace environments to our past are discussed in this article.

Hospitable and Effective Workplaces

Designers of modern offices can create hospitable, effective workplaces by respecting the evolution of work environments. Obviously, today's workers are more evolved than their hunting-and-gathering ancestors – they require progressive work spaces that address issues such as cognitive ergonomics. However, these interiors should incorporate fundamental aspects of preferred physical environments that are part of the human psyche.

The natural physical environments experienced by the human race as it grew to dominate the planet have not faded from its collective memory. The most effective interior environments approximate nature, supplying the resources and support for which thousands of generations have developed a need and preference.

In 100,000 generations, human work environments have turned from outside in. Today, the average person spends more than 80 percent of a day indoors - in reverse proportion to previous millennia.

While our ancestors were outdoors scavenging and farming, we toil 10-hour days in office "cube farms" lampooned in ***Dilbert*** comics and films such as ***Office Space***.

Past Preferences Improve Modern Productivity

Over time, humans have become attuned to specific aspects of the natural physical environment that optimize the performance of cognitive and emotional processing systems. Interior designers who incorporate fundamental aspects of preferred human environments will create workspaces in which modern knowledge workers can excel individually and as teams.

After all, human experiences have not changed as dramatically as employment venues. The same environmental situations that indicated safety or sustenance at the dawn of human history can still relax and engage people. Paralleling key structural elements of prehistoric environments can frame modern workplaces in which people are comfortable and productive. While knowledge workers won't use up mental capacity resolving stressful situations generated by their surroundings, they will be more productive and creative if their workplaces can be subtly designed to engage human sensory and perceptual processes, as preferred physical environments of the past did.

Sit in the Sun or Under a Tree

What early generations saw in natural light predicates modern preferences. Rodemann (1990) noted in her review of visual patterns in human physical environments that floral patterns (in wallcoverings, etc.) become less desirable as they become "busier." She hypothesized this is true because, in prehistory, heavy foliage prevented humans from seeing or responding appropriately to dangerous situations.

Interestingly, the overwhelming cross-cultural preference for the color blue is consistent with the ancients' positive association to the color of clear skies and clean water. Modern humankind's perceived color constancy reflects how natural colors are affected by the daily changing conditions of sunlight. Under low illumination, people are most sensitive to the reflectance of green leaves; under high illumination, to the color of dry grasses.

People prefer high-level, canopy interior lighting. Illumination enters mostly horizontally on several levels overhead, creating a dappled assortment of lighter and darker areas on the floor. Canopy lighting creates

brightness in the far visual surround. This pattern imitates the comforting lighting pattern that prehistoric humans experienced when they sat under trees on the savanna, a transitional setting between the forest and open plain, protected from the elements and predators. Dappled illumination is frequently found in retail environments, but has yet to make inroads into the workplace.

The most preferred aerial lighting for workplaces continues to be a combination of direct and indirect, which creates the scattering illumination of a clear sky with brightness for focal tasks. Unfortunately, most basic office lighting schemes try to minimize glare on display screens by using simple parabolic diffusers that make sitting in a workspace similar to crouching in a cave's dark interior. Prehistoric, certainly, but hardly an environment that inspires creative work.

Create Positive Energy with Environment

Many green-building benefits widely reported in anecdotal and post-occupancy studies are linked to design elements that would have been perceived positively by our prehistoric brethren. The same processes that make certain buildings more energy-efficient and less abusive to the environment are linked to the species' preferences for air movement, comfortable thermal conditions, and visual- and hearing-based experiences.

Wise and Hazzard summarized the research, "Buildings that reproduce, in real or analog fashion, the biologically preferred environmental qualities of the natural world also produce benefits for people" (2000). In these buildings, people experience biological ideals that make them comfortable and maximize performance.

Preferred environments of the past engaged people for optimal emotional and cognitive interactions with their settings. There is no reason why modern work environments cannot produce the same affect. A growing body of theory and convergent research from evolutionary psychology suggests connections between the physical work environment and employees' performance and quality of life. Positive affects on cognitive performance, group dynamics, job satisfaction, and productivity have been linked to design elements that analogously, or literally, recreate beneficial environmental features and qualities of the savanna that humans mastered in prehistory. These effects are created, in part, because of the positive moods generated by experiences in preferred environments. Isen (1990) and others have undeniably linked positive moods to improved decision-making and memory function, greater job satisfaction, increased organizational commitment, and creative problem solving. This may be because little of a positive person's mental processing power is dedicated to dealing with difficult or potentially dangerous situations.

Provide Refuge and Prospect, and Encourage Exploration

Influences in a particular culture may affect the nuances of its interaction with the physical environment, but the same basic factors govern these interactions in all cultures. Grant Hildebrand reached this conclusion when he synthesized cross-cultural research on architectural preference in his 1999 publication, "Origins of Architectural Pleasure." Parsons' 1991 review of research literature reached the same conclusion. From culture to culture, the same factors are preferred and are the ones that supplied comfort and support to early ancestors.

Hildebrand wrote of humans' fondness for places that provide not only prospect, but refuge – an easily defensible location in which to relax and create a safe and comforting nest. These places let people survey their physical environments and identify potential problems (predators) or opportunities (tasty lunches) while sill allowing them to deal successfully with challenges. Ideally, natural prospects are more brightly lit than refuge areas.

However, open-office environments provide many workers with only limited prospects and often fail to supply any effective refuge. Individuals often do not have sufficient control of their work areas, enclosures, or avenues of approach. Prospects are not more brightly lit than refuges, even though lighting quality studies continue to emphasize the importance of (volumetric) brightness in the far surround.

Building on the work of Stephen Kaplan, Hildebrand also wrote that preferable settings are not boring. They have a mysterious aspect that entices people to explore them. Exploration generally had positive consequences for early people, who had to roam widely because their hunting and gathering depleted resources that were replenished naturally while areas lay fallow. Although it was possible for exploration to end tragically, an expedition also was an opportunity for humans to learn more about their physical environment.

Similarly, humans prefer environments that present a relatively complex assortment of stimuli, but not so complicated that individual elements cannot be categorized. These types of ancient physical environments likely were richer in life-sustaining and enhancing materials, when they were recognized. So while modern work environments should not be chaotic, neither should they be visually monotonous.

Allow Movement

Researchers have developed an extensive array of studies indicating that humans' interactions with their physical environments are influenced by their ancestors' lives on the savanna. Stephen and Rachel Kaplan say that people prefer the landscapes most appropriate for their evolved physical form (1989). Humans do not run quickly or have

powerful jaws as compared to other species. Savanna environments that mitigated such weaknesses were more comfortable and safer for the humans.

In a study completed by Rachel Kaplan (1983), photographs of roadside vistas in which a glade of trees interrupted farmlands were preferred over scenes of the same farmlands without trees. A research summary by Ulrich (1983) revealed some features of preferred natural environments: ground texture conducive to forward movement, low estimated threat, and a visible body of water. All of these conditions are hallmarks of savanna environments.

Relate Spaces Naturally

Major areas within an effective workspace connect in ways that mimic nature. Spaces open naturally onto each other, preserving similarity from small spaces to larger ones, and creating stable information units while increasing interconnectivity. Replicating this pattern removes closed geometric spaces, substituting organically structured spaces that flow together and include defensible positions.

As in the outdoors, interior spatial arrangements should be adjustable as users' needs change. Natural environments change in response to factors such as wind, water, and the orientation of the sun above the horizon. People are not designed to spend an entire day seated in one place. The emergence of flexible teamwork, combined with the flexibility of mobile furniture, facilitates such desirable modifications to workplace environments.

Allow People to Connect with Their Environments

The emerging, dynamic systems view of life and the universe reinforces and clarifies the deep connections that humans and other creatures have to their habitats. An organism's surroundings are integral to it and the way it functions. A workplace is not merely a place waiting to be filled with behavior. Positive human abilities enter and interact with the resident potentials of a setting to enact the most positive and fulfilling of experiences.

Buildings and interiors are symbiotic with people and co-produce their living and working activities. Winston Churchill said, "First we shape our buildings, then our buildings shape us." The symbiosis Churchill observed is deeper than conscious awareness. Interior designers are learning how ongoing neural processes – perception, cognition, and emotional management - utilize the surrounding physical environment. This is called "externalized" or "situational" cognition.

As Wise and Hazzard (2000) described, "In active processes of thought and memory, the eye scans the surround and fixates briefly on a visual edge, demarcation, or feature that is 'tagged' by the actual position of the eye at that moment. Those retinal coordinates then serve as an 'address' for an abstract cognitive component held in working memory. A spatial coordinate in the environment becomes the means to retrieve a mentally held object, and a cognitive information loop is established 'external' to the body."

This complicated process takes milliseconds - far below the time horizon of consciousness. These external information loops transfer storage tasks from the brain to the surrounding environment, facilitating mental operations by reducing the neural cost of cognition to the organism. Through this externalized cognition, neural energy can be conserved and human welfare is even more closely linked to the experienced environment.

Research indicates that environments most supportive of externalized cognition are visually structured and patterned in ways similar to biologically preferred natural environments. It is a reasonable assumption, as human brain size and cerebral capabilities expanded very rapidly at the time prehistoric humans exploited savanna environments.

Externalized cognition is the reason people complete projects most productively in places where they have done similar work. This phenomenon is also why individuals perform better on a test taken in the room in which they learned the subject matter.

To maximize performance, people who are not part of a project should not modify a work environment being used by other individuals or teams. These sorts of ad hoc modifications can literally wipe out memory cues and cognitive artifacts that intrinsically support workers as they recall and think about relevant material.

Mind the Fractals

The deep structure of nature is captured and expressed through what mathematician Benoit Mandelbrot termed "fractals." Fractal geometry describes the composition and hierarchical structure of nature. It is intrinsic to natural landscapes, thus involved in the production of externalized cognitive and emotional control processes.

Fractals in nature are dynamic processes made visible. Mandelbrot first defined fractals in terms of their mathematical method of generation, but later favored an intuitive approach, ". . . for me, the most important instrument of thought is the eye. It sees similarities before a formula has been created to identify them."

Fractals are self-similar patterns that reoccur in a non-integral way as scale changes across a scene. Patterns do not repeat exactly. Elements are clumped, rather than homogenous or regularly distributed. Details do not disappear or flatten out when inspected at smaller or larger scales. Random elements of surprise occasionally appear.

Natural fractal patterns are detectable by each sense. The pattern created by the topography of a landscape that gently rolls to the horizon is a natural fractal. Dappled light has the same structure as a natural fractal. Fractals may be temporary; natural light and corresponding patterns change during the course of a day.

These patterns traditionally helped humans quickly understand and respond to their environments. They provided clues to interpret environments and identify aspects of interest.

To distinguish natural fractals from the patterns present in many office environments, consider the usual office décor. It repeats the same visual patterns at very few scales, in a way that creates visual tedium. Research has linked natural fractal patterns to positive human experience, so it is not surprising that many modern designs, which are geometrically regular and achromatic, are not perceived favorably by occupants.

However, not all designed interiors are fractally sparse. Carl Bovill describes Frank Lloyd Wright's Robie house, "We experience architecture by observing the overall profile of a building from a distance; as we approach closer, the patterns of windows and siding come into attention, down to what the door knob is like. The process then continues inside the building. The fractal characteristic of an architectural composition presents itself in this progression of interesting detail as one approaches, enters, and uses a building (1996, p.117)."

Many of Wright's designs utilize natural fractals. His creations often involve a similar pattern use and ornamentation at various scales within the same building, as did Rudolph Steiner's and Erik Admussen's anthroposophical designs.

Richard Neutra's architecture also employs fractals, albeit in a very different way. Neutra emphasized access to natural fractals through views to the patterns of horizon lines and clouds. His austere interiors actually nested spaces in a fractal composition.

These and other architects' work demonstrate that designers can recreate essential elements of natural fractals without having the interior look anything like a natural environment. Designing from nature, or with nature in mind, does not mean gratuitously copying it. It is scaling and composing an interior so that its pattern reiterates the structure of preferred natural environments.

The use of natural fractal patterns is entirely different than providing windows through which to view them. Visual access to natural fractals can refresh individuals, but an interior environment properly enhanced by natural fractals can substitute for window views, at least to the extent that they provide emotional support and engagement of cognitive processes.

Fractal enhancements deliberately embed a kind of natural structure into the work environment that people will intuitively and instinctively use to assist their emotive, reasoning, and creative problem-solving processes. These enhancements build on the latest cognitive science evidence of how people and settings interact temporally and spatially. This might affect floor plans of workstations and team spaces, as well as how spaces are enclosed or subdivided in storage units. It might influence fabric patterns on walls and workstations, materials and textures, illumination, floor-scaping, and even the induced background auditory rhythm of the space.

Fractally enhanced workspaces also may include interior isovists - the spaces visible from given points - that are reminiscent of views that savanna-type spaces provide onto glades and plains. A first approximation of such a view is obtained when interior designers develop spaces using diagonal axes. This technique is widely recognized as a simple but effective means of introducing visual complexity and dynamism into an interior.

Fractal patterns combine with savanna-like features to produce environments in which mood is elevated while stress is reduced, promoting mental states linked to the highest levels of thoughtful productive work. This reintroduces into work the structure the natural world once provided.

Avoid Natural Negative Associations

Although there were rewards associated with certain features of the physical environments encountered by our prehistoric relatives, there also were less positive associations for other aspects. These are natural structures and patterns to be avoided (or reserved for special use) because they act as inhibitors or warnings to our nervous system. As Ulrich has noted, "Recent findings suggest that processing of biologically prepared, fear-relevant, natural stimuli can be fast and may often occur automatically or unconsciously (1993, p. 85)."

Humans from infancy avoid apparent dramatic changes in ground level, such as cliffs. Adjacent strong differences in the brightness of surface patterns also communicate danger in the natural world. Both of these design strategies are routinely used to affect people's movement patterns, such as highway stripes as caution markers. Other natural warning signals append to dark, tall, vertical elements in the foreground and darkness in the far surround. The introduction of certain regular elements of decoration, such as large horizontal stripes on boundary walls, also produce emotional revulsion. This type of stripe reiterates the boundary condition and captures focal attention at all parts of the visual field.

Success on the savanna meant survival. That kind of extreme incentive explains why natural structure and cognitive structure converged quickly in developing minds.

As knowledge work increases, cognitive ergonomics becomes more critical. It is a natural design evolution from workstation ergonomics, which recognized physical work processes.

The natural extension of this research is to look deeper at the ongoing cognitive and perceptual processes that have linkages to the physical environment, and to design work environments to specifically enhance mental processes.

Ultimately, the most productive spaces mimic preferred natural physical environments in all dimensions at which people engage the natural world.

There is a necessary unity between mind and environment, according to Gregory Bateson. This interaction must be recognized to enhance the design of high-technology workplaces, but recognition and respect for this simple, deep truth is also crucial for future relationships between people and their physical worlds. Eminent biologist E.O. Wilson was once asked why we should acknowledge and act to preserve the diversity of nature. "Because," he answered, "it ennobles us."

It does even more. The structure of the natural world is an essential part of who we are and how we think and feel. It enables us, and we are intrinsically poorer for its loss. As technology replaces biology in human attention, we must find the means to reintroduce elements of our preferred natural environments into 21st century workspaces.

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