

Research-Informed Design

# How a Place Makes Us Feel

 Kimball International



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## 01 / Introduction

The single most important thing that design does is affect our mood. Being in a space can make us feel relaxed and ready to resolve issues at hand, or too tense to focus, for example. Environments can encourage people to be engaged, satisfied with their jobs, or to trust their co-workers.

Design does this wherever we are but our focus in this review is on designing spaces where people are likely to achieve their professional objectives and work to their full potential, are satisfied and engaged while doing so, and have positive relationships with co-workers.

We will discuss how to apply science-informed strategies to optimize professional performance, to make it more likely that people are not just productive but highly productive. The research evidence is clear: to increase the likelihood that employees excel professionally, workplace design should make positive moods more likely.

Since the studies discussed in the sections that follow have been rigorously conducted using well-supported scientific protocols, you can apply their findings with confidence.

The information that follows provides an actionable direction for designers, rooted in evidence-based design, and is not current perceptions and trends.



### SETTING THE SCENE

Scientists have been investigating the emotional consequences of experiencing design for some time. Their findings support general frameworks for assessing place-based experiences as well as recommendations for particular sensory inputs.

One of the most widely known and respected fundamental models of the emotional experience of space was developed by Russell and Snodgrass. Russell and Snodgrass (1987) identified the emotional qualities of spaces and the states that can be generated via design. They use two factors to do so, pleasurableness and energy level. Spaces can therefore be relatively more energizing and pleasant (for example, exciting, exhilarating, pleasing or interesting), pleasant but less energizing (for example, calm, serene, or tranquil), less pleasant and less energizing (for example, unstimulating, dreary, boring), or less pleasant but more energizing (for example, intense, tense, or frenzied). Someone in a more energizing and pleasant space is more likely to be in an invigorated positive mood than someone who is not, for example. (figure 1)

But why should we care what sort of mood we experience in any particular space? Research consistently shows that there are significant, positive implications of being in more positive

moods. For example, when people are in more positive moods, it is likely that their ability to think creatively and innovatively will be higher than when they're not (Isen, Johnson, Mertz, and Robinson, 1985) and that they'll similarly be better at problem solving and decision making (Isen, 2001), and getting along well with others and will act in a more socially responsible way (Isen, 2001). (figure 2)

Veitch (2012) effectively summarizes the workplace design-related research on mood, while highlighting the links between experiencing preferred conditions and positive moods: "Regardless of whether one has chosen the conditions or has the power to alter them, working under preferred conditions can create a state of positive affect [mood] that in turn leads to benefits in the form of increased cooperation, reduced competition, improved intellectual performance, and increased creativity. The benefits of conditions that create positive affect can be used to justify investments in specific design features known to be generally preferred." Being in spaces perceived to be physically comfortable has direct implications for professional performance/ productivity" with differences in productivity as high as 25% reported between comfortable and uncomfortable staff" (Commission for Architecture and the Built Environment and the British Council for Offices, 2006). Norman (2004) reports that,

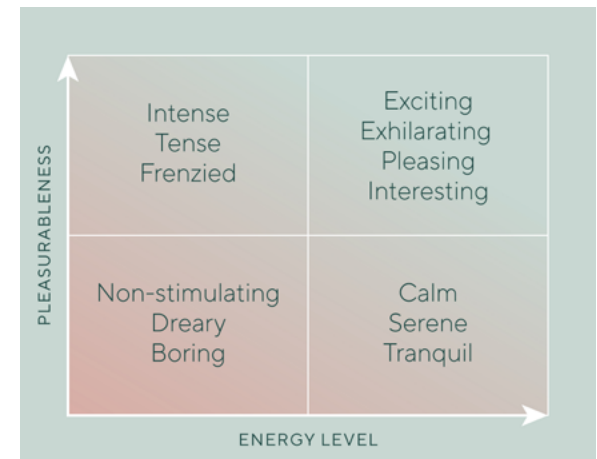


figure 1



figure 2



“attractive things make people feel good, which in turn makes them think more creatively.

Satisfaction with the physical work environment has a broad set of positive ramifications. Newsham and teammates (2009) tied satisfaction with the physical environment to satisfaction with management and to opinions about compensation received by employees. The higher their levels of environmental satisfaction, the greater the levels of employee satisfaction with management and their compensation. Satisfaction with management and compensation were positively linked to job satisfaction. Job satisfaction is particularly important because research has tied higher

levels of job satisfaction to better performance of professional work (Judge, Thoresen, Bono, and Patton, 2001).

Stress induced by the physical environment destroys positive moods (Gifford, 2014). Vischer (2007), reports that functional and symbolic stressors can degrade performance. Lamb and Kwok (2016) quantified the effects of workplace stressors on performance. Data were collected from office workers over 8 months “Participants completed a total of 2261 online surveys measuring perceived thermal comfort, lighting comfort and noise annoyance, measures of work performance, and individual state

factors underlying performance and wellbeing. Characterising inadequate aspects of IEQ (Indoor Environmental Quality) as environmental stressors, these stress factors can significantly reduce self-reported work performance and objectively measured cognitive performance by between 2.4% and 5.8% in most situations, and by up to 14.8% in rare cases.”

It is our perceptions of stressors and not objective assessments of those stressors that negatively effect our health, with higher perceived stress levels having more negative effects on our health (Kozusznik, Peiro, Soriano, and Escudero, 2018). Kozusznik and team mates report that “the participants in our study with less positive emotions tended to appraise more noise in the office compared with those with more positive emotions. Similarly, positive emotions may ‘color’ the appraisal, making it more positive... so that the stressor is appraised as less harmful and easier to overcome.”

Our mood can degrade in a space over time, unless we take steps to maintain it, as discussed later in this document. When we do mental work that requires us to focus/concentrate for an extended period (with the exact length of this period varying slightly from person to person) we become cognitively exhausted. When we’re cognitively exhausted, our professional performance declines and we become irritable and don’t get along as well with others as we normally do (Gifford, 2014).

Awe is another emotional state that can be tied to experiences in the physical environment, as will be





detailed below, and feeling awed can have special and important implications for how we feel and act. Griskevicius, Shiota, and Neufeld (2010) define awe as “the feeling of wonder and astonishment experienced in the presence of something novel and difficult to grasp—a stimulus that cannot be accounted for by one’s current understanding of the world.” Rudd, Vohs, and Aaker link awe to “perceptual vastness, which is the sense one has come upon something immense in size, number, scope, complexity, ability, or social bearing (e.g., fame, authority).” Danvers and Shiota (2017) report that awe is “an emotion elicited by vast, unfamiliar stimuli such as panoramic views, great works of architecture and art, and astonishing human accomplishments.”

Feeling awed has multiple desirable consequences. People who feel awed not only feel more connected to their nearby world, but they also process cognitive information more effectively and efficiently (Shiota, Keltner, and Mossman, 2007). They are also likely to think more creatively (Yeung, Tschetter, and Shiota, 2011), to be curious (Anderson and Keltner, 2014) and to having an open mind (Danvers and Shiota, 2017). Rudd, Vohs, and Aaker (2012) found that people “who felt awe, relative to other emotions [such as happiness], felt they had more time available... and were less impatient. Participants who experienced awe were also more willing to volunteer their time to help others... more strongly preferred experiences over material products... and experienced a greater boost in life satisfaction.”

## INTRODUCING DESIGN SCIENCE

The material in this document is based on research in environmental psychology. Environmental psychology is sometimes called design psychology or design science. Environmental psychologists are scientists who focus on how aspects of the physical environment influence how humans think and behave. Environmental psychology is a cross-disciplinary field; environmental psychologists often apply research done by anthropologists, sociologists, and other social scientists, as well as the findings of studies done by designers.



## 03 / The Power of Design to Drive Emotional Experience

To make positive user moods more likely, places must share two qualities. Whatever sort of space is being designed, its energy level must align with what's best for the activities likely to take place there and it needs to send positive nonverbal messages to users. A universal workplace design consideration, regardless of location on the planet, is that the energy profile of a work environment needs to be consistent with the tasks to be accomplished there. Research consistently shows that activities requiring concentration/ focus, ones that are mentally challenging, should be done in less stimulating environments and work that's less challenging, that doesn't require as much mental effort, is best accomplished in more stimulating ones (Wohlwill, 1966; Stone, 2003). Having other people nearby energizes us (de Croon, Sluiter, Kuijer, and Frings-Dresen. 2005) and so do particular sensory experiences, as detailed in the sections that follow.

### Recommendation:

Coordinate the emotional experience of the design elements people in a space will experience with the work they need to do there; more relaxing spaces are better for work that requires more mental concentration/focus while relatively more energizing ones are best for work that doesn't require as much concentration/focus.

Soriano, Kozusznik, Peiro, and Mateo (in press) report that "Nearly half of workers agree that their workspace is unsuitable for their work tasks... the misfit between employees' office type and their work patterns ([task] complexity and [social] interactivity)... hamper [the] relationship between [employee] well-being and performance [both in-role and extra-role]." In-role performance is "carrying out formal tasks, such as those included in a job description" and extra-role performance

is "carrying out activities that are important for the organization but optional in nature, such as helping others. In-role performance activities are related to ability, whereas extra-role performance activities are related to characteristics such as personality and motivation." The Soriano-lead team found that individual cell offices support work with high task complexity that doesn't require constantly interacting with others. Group offices (6 to 20 work stations) support teams that need



to frequently communicate and who are doing relatively complex tasks. Open plan offices (more than 20 work stations) are good options for “big teams that need constant interaction and perform monotonous tasks without much cognitive demand... Open-plan office settings are also suitable for individual routine process work with low levels of interaction.”

Another universal concern is the nonverbal messages silently sent to users of a space by its design; only user research will definitively determine the messages being drawn from a space. An area can “say” that a group is important to the future success of an organization if it is prominently located and well-equipped for the tasks-at-hand, for example. A space that is technology-rich may indicate that a group is doing significant, state-of-the-art research. An area the ideas silently communicated by a space have an important influence on employee psychological state (Commission for Architecture and the Built Environment and the British Council for Offices, 2006): “Whether or not the message is being consciously managed, staff will interpret the physical clues around them to evaluate the organization and their relationship to it. Even if basic physical health and comfort needs have been met, and operational performance has been optimized, a workplace can still fail dramatically if it conveys messages, which contradict organizational values. Emotional, communal, and personal needs of users are either satisfied or frustrated, with attendant impacts on job satisfaction, productivity and job retention.”



As Becker and Steele (1995) report, we use signals we read in an organization’s physical environment to understand their organizational culture and priorities. We also believe that these messages are a truer indication of organizational culture and values than written mission, etc., statements.

When the silent messages employees receive from their physical environment indicate that the organization values them, their engagement levels are likely to increase (Maslach, Schaufeli, and Leiter, 2001).

Radermacher and colleagues (2017) found that “corporate architecture as an effective signal to knowledge workers in the recruiting process. Two types of corporate architecture that are common in the knowledge economy are distinguished: traditional functionalist and new functionalist architecture. New functionalist architecture

combines a flat, transparent facade with semi-open office layouts including areas for social interaction. Holistically these functional elements signal and symbolize a non-bureaucratic, non-hierarchical organization.” Data collected indicate that “Students’ [young potential knowledge workers’] stated preferences imply that they would forgo on average 10% of their starting salary in order to work in the new functionalist rather than the traditional functionalist workplace. The magnitude of this effect supports the view that architecture matters for job choice.”

#### **Recommendation:**

Make it more likely that people in a space will be in a positive mood by eliminating physical stressors from it and by reviewing the silent messages sent by its components to make sure they are all desirable.

It’s important to recognize the universal factors that influence emotional response to space, aligning energy levels with tasks and recognizing nonverbal messages sent because as Bodin Danielsson (2013) states “If the standardization process does not recognize the physical and behavioural environment importance for office occupiers by different work process types, productivity will decline... standardization can lead to a lack of personal control among employees, which is a risk factor for overload and stress... Besides these risks, if the standardization of the office leads to sterile work environments it may also have negative effects such as a decline of employees’ organizational identification, well-being and productivity.”



### APPLYING NATURE'S BEST DESIGN LESSONS DESIGN ELEMENTS IN BIOPHILIC SPACES

*This section includes information about design factors that have been linked to particular mood states. Recommendations for encouraging the sorts of positive moods that enhance workplace performance flow directly from the links between experience and mood highlighted.*

#### Design Elements in Biophilic Spaces

Biophilic design applies the same design principles in manmade environments that are found in the sorts of natural environments where humans spent pleasant days in the early years of our species

(Kellert, 2008). We feel very comfortable in these sorts of places and being in biophilic designed spaces has been linked to enhanced employee performance (Kellert, 2008). Browning, Ryan, and Clancy (2014) report that “Biophilic design can reduce stress, enhance creativity and clarity of thought, improve our well-being and expedite healing.”

Yin and colleagues (2018) had people spend 5 minutes in virtual and real environments, some biophilic designed, some not. They found that “The indoor biophilic environment was associated with a decrease in participants’ blood pressure... Short-term memory improved by 14% [in the biophilic space compared to the non-biophilic

one]. Participants reported a decrease in negative emotions and an increase in positive emotions after experiencing the biophilic setting... participants experiencing biophilic environment virtually had similar physiological and cognitive responses as when experiencing the actual environment. This gives rise to the possibility of reducing stress and improving cognition by using virtual reality to provide exposures to natural elements in a variety of indoor settings where access to nature may not be possible.” The non-biophilic environment was “a classroom that does not have windows or indoor plants,” while the biophilic one was described as “an office common area with plants, bamboo floor and external views of green space and a river.”

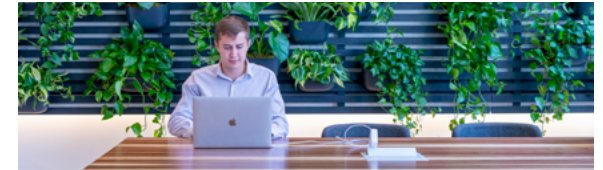


Kellert (2012) outlines six basic features of biophilic design. It utilizes:

1. “Environmental features: Characteristic features of the natural environment such as sunlight, fresh air, plants, animals, water, soils, landscapes, natural colors, or natural materials such as wood and stone.”
2. Shapes and forms found in nature
3. Natural patterns and processes, which include “designs that stimulate a variety of senses, simulate the qualities of organic growth, or reflect the processes of aging and the passage of time.”
4. “Spatial and lighting features that evoke the feeling of being in a natural setting. These include natural lighting, a sense of spaciousness, and more subtle and indirect expressions such as sculptural qualities of light and space, and the integration of light, space, and mass.”
5. Design elements that tie the space developed to the nearby physical and cultural environments. A biophilic office in Phoenix, for example, should not have the same appearance as one in Boston.
6. “The feeling of being in a coherent and legible environment, the sense of refuge and prospect [described below], the simulation of living growth and development.”

Heerwagen and Gregory (2008) detail additional features of biophilic design:

- **Sensory Richness**  
“Natural environments have an abundance of odors, sounds, tastes, smells, haptic sensations, and visual patterns that fluctuate with time (daily and seasonal) and weather.”
- **Motion**  
“Motion that ebbs and flows in a rhythmic way is soothing and pleasant, while sudden erratic activity is alarming.”
- **Serendipity**  
An example: “Incentives to shift attention from the large to the small, from the wide environment to the close-at-hand are design features in many Japanese gardens... people invariably stop and search for the sound, or look down at their feet and, in doing so, discover another element that they would have missed otherwise.”
- **Resilience**  
“It is worth exploring how buildings could be more resilient, perhaps through characteristics of nature, such as the ability to bend in the wind.”
- **Sense of Freeness**  
“Barriers and blockages that reduce sensory connections inside the building as well as between the building and the outdoors, hinder a sense of freeness in today’s built environment.” Freeness does not mandate open plan design, however, as views from one



part of a space to another can be provided by carefully located doorways and sightlines, for example.

- **Prospect and Refuge**  
People are comfortable when they feel that their location is secure (refuge) and that they have a view over the nearby area (prospect). People sitting in a cave on a hill overlooking a valley have prospect and refuge, for example, and so do people in an inglenook tucked into a larger room or a hallway or working on a mezzanine (or just below it in an area with a lower ceiling) with a view out over a floor of other workers.

The elements of biophilic design noted above and in sections of this document to follow, should be present in workplaces whenever possible.

#### **Recommendation:**

Develop work environments that recreate, conceptually, the aspects of natural environments where we felt comfortable in our early days as a species. These sorts of spaces offer secure views to users, are sensory rich, feature gentle movement and natural materials and light, and are linked in some way to the geographic area in which they are located, for example.



## Controlling Experiences in Spaces

When humans have a comfortable level of control over their physical environment, as they do in biophilic designed spaces, their mood is optimized, along with their performance. Environmental control can take a variety of forms, from having access to an assortment of work areas to being able to open and close windows; design must support comfortable levels of environmental control.

For psychological wellbeing, humans must feel that they have a comfortable level of control over their environment (Gifford, 2014). But what is a comfortable amount of control? In short, it is having a limited number of options to choose among (Iyengar and Lepper, 2000). So, people are happier when they have a set of 4 to 6 lighting presets to select from in a conference room than when they have 30 or an infinite number (Iyengar and Lepper, 2000). Having a set of 4 to 6 options optimizes mood and performance (Iyengar and Lepper, 2000). The 4 to 6 options available should be determined based on the ways that it is likely that a place or object will be used.

Having control and the ability to make choices regularly leads to working under preferred conditions, and, as the Veitch (2012) quote included earlier in this document indicated when people are working in preferred conditions, their mood is apt to be positive. Preferred sensory and other conditions are often noted below and design recommendations should support the presence of these preferred design elements.

Supporting Veitch's point, Newsham, Mancini, Veitch, Marchand, Lei, Charles, and Arsenault (2009) found that "Participants with personal control [of their work environments] have better environmental satisfaction, mood, and task performance, compared to those without such control....Participants with personal control use these controls to create individualized microclimates." Vischer (2011) concurs that when individuals have control of a space, their performance there improves.

Samani, Rasid, and Sofian's (2015) report on positive consequences of environmental control: "the design and appearance of workspace and individual ability to control the ambient conditions of the workplace have significant effect on their [worker] behavior, satisfaction and overall outcome including creativity. Employees need to have the ability to control their ambient conditions at workspace, which can motivate them to perform their tasks better and enhance their environmental satisfaction, effectiveness and creativity. Hence, personal control over the work environment becomes crucial. Personal control over the workspace can reduce the negative effect of environmental distraction, improve individuals' mood, and enhance their level of environmental satisfaction, productivity and creativity at work. High level of environmental distractions have low level of support for creativity in work environments. Having control over the work environment, which seems difficult and impossible most of the times in open-plan office environments, is critical for employees' well-being and satisfaction. Satisfaction with workplace also has critical effect

to enhance individual outcome including creativity and productivity at work."

Research by Maslach, Schaufeli, and Leiter (2001) also links comfortable control over the physical environment to higher levels of employee engagement.

### Recommendation:

Work environments where users have a comfortable level of control are best. These are spaces in which people can select from a carefully curated set of four to six alternatives, any of which might support a plausible use option.



For privacy, people need to have some control over their physical environment. When people have privacy, they are able to control who they see and hear and who sees and hears them. Privacy is necessary for psychological wellbeing (Westin, 1967) and both individuals and groups need to be able to have privacy, when desired (Gifford, 2014). Without privacy when desired, people become stressed, which degrades not only their mental performance but their ability to get along with others. Veitch (2012) links privacy on demand to enhanced professional performance by individuals and groups.

In 2018, Veitch tied visual privacy to between-worker panels at least 65 inches high and she also reports that workers feel less satisfied with in-work area privacy when panels are shorter than 54 inches, although satisfaction with lighting, and the flow of daylight through a space and shadows from lighting are best with panels shorter than 65 inches.

The spaces available to individuals and groups must support both privacy and interaction—humans are a social species and need to be able to talk with other people, when desired and needed (Gifford, 2014).

Byron and Laurence (2015) state that “Most employees personalize their workspaces with photos, memorabilia, and other items—even in the face of constraints such as rules prohibiting personalization. The objects with which employees personalize their workspaces (and even the absence of such objects) symbolize who they are and who they want to be. Through their symbolic

representations of self, they find common ground (often through shared nonwork experiences), establish a common understanding of employees’ work roles, and share personalistic information about the self—all of which contribute to relationship development among employees and their coworkers, customers, and clients. “The development of relationships supports trust-based links.

The British Council for Offices (2016) report that “Employees are seeking greater control of their office. Lighting and temperature are of key importance to employees, and there is increased demand for new technologies that would allow these factors to be controlled at desk level.”

#### **Recommendation:**

Users need privacy from time to time, and workplaces should support privacy with areas where individuals and groups of people working together can visually and acoustically separate themselves from other individuals and teams.

## **Having the Right Views**

Views of nature, whether they come via windows, art, videos, or something else, enhance mood and professional performance. They boost emotional state and our ability to concentrate after we’ve become mentally exhausted doing knowledge work (van den Berg, Koole, and van der Wulp, 2003). Veitch (2012) reports that looking at nature, whether it’s presented via windows or in relatively realistic images/art helps individuals restock their mental energy levels after they’ve been depleted by tasks requiring concentration/ focus and that replenishment boosts performance. Data collected via functional MRIs, also indicates that nature views reduce human stress levels and help us return to full mental productivity after we’ve become mentally exhausted (Kim, Jeong, Baek, Kim, Sundaram, Kang, Lee, Kim, and Song, 2010). Seeing water makes nature views particularly powerful (White, Smith, Humphreys, Pal, Snelling, and Depledge, 2010). White and his colleagues determined that “as predicted, both natural and





built scenes containing water were associated with higher preferences, greater positive affect and higher perceived restorativeness than those without water... Intriguingly, images of 'built' environments containing water were generally rated just as positively as natural 'green space.' The same effects were found whether water was naturally occurring, such as a river or lake, or not (for example, a fountain).

Green roof views are also good for our performance. Lee, Williams, Sargent, Williams, and Johnson (2015) found that "micro-breaks spent viewing a city scene with a flowering meadow green roof... boost sustained attention. Sustained attention is crucial in daily life and underlies successful cognitive functioning... Participants who briefly [for 40-seconds] viewed the green roof did a better job on cognitive tasks than participants who viewed the concrete roof."

**Recommendation:**

Views of nature, "live" at street level or on green roofs or in art/videos/etc. support cognitive refreshment.

### Moderating Visual Complexity

Moderate visual complexity is inherent in biophilic designed environments (Kellert, 2008). People generally prefer spaces with moderate visual complexity and moderate visual complexity has been tied to environmental satisfaction (Kaplan, 1987). In spaces with moderate visual complexity there are only a handful of colors and patterns



present, for example, and also just a couple of textures and finishes are in use. The same shapes are often used at various scales in an environment with moderate visual complexity.

Blanding (2015) linked visual clutter, which is high visual complexity, to degraded analytical performance: "visual clutter competes with our brain's ability to pay attention and tires out our cognitive functions over time... Kastner's studies found that the brain may not be good at blocking clutter... The more objects in the visual field, the harder the brain has to work to filter them out, causing it to tire over time and reducing its ability to function." High visual complexity is stressful

For reference, interiors of homes designed by Frank Lloyd Wright are examples of spaces with moderate visual complexity (Vaughan and Ostwald (2014).

**Recommendation:**

Moderate levels of visual complexity are best in workplaces.

### Making Sure There's Movement

Shaeffer and colleagues learned that cognitive performance, and particularly memory, is enhanced when people are walking at a pace they select (Schaeffer, Lovden, Wiekhorst, and Lindenberg, 2010). Similarly, Oppezzo and Schwartz (2014) determined that "walking boosts creative ideation [thought] in real time and shortly after." Oppezzo and Schwartz registered this boost in creative thinking whether people walked on or off a treadmill, inside or outside. The Oppezzo/Schwartz team also found that "Walking increased the tendency to talk, and people were especially loquacious when walking outside."

**Recommendation:**

Incorporate opportunities to walk into work environments, inside and outside.

### Incorporating Natural Light

Incorporating natural light into an environment is a key tenet of biophilic design. It will be discussed later in this document, with lighting in general.



## Using Natural Materials & Plants

Biophilicly designed spaces feature natural materials and plants, as noted.

Fell's research (2010) indicates that seeing wood grain reduces human stress levels: "wood provides stress-reducing effects similar to the well studied effect of exposure to nature in the field of environmental psychology... wood may be able to be applied indoors to provide stress reduction as a part of the evidence-based and biophilic design of hospitals, offices, schools, and other built environments." Fell's research applies to viewed wood grain and not wood that has been painted or otherwise treated in a way that obscures the view of its grain.

Plants are particularly important in biophilic designed spaces. Nieuwenhuis, Knight, Postmes, and Haslam (2014) found that "enriching a previously lean office with [green leafy] plants served to significantly increase workplace satisfaction, self-reported levels of concentration, and perceived air quality. Enriching space also improved perceived productivity and actual productivity. Simply enriching a previously spartan space with plants served to increase productivity by 15%. A green office leads to more work engagement among employees... the results unambiguously indicated that participants who worked in green office space were more productive than their counterparts who worked in a lean office space. Tasks were completed faster and—importantly—without any accompanying rise in errors." Plants used by the researchers had an average height of 90 centimeters (about a yard).

In "green" test conditions, subjects could see at least one plant, and usually between one and three plants as they worked. No plants were visible in lean spaces.

Raanaas and colleagues found that indoor plants support cognitive restoration after workers have become mentally exhausted (Raanaas, Evensen, Rich, Sjøstrom, and Patil, 2011).

### Recommendation:

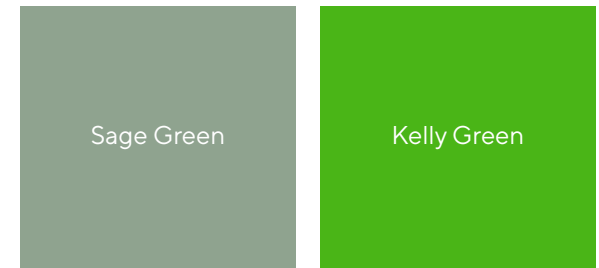
Plants and natural materials, particularly surfaces with visible wood grain, support cognitive restoration and optimize professional performance.

## OPTIMIZING SENSORY EXPERIENCES

### Vision

#### Selecting Surface Colors

Color has three attributes: saturation, brightness, and hue. Hue is the name we give to a family of wavelengths, such as blue or green, or red. Saturation is how pure a color is, with more saturated colors being purer than less saturated ones; so Kelly green is more saturated than khaki green. Brightness is the apparent amount of white added to a color, so baby blue is brighter than Navy blue. Brighter and less saturated and colors are more relaxing to view while less bright and more saturated ones are more energizing (Valdez and Mehrabian, 1994). Sage green with lots of white mixed into the paint, so that the color seems light, is a relaxing color to view, so it is a good



color for the walls in a space where people will do challenging mental work.

Hues have different connotations in different cultures, (Aslam, 2006); so it is important to review color selections with users before they are finalized.

Colors influence our interactions with others. Choi, Chang, Lee, and Chang (2016) found via "experiments and field surveys in the USA and South Korea... that an anonymous person against a warm color background (vs. neutral and cold color background) is perceived to be one with warmer personality." More generally, Dubois and Mehta (2012) found that individuals standing in front of warm colors seem less powerful than those in front of cool-colored ones and that people in cooler colored places seem to feel more powerful than those in warmer colored ones.

### Recommendation:

Colors that send culturally positive messages and are relatively bright but not very saturated are the best options for a workplace where people will add the most value to their organization doing work that requires concentration/focus.



## Using Design Fundamentals

Line and symmetry are fundamental qualities of designed objects and spaces.

Human's fundamental responses to curved and straight lines have been extensively researched. When Dazkir and Read (2012) had people look at pictures of rooms that contained either mainly rectilinear or curvilinear furniture they found that "the curvilinear settings elicited higher amounts of pleasant-unarousing emotions (such as feeling relaxed, peaceful, and calm) than the rectilinear settings." At-work environments with relatively more curvilinear lines are more likely to create the sort of at-home feel that is prized in many current work environments, for example.

Leder and Tinio (2014) report, in research findings that are consistent with those of many others, that "Symmetry is found in nature, symbol systems, and graphic depictions across different cultures and eras. Even infants show preference for symmetry...

positive bias toward symmetry has been found using different stimuli... the preference for stimuli has also been shown in aesthetic judgment of meaningless, abstract patterns."

### Recommendation:

At least a few curvilinear design elements are needed in any work area.

## Selecting Patterns that Support Design Objectives

The research on line and symmetry noted above is relevant to the selection of patterns that support design objectives.

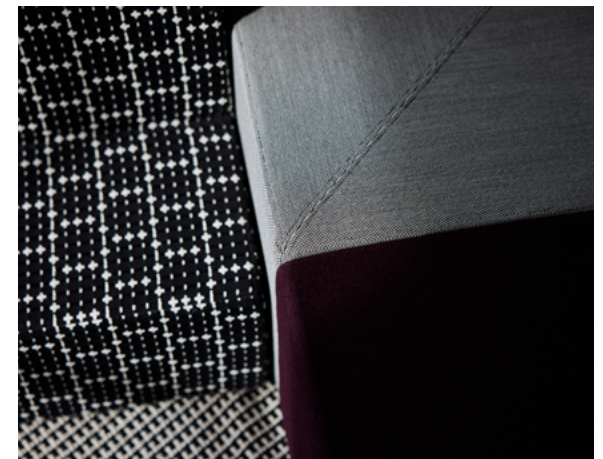
In addition, Chen, Wu and Wu (2011) determined that "Symmetric patterns are more appealing to human observers than asymmetric ones... [and] preference can be accounted for by the complexity of the image."

Desirable patterns have moderate complexity, just as spaces do. Moderately complex patterns are preferred (Forsythe, Nadal, Sheehy, Cela-Conde and Sawey, 2011).

Rodemann (1999) reports that "The larger the scale of the design, the smaller the group of people the pattern appeals to... There may be evolutionary biological explanations, or lifestyle/behavioral factors at work. A fatigued individual probably is less likely to select a 'busy' combination of florals. Perhaps in our distant past, busy florals in a setting of heavy vegetation concealed danger."

### Recommendation:

Desirable patterns to use in workplace environment have a mix of curved and straight lines and moderate visual complexity. It's desirable to have some symmetry present in the patterns themselves or the way that they are used.



## Natural Light

Natural light enhances both physical and mental wellbeing and optimizing the flow of natural light into a space seems to be a generally accepted principle of workplace design. Natural light's effects on employee mood and maintenance of location-specific circadian function (described further in a later section of this document), for example, have been extensively discussed in the design press.

Natural light seems to be a wellbeing booster; research consistently indicates that natural light enhances mood and mental performance. Research has shown that being in natural light reduces blood pressure ("Here Comes the Sun to Lower Your Blood Pressure," 2014) and boost mood (Sanders, 2014 reporting on Fell, Robinson, Mao, Woolf, and Fisher; Harb, Hidalgo, and Martau, 2015).

As Edwards and Torcellini (2002) report "Daylighting has been associated with improved mood, enhanced morale, lower fatigue, and



reduced eyestrain. Occupants in daylit office buildings reported an increase in general well being. Specific benefits in these types of office environments include better health, reduced absenteeism, increased productivity and preference of workers. The pleasant environment created by natural light decreases stress levels for office workers.

People have better self control in spaces with more natural light (Beute and de Kort, 2012) which has repercussions for intragroup member bonding, for example.

### Recommendation:

Optimize the amount of glare-free natural light in an office to boost knowledge worker mood and performance.

## Artificial Light

### Optimizing Color

The color and intensity of artificial light influences employee mood and wellbeing, with performance implications. There are differences in the lighting requirements of different groups, for example, older individuals need higher light levels in a space than younger individuals do to have a comparable

visual experience, so providing space users with some control over lighting can be particularly desirable. Veitch, Stokkermans, and Newsham (2013) determined that "People who appraise their lighting as good will also appraise the room as more attractive, be in a more pleasant mood, be more satisfied with the work environment, and more engaged in their work."

Knoop (2007) reports that cool lights support alertness and warm lights are relaxing. Supporting Knoop's work, Weitbrecht Barwolff, Lischke, and Junger (2015) report that when concentration and creativity were tested under three colors of light (3000K [warmer], 4500K, 6000K [cooler]) at the relatively high intensity of 1000 lux "creativity was better under warm light (3000 K) than under colder light (4500 K, 6000 K). Concentration was best under cold light (6000 K)."

Abdullah, Czerwinski, Mark, and Johns (2016) report that "dynamic lighting systems in the workplace have been shown to improve productivity, mood, and sleep quality of office workers. Such a dynamic system would be particularly helpful in enabling individuals to shift between phases of divergent and convergent thinking modes and optimizing the creative process."



### *Considering Light Intensity*

Wessolowski, Koenig, Schulte-Markwort, and Barkmann (2014) report on “Empirical studies [that] indicate an improvement in communication and an increase in prosocial [for example, altruistic] behaviors as a result of using warm [as opposed to cool], dimmed lighting in work environments.”

Smolders and de Kort (2014) found that when they studied “whether a higher illuminance level particularly benefits individuals who suffer from mental fatigue—not from sleep pressure, but from mental exertion. We investigated effects of 1000 vs. 200 lx at the eye on self-report measures, task performance and physiological arousal after a mental antecedent condition (fatigue vs. control). Results showed that participants felt less sleepy, more vital and happier when exposed to bright light.”

Steidle and Werth (2014) found that people have more self-control in brighter spaces (1500 lux) than in darker ones (150 lux). The researchers share that their findings align with previous ones indicating that “individuals preferred brighter light for behaviors requiring self-control and a reflective behavior regulation (working, studying, meeting guests) than for behaviors requiring no or little self-control (listening to music, thinking, taking a break, dining with the partner). People prefer brighter illumination in public and working contexts (e.g., class room, office) than in private contexts (e.g., family room, bed room)... and during interaction with friends (rather close relationship) than with the partner (very close relationship).”

### *Simultaneously Considering Both Light Color & Intensity*

Light that helps people regulate their circadian rhythms, by providing access to/reproducing naturally occurring outdoor-type lighting conditions enhances wellbeing, because it helps keep circadian rhythms aligned with users’ place on the planet. When circadian rhythms are disrupted and inconsistent with where we are, we feel stressed and sort of jetlagged (Figueiro and Rea, 2016). Bedrosian and Nelson (2017) report that “circadian disruption alters the function of brain regions involved in emotion and mood regulation.” Walmsley and colleagues (2015) determined that “Twilight is characterised by changes in both quantity (“irradiance”) and quality (“colour”) of light. Animals use the variation in irradiance to adjust their internal circadian clocks, aligning their behaviour and physiology with the solar cycle. However, it is currently unknown [before this study was conducted] whether changes in colour also contribute to this entrainment process. Our data show that some clock neurons are highly sensitive to changes in

spectral composition [light color] occurring over twilight and that this input dictates their response to changes in irradiance.” Lighting systems that support circadian systems are readily available.

#### **Recommendation:**

The color and intensity of artificial light in a workplace should be tuned to optimize performance on valued tasks. Vary light color and intensity throughout the day to insure that worker circadian rhythms align with their physical locations.

### *Distributing Light Through a Space*

How light is distributed through a space has implications for its effects on humans. Veitch, Newsham, Mancini, and Arsenault (2010) determined that “Workstation-specific lighting with individual (personal) control was preferred over parabolic-louvered luminaires regardless of the surface reflectances of the furnishings... Pleasure, room attractiveness and illumination, lighting satisfaction, overall environmental



satisfaction, job satisfaction and organizational commitment were all higher for the people in offices with workstation-specific luminaires [these lights were controllable by individual employees]. The frequency and intensity of physical symptoms and the intent to turnover were all lower for the people in offices with workstation-specific luminaires.”

The use of both direct and indirect light is preferred in a space (Veitch, 2018).

Soler (2018) reports that with interior circadian lighting “During the Day time [with cooler light] light up your ‘sky’. During the Night time [with warmer light], darken your “sky” and light your ‘fire’. Focus light on horizontal surfaces.” Soler’s comments mean that cooler lights should be placed in a relatively higher position (sky) and that warmer ones lower down.

#### **Recommendation:**

Cooler lights should be positioned at higher points in a work environment while warmer ones should be lower, closer to a horizon line.



## **Haptics**

### **Using Tactile Experiences for Desired Effects**

What we touch has an influence on how we feel and act.

Some materials warm more quickly and retain heat better than others—and the temperatures of surfaces experienced have significant psychological implications. Williams and Bargh (2008) had people hold warm or cool drinks and then put the drinks down. People whose hands had been heated by the warm drinks judged other people to be more generous and caring than the study participants who had just held cold drinks. Also, people were more generous when their hands had been warmed than when their hands had been cooled. Kang, Williams, Clark, Gray, and Bargh (2011) found that people were more trusting after they had held something warm than after they’d held something cool. Storey (2014) reports that people are more cooperative after briefly holding something warm than after briefly holding something cool.

Ackerman, Nocera, and Bargh (2010) found that people in their studies who were playing the role of negotiators did not drive as hard a bargain when they were sitting on soft chairs (with a cushion at least an inch or so thick) as they did when sitting on harder chairs, without cushions.

#### **Recommendation:**

Seat cushions, even modest ones, are best in spaces where less competitive exchanges are desirable.

## **Setting the Right Temperature**

Temperature influences how we think and behave.

Baker and Bernstein (2012) have determined that temperatures 68-74 degrees Fahrenheit and humidity levels of 40-70% are best for our cognitive performance. Also, our professional performance is best when the temperature in a space we’re in aligns with the sort of room temperature we prefer (Sellaro, Hommel, Manai, and Colzato, 2015). The Sellaro-lead team



reports that “subjective preferences are more reliable predictors of performance than objective temperature and that performing under the preferred temperature may counteract ‘ego-depletion’ (i.e., reduced self-control after an exhausting cognitive task) when substantial cognitive control is required.”

We’re more likely to go along with the opinions of other people when we feel comfortably warm compared to when we feel comfortably cool (Huang, Zhang, Hui, and Wyer, 2012), which has implications for interactions among team mates.

#### **Recommendation:**

Align interior temperatures with employee preferences for their workplaces, within the range of 68 to 74 degrees Fahrenheit.



## Acoustics

### Managing the Sound Experience

Just as the visual experience of seeing someone walking by or engaged in some sort of professionally-relevant activity, such as talking to the boss, can be distracting, acoustic experiences can also be diverting, and divert mental processing power from desired activities. Workers indicate preferred volume levels, but acoustic experiences are not entirely objective.

Haapakangas, Hongisto, Hyona, Kokko, and Keranen (2014) found that “The reduction of the STI [Speech Transmission Index] by room acoustic means [such as degree of absorption, screen height, desk isolation, and level of masking sound] decreased subjective disturbance. Reducing the STI is beneficial for performance and acoustic satisfaction especially regarding speech coming from more distant desks. However, acoustic design does not sufficiently decrease the distraction caused by speech from adjacent desks.”

Veitch (2012) reports that “Masking sound, being a continuous sound with no changing state, should not cause cognitive performance problems. A successful masking sound will be loud enough to cover speech sounds and with enough high-frequency sound to cover most speech sounds, but neither loud enough nor over-weighted in the high frequencies to cause annoyance. In workplace sound levels of 45dB(A) are generally preferred (Veitch, 2018).



Oseland and Hodsman (2015) report on psychoacoustics: “Reported noise annoyance does correlate with sound level measurement, but it is generally accepted that the sound level accounts for only 25% of the variance in [relative amount of] annoyance. The research literature assessed for the purposes of this report suggest that there are four key non-physical factors that affect noise perception and performance in office environments: Oseland and Hodsman (2015) report on psychoacoustics: “Reported noise annoyance does correlate with sound level measurement, but it is generally accepted that the sound level accounts for only 25% of the

variance in [relative amount of] annoyance. The research literature assessed for the purposes of this report suggest that there are four key non-physical factors that affect noise perception and performance in office environments:

- Context and attitude [toward the people creating the noise, the perceived need for the noise, whether the noise source is perceived as being useful, etc.]
- Perceived control and predictability
- Personality and mood

Noise is clearly a psychophysical matter and it relates as much, if not more, to the interpretation and meaning attached to the sound and how distracting it becomes as to the sound level per se. The solution to noise distraction is as much to do with the management of the space and guidance on behaviour as it is about the design and acoustic properties.” Noise is clearly a psychophysical matter and it relates as much, if not more, to the interpretation and meaning attached to the sound and how distracting it becomes as to the sound level per se. The solution to noise distraction is as much to do with the management of the space and guidance on behaviour as it is about the design and acoustic properties.”

Haapakangas, Hongisto, Varjo, and Lahtinen (2018) studied two organizations that moved from a layout with mainly private offices to an open plan with assigned desks. At one of these organizations, the new site contained more rooms for quiet work and there was more variety in the form of those

rooms. The researchers determined that after the move “Perceived distractions increased in both organizations... negative effects on environmental satisfaction, perceived collaboration and stress only emerged in the open-plan office where the number of quiet rooms was low... Extensive provision of quiet workspaces, as well as the match between the employee needs and the perceived ease of access to such spaces, was associated with less distractions, less stress symptoms, higher satisfaction with the environment and better perception of collaboration.”

Employees can find environments that seem too quiet, or are silent, as stressful as offices where noise levels are above desire levels (Acun and Yilmazer, 2018). Using surveys, interviews, and measurements of sound volumes, among other research tools, Acun and Yilmazer determined that “Sounds that were not expected or out of context and those that interfere with the concentration demanding tasks caused a negative interpretation of the soundscape... employees were concerned with silence as much as they were concerned with the noise. Both a very loud and a very quiet office environment can cause a negative effect on factors such as task performance, satisfaction and wellbeing. When sound is heard by the listener, they search for pieces of information within it. Objective measurements alone do not reflect individuals’ perception of the soundscape.”

**Recommendation:**

Recognize that eliminating audio distractions may, to some extent, involve subjective considerations.

### Working in Water & Natural/Personally Meaningful Sounds

Natural sounds can be calming; they can be used to cut in-office stress levels.

Benfield, Taff, Newman, and Smyth (2014) report that “Visual exposure to natural scenes can aid in recovery from stress, attentional fatigue, and physical ailments including surgery and sickness. Natural soundscapes can provide restorative benefits independent of those produced by visual stimuli.” Benfield and colleagues worked with the sounds of birds singing and gently rustling leaves.

DeLoach, Carter, and Braasch (“Natural’ Sounds Improve Mood and Productivity, Study Finds,” 2015) report on “work by Braasch and his graduate student Mikhail Volf, which showed that people’s ability to regain focus improved when they were

exposed to natural sounds versus silence or machine-based sounds.”

Thoma and colleagues determined that “the sound of rippling water... had a relaxation effect stronger than that of music” (Thoma, La Marca, Bronniman, Finkel, Ehlert, and Nater, 2013). The relaxing music that served as a comparison was “Miserere” by Allegri.

**Recommendation:**

Carefully manage workplace acoustic environments by using sound absorbing materials, etc., to keep work time volumes below 45 db(A) whenever possible and soundscaping with natural sounds of gently rustling leaves and water. Also, psychoacoustics teaches us that not all audio experiences are fully assessed objectively.





## Scents & Olfactory Factors

### Understanding Odor Memories

Odor memories have a significant and continuing effect on our mood and wellbeing (Gifford, 2014). Sometimes groups share common scent memories, others are restricted to a single individual with unique experiences. For example, across much of the Western world, the smell of baking brings to mind pleasant memories, often of holidays. Worldwide, the scents of at-work coffee bars influence travel through spaces and serve as cues for behaviors such as spending time casually with colleagues. Thoughtful management of smellscape is often an afterthought, but carefully considering odor-related sensory experiences can significantly enhance lived experiences.

Any actual or planned scentscape should be evaluated via research with space users so that smellscape can reflect odor memories of users.



### Focusing on Smell Basics

Baron (1997) determined that smelling a scent we feel is pleasant boosts our mood. Worldwide, there are some scents that are consistently judged to be positive, such as floral smells (Ferdenzi, Schirmer, Roberts, Depplanque, Porcherot, Cayeux, Valazco, Sander, Scherer, and Grandjean, 2011). Smelling unpleasant scents increases stress levels while smelling pleasant scents can reduce them (Schweitzer, Gilpin, and Frampton, 2004).

### Using Smells to Achieve Emotion-based Goals

Research with particular scents indicates that some are particularly useful in workplaces.

Lemon scents have been tied to improved performance on cognitive/mental tasks generally (Martin and Cooper, 2007) and better worker moods (McKim and Pederson, 2011). The smell of peppermint has been linked to improved performance and speed of execution of tedious clerical tasks (Barker, Grayhem, Koon, Perkins, Whalen, and Raudenbush, 2003).

Madzharov and colleagues (2018) investigated “the effect of an ambient coffee-like scent (versus no scent) on expectations regarding performance on an analytical reasoning task as well as on actual performance. People in a coffee-scented (versus unscented) environment perform better on an analytical reasoning task due to heightened performance expectations. People expect that being in a coffee-scented environment will increase their performance because they expect it



will increase their physiological arousal. A coffee-like scent (which actually contains no caffeine) can elicit a placebo effect.” When a coffee odor was present, “The scent smelled like coffee but contained no actual caffeine or other stimulants.”

Sellaro and colleagues (2015) determined that “compared to peppermint and control (no aroma) exposure, being exposed to lavender aroma increased interpersonal trust... being exposed to peppermint aroma did not reduce interpersonal trust compared to the control (no aroma) condition.”

Liljenquist led a team that found that people are fairer and more generous when they find themselves in spaces that smell clean to them (Liljenquist, Zhong, and Galinsky, 2010).

Smelling rosemary enhances prospective memory, which is our ability to remember a future event or commitment (Vallance, Heffernan, and Moss, 2007) as well as alertness (Moss, 2002). Some of the memory tasks whose performance was improved were completed after study participants left the researchers' laboratory. The scent of common garden sage also improves memory performance and alertness (Moss, Rouse, Wesnes, and Moss, 2010).

Several scents have been shown to reduce anxiety levels including sweet orange, that's the scent of the fruit that we normally eat (Goes, Antunes, Alves, and Teixeira-Silva, 2012), floral odors are associated with lower levels of anxiety, (particularly strong effect for the odors of jasmine and hyacinth; Warren, 2007), and vanilla (Hirsch, 2003). The odor of the flower ylang-ylang's odor makes people feel less alert and more calm (Moss, Hewitt, Moss, and Wesnes, 2008). Also relaxing are lemon, mango, and lavender scents (all of which contain linalool) (Nakamura, Fujiwara, Matsumoto, and Abe, 2009). These smells reduce stress levels through their influence on the immune system and blood chemistry.

**Recommendation:**

Scent workplaces with odors that workers view positively; customizing scentscapes to align with tasks at hand.



**Considering/Blending All Our Sensory Experiences**

Schifferstein and Desmet (2008) report that the implications of individual sensory experiences are combined to create an overall psychological (emotional, cognitive, etc.) response to a space or an object in it; sensory stimuli do not have to be consciously perceived to have an effect to influence responses. Forster (2011) concurs that the implications of individual sensory experiences are combined to produce an overall response. Schifferstein and Desmet (2008) indicate that it's best if sensory experiences are consistent: "Consumers tend to prefer products for which different pieces of sensory information duplicate or complement one another, it is easier to understand. The downside of coherence, however, is that for common products with which everybody is familiar (such as furniture), this predictability can evoke boredom. A limited degree of conflict between information gathered by the different senses may result in a surprise and, hence, may be evaluated as pleasant. Sensory discrepancies only improve product evaluations when the

discrepancies are relatively small." If walls in a space are painted a relaxing color, lighting is relaxing, the soundscape is soothing, but a particular throw pillow on a couch is an energizing color, the overall experience of being in a space with be calming, for example.

Blending these research findings, it's possible to determine someone's overall response to a space. The emotional effects of each component of the physical environment combine in our mind in a straightforward way, just as we add up separate numbers to get a total. (figure 3)

**Recommendation:**

Integrate sensory experiences in a work environment to produce the emotional environment that supports the task at hand, remembering that material collected through individual sensory channels combines into an overall emotional response much as the spices in a stew develop into a single taste profile.

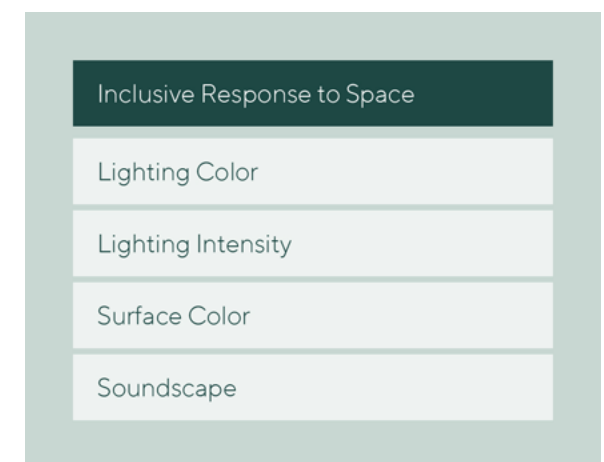


figure 3

## Considering Furniture & Finishes

### Furniture/Furnishings

People are more likely to be comfortable in a space, and perform to their full potential, when the furniture present supports desired activities. For example, people are more likely to participate in a meeting when they can make eye contact with the other people present and people are most likely to interact with others that they can make easy eye contact with (Sundstrom and Sundstrom, 1986). However, Akechi and team (2013) determined “individuals from an East Asian culture perceive another’s face as angrier and more unapproachable and unpleasant when making eye contact as compared to individuals from a Western European culture.” So, worldwide, encouraging eye contact may not be desirable. Sundstrom and Sundstrom report that “To emphasize leadership, a manager might choose a long table with a chair at the head (and none at the other end). A circular table, on the other hand, would de-emphasize leadership.” De-emphasizing may encourage people present will interact with each other. The Sundstrom team also report that when there is some sort of furniture barrier between people at a meeting, such as a table, the psychological distance between those talking increases, which reduces the emotional connection between them. Sommer (1969) learned that people are more likely to form relationships with others, and actually prefer to talk to other people, across the corner of a table, when their chairs are at 90 degrees to each other. This alignment allows people to gracefully break eye contact when desired,

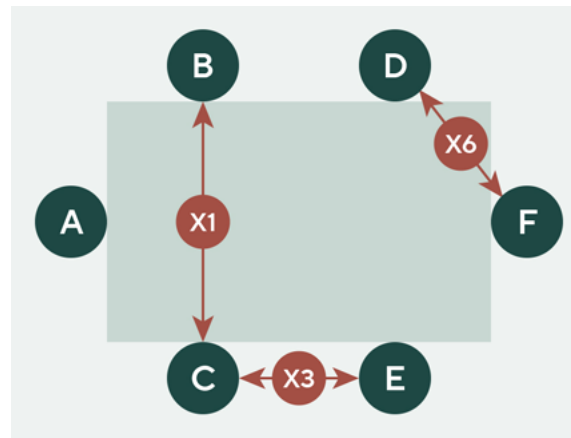


figure 4

particularly when topics are being discussed that may make participants tense, such as issues with performance. (figure 4)

The heads of all participants in a meeting should be at roughly the same height above the floor. Makhanova and team mates (2017) determined that when someone is being physically looked down on they seem younger and less powerful or experienced while people being looked up at are perceived to be relatively more powerful/experienced. Bertamini, Byrne, and Bennett (2013) found that people find other individuals more attractive when their postures align—both are standing or sitting, for example— and this is important because perceptions of attractiveness are linked to perceived trustworthiness, for example. Schnobrich (2012) found there was more discussion among meeting participants if some were standing if the other present were on extra tall chairs. These finding support making sure the heads of everyone participating in a conversation

are the same height above the floor, whether that is at roughly a seated or standing height.

#### **Recommendation:**

Select furnishings so that people can make eye contact, or not, with each other, as dictated by situations and their cultures, and so that the eyes of everyone participating in a conversation are at roughly the same height above the floor.

It’s also interesting to note that when reclined, we seem to get less angry when we’re provoked than people who aren’t reclining but hear the same news, etc. (Harmon-Jones and Peterson, 2009) and also that Lipnicki has found that we seem to think more creatively when lying down (“Creative Thinking: Try Lying Down,” 2005).

Sliter and Yuan (2015) “conducted an experimental study, in which boredom, task satisfaction, stress, arousal, and performance were evaluated and compared across 4 randomly assigned conditions: seated workstation, standing workstation, cycling workstation, and walking workstation. Additionally, body mass index (BMI) and exercise habits were examined as moderators to determine whether differences in these variables would relate to increased benefits in active conditions. Participants in the walking condition had higher satisfaction and arousal and experienced less boredom and stress than those in the passive conditions. Cycling workstations, on the other hand, tended to relate to reduced satisfaction and performance when compared with other conditions. Walking workstations might have psychological benefits to individuals, regardless of BMI and exercise habits.”



## Finishes

Shiny surfaces are more likely to be preferred to matte ones.

Silvia and team (2018) share that “Researchers in the evolutionary aesthetics tradition have suggested that people prefer shiny objects because glossiness connotes water. We... present an experiment that manipulated the glossiness of metal objects. Young adults viewed silver coins that were either dull or in ‘brilliant uncirculated’ condition as well as copper cylinders that were either rough and tarnished, polished with a brushed surface, or polished with a mirror finish. Ratings of attractiveness showed that people preferred the shiny over the tarnished coin and the glossy copper bar over the tarnished and brushed ones. These effects were not due to perceived quality or implied effort.”

Matte surfaces are recommended, however, to reduce opportunities for glare.

### Recommendation:

Use matte finishes more frequently than glossy ones.



## Architectural Effects

The architectural form of a structure, its layout and materials, influence emotional state, wellbeing, and performance. For example:

Waber (2013) found, via electronic sensors worn by workers that “Coffee machines, kitchens cafes, and recreational areas provide a similar environment that can greatly enhance social connectivity in the workplace.” Waber’s data also indicate that although we interact most with people who sit near our desk, we will purposely seek out particular other people and travel to their desks, when we need to connect with them.

Nicolai, Klooker, Panayotova, Husam, and Weinberg (2016) found that teams vary their location to change their emotional state, which suggests that providing a range of meeting options is best. Nicolai and colleagues found that “team performance can be fostered by the change of the team’s workspace location. Teams did not only change the location of their teamwork based on the stage of the innovation process stage they were currently working on, they quite often changed their spatial setting as a means to ignite their creative potential and therefore team performance. Quite often the teams went to seek a space that seemingly offered them the opposite to the current state [for example, from more contemplative to more action-oriented spaces]. It seems that creativity was fostered when teams transformed [a space] it to make it their own. A space that fosters creativity suggests a direction of usage but also leaves room to change it.”

Transparent glass walls are used extensively in workplaces; Bernstein’s work (2014) indicates that their utilization should be carefully considered, with pluses and minuses weighed. Bernstein reports on the transparency paradox: “For all that transparency does to drive out wasteful practices and promote collaboration and shared learning, too much of it can trigger distortions of fact and counterproductive inhibitions. Unrehearsed, experimental behaviors sometimes cease altogether. Wide-open workspaces and copious real-time data on how individuals spend their time can leave employees feeling exposed and vulnerable. Being observed changes their conduct. They start going to great lengths to keep what they’re doing under wraps, even if they have nothing bad to hide. If executives pick up on signs of covert activity, they instinctively start to monitor employee behavior even more intensely. And that just aggravates the problem.” Bernstein values “boundaries around individual teams—zones of attention—to avoid exposing every little action to the scrutiny of a crowd.” Physical boundaries that create private zones for teams make it less likely that people act to “to control others’ impressions and avoid embarrassment.”

### Recommendation:

Create a variety of environments in any workplaces, including some where people can decompress, and locate the primary work zones of people whose interactions are likely to add the most value to an organization near to each other. Understand that transparent walls have clear implications for employee actions.

## Working in Green Buildings

Working in green buildings seems to be nearly as positive for our wellbeing and performance as it is for our planet. WELL and FITWEL standards align with research on “living green.”

Leaman and Bordass (2007), reviewing occupant surveys from 177 buildings in the United Kingdom, determined that people working in environmentally responsible buildings feel better about the image presented by their building and the way it meets their needs than people who are working in conventional buildings. Leaman/Bordass also learned that people who know they are working in green buildings are also more tolerant of comfort-related problems (in ventilation or lighting, for example) in their workplaces than employees working in conventional buildings are of similar issues.

Newsham, Veitch, and Hu (2017) also researched the implications of working in green buildings: “Data on... engagement, job satisfaction, job

performance, and facility complaints for thousands of employees of a large Canadian financial organization were analysed to explore differences in outcomes between those working in green-certified office buildings and those in otherwise similar conventional buildings. Overall, green buildings demonstrated higher scores on survey outcomes related to job satisfaction, value to clients and stakeholders, evaluation of management, and corporate engagement. There was also a tendency for manager-assessed job performance to be higher in green buildings. Nevertheless, not all green buildings outperformed all conventional buildings, and superior performance was not exhibited on all outcomes examined.” Newsham, Veitch, and Hu believe employees know if their workplaces are LEED certified.

### Recommendation:

Design in an environmentally responsible way and make sure that employees know when they are working “green” and working “well”.

## Recognizing New Ways of Working

Many of the studies mentioned above relate to new ways of working. The additional research findings discussed in this section also indicate significant links between new ways of working, mood and performance, for example.

Wohlers, Hartner-Tiefenthaler, and Hertel (in press) researched experiences in activity-based workplaces—areas for concentrated work without distraction are called “WEs that support undisturbed work” by the researchers and more collaborative, group type areas are called “WEs that support communicative work.” The team also details that the vitality factor “captures the subjective experience of energy, liveliness, and the willingness to invest effort” and that “job attitudes” refers to levels of job satisfaction and affective (emotional) organizational commitment. The Wohlers-lead team reports that when survey data were collected from “office workers from different organizations. The availability of WEs that support undisturbed working was positively related to job attitudes and vitality. For WEs that support communicative work, job attitudes and vitality were additionally explained by the relative fit to the task and appropriate use of WEs. The mere supplies of undisturbed WEs were positively related to office workers’ job attitudes and vitality. More favorable job attitudes occurred for supplies of communicative WEs that exceeded workers’ needs. The mere supply of undisturbed WEs as well as communicative WEs can positively relate to office workers’ job attitudes and vitality, irrespective of the office workers’ task requirements for such WEs.”





## Creating Culture-consistent Events

Culture can be assessed at an organizational level and nationally. Designed experiences that align with a culture's expectations support positive moods (Hofstede, Hofstede, and Minkov, 2010).

Cameron and Quinn (2006) have identified 4 different organizational cultures: hierarchies, clans, adhocracies, and market cultures. The professional goals of each can be summarized in a single word, that indicates its orientation (Cameron and Quinn, 2006): hierarchies are oriented toward controlling, clans are oriented toward collaboration, adhocracies' orientation is creative and markets are oriented toward competing. Effectively managing organizational culture and all of its attributes is key to organizational success (Cameron and Quinn, 2006). An example of how the Cameron and Quinn system can be used: in adhocracies, creating is paramount and if environmental flexibility is not clearly present, environments can be "uglyed up" fast as people in this culture modify them in ways that support their creative endeavors. (figure 5)

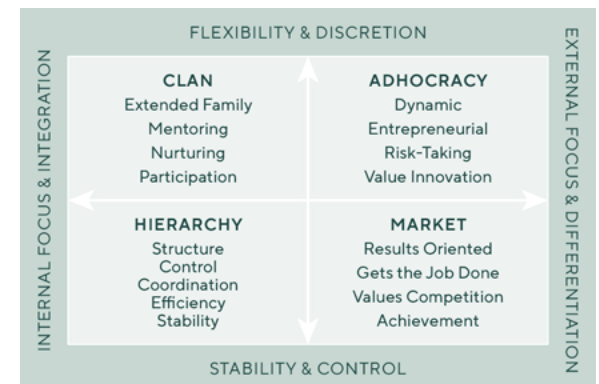


figure 5

Hoendervanger, Ernst, Albers, Mobab, and van Yperen (2018) report that "Optimizing satisfaction with the physical work environment... has been found to be related directly to job satisfaction and indirectly to other organizational outcomes such as commitment, intention to leave, engagement, and absenteeism... ABW [activity-based work] environments are suitable specifically for work that is highly interactive and highly autonomous."

The Hoendervanger-lead team encourages designers to increase workplace privacy via the use of sound absorbing materials, dividers between workstations, floor plans that maximize the distance between workers, and similar acoustic techniques as well as provide off-site locations for use when the ABW environment is unable to support the level of privacy required.

Brunia, Been, and van der Voordt (2016) studied activity-based workplaces with higher and lower

levels of environmental satisfaction, finding that "Regarding the physical environment, most critical seems to be a well thought-out spatial support of both communication and concentration. Open spaces should be alternated with enclosed rooms that are dedicated to concentration work or telephone calls and provide some privacy. Sufficient acoustic measures are needed to avoid aural distraction. Large open workspaces, accommodating more than approximately 15 people, should be avoided due to concentration and privacy issues. Large open spaces can be visually and acoustically subdivided in smaller areas. Meeting spaces turn out to be ideally located in the vicinity of the work areas, especially when it comes to (smaller) meeting spaces in order to facilitate ad hoc gatherings or sessions."

**Recommendation:**  
Support activity-based working.



Hofstede has developed a 6-factor system for categorizing national cultures, which is detailed in Hofstede, Hofstede, and Minkov (2010). The dimensions of his model are individualism–collectivism, power distance (acceptance of unequal distribution of power), tolerance for uncertainty, masculine–feminine (toughness), long- or short-term orientation, and indulgent–restrained. (figure 6)

These factors have design implications that should be reflected in the form of the physical environments used by members of each culture (Hofstede, Hofstede, and Minkov, 2010). The cultural profiles of particular countries are available in charts included in Hofstede, Hofstede, and Minkov. Information presented by Hofstede,

<div> 0 ← Hofstede's Cultural Dimensions → 100 </div>		
Low Power Distance	PDI	High Power Distance
Collectivistic	INV	Individualistic
Feminine	MAS	Masculine
Low Uncertainty Avoidance	UAI	High Uncertainty Avoidance
Short Term Orientation	LTO	Long Term Orientation
Restraint	IND	Indulgence

figure 6

Hofstede, and Minkov, for example, indicates that people from more individualistic cultures have higher expectations of having privacy, are more likely to try to modify their environment, and are less willing to share (resources, spaces, etc.), than people from more collectivistic cultures. In countries that are more tolerant of an uneven distribution of power, there are likely to be more power-based amenities, such as executive dining rooms. People from more feminine cultures are more concerned about optimizing about quality-of-life and environmental responsibility than people from more masculine cultures.

**Recommendation:**  
Work with users to align national and organizational culture and design.



### INTEGRATING UNIVERSALS AND SPACE STRATEGIES TO SUPPORT DESIRED EMOTIONAL EXPERIENCES

Many factors influence someone's experience in their workplace, their emotional response to that workplace, and their ultimate performance in it.

We combine all of our experiences via a system reminiscent of some of the first math we learn, addition. Research cited above indicates that sensory information that people receive through one of their sensory channels is added to the



figure 7

material that flows into their brains via others and the "total" of all of those inputs determines overall emotional state.

Maslow's Hierarchy of Needs can help structure our discussion of designing for positive emotions. First, let's review each of the levels of Maslow's hierarchy as Koltko- Rivera (2006) does, by describing a person at each of its levels (from the foundation to the peak): (figure 7)

- **Physiological (survival) Needs**  
Seeks to obtain the basic necessities of life.
- **Safety Needs**  
Seeks security through order and law.
- **Belongingness and Love Needs**  
Seeks affiliation with a group.
- **Esteem Needs**  
Seeks esteem through recognition or achievement.
- **Self-actualization**  
Seeks fulfillment of personal potential.
- **Self-transcendence**  
Seeks to further a cause beyond the self and to experience a communion beyond the boundaries of the self through peak experience.

Although Maslow's hierarchy is generally presented as a 5-level pyramid, current psychologists such as Mark Koltko-Rivera feel that a person can be working to achieve objectives at several different levels of the hierarchy simultaneously and that Maslow's reasoning shifted over the course of his career. Maslow set a higher motivational level above self-actualization naming this "self-transcendence." At that level of transcendence, the individual's own needs are put aside, to a great extent, in favor of service to others.

In the sorts of workplaces that readers of this document are designing or managing, the satisfaction of physiological and safety needs is the expected foundation. Current and future design plays a key role in supporting belongingness, esteem, and self-actualization related needs.

#### Recommendation:

Nonverbal communication of respect for an employee via design and support for the work employees are asked to do is particularly important for the satisfaction of esteem and self-actualization needs.

Of all of the factors noted above that influence our emotional response to a space, the one that seems to have the most significant effect on our emotional state is the way a space communicates



nonverbally to its users. When people interpret the clues they find in their workplace that they believe indicate what their employer thinks about them, their assessments can have an extremely significant effect on how they think and behave. If employees feel valued, their mood is better and their motivation levels are higher than when the data available seem to indicate that employees don't feel that their employers view them too positively.

Only research with user groups— via individual and group interviews/discussions or similar open,

direct communication—will indicate for sure what impressions employees are deriving from the workplaces supplied to them. The same situation or item can be positively received by one group and negatively interpreted by another. In some workplaces it's prestigious to sit near the boss and groups placed near executives seem to be important for the future of the organization, for instance. At other firms, being placed by the boss can be a sign that an individual or a group needs a little extra attention or help to work to their full potential.

One way that management conveys respect is by giving individuals and teams choices about where they work and the form (e.g., light intensity, furniture arrangement) of the places where they do. Control signals confidence in choices made. Opportunities for environmental control should be carefully curated so that the options presented align with what people are likely to want or need to accomplish in a space.

Light color options in a space where people are likely to want to hang out and decompress should include warm ones, for example, just as



the walls/ other surfaces should feature not very saturated but relatively bright surface colors. One of the reasons for the success of activity-based working, compared to open office spaces, is that in the activity-based work areas people have an assortment of work areas to choose from (and, in the best of all worlds, options provided support the sort of work at hand and are available, not in use by others).

Workspace design also needs to reflect the sorts of thinking that people will need to do in a space. Spaces where people will do work requiring concentration and focus should be less stimulating. For example, use more visual boundaries between workers, more relaxing colors on surfaces and in light, and natural soundscapes that mask conversations. When people are doing knowledge work they become cognitively exhausted and design that features views of nature inspired art and green roofs, for example, can help return them to peak mental performance. Colors in use need to support needed mental activity as do lighting, finishes, and furniture configurations, for example. Visual complexity needs to register at moderate levels in spaces where people will excel at knowledge work. Aligning soundscapes and smellscapes with space-action goals is also desirable—although visual experiences are particularly important in North America and Europe.

If you develop workplaces where people feel valued, have control and opportunities for cognitive refreshment as well as environments that align with the task at hand, all while creating

the sorts of environments that people prefer, you make it much more likely that people will be in a good mood. And good moods at work are very important. When our mood is positive, we're better at problem solving, creative thinking, and getting along with others, for example. What's more important in a workplace than problem solving, creativity, and getting along?

Oseland and Burton (2012) have assessed the implications for worker performance of various design modifications. Oseland and Burton conducted a thoughtful literature review and after weighting published performance outcomes in light of the "place where the productivity research was carried out... the measurement made to evaluate the change in productivity... [and] the

amount of time that the measurement might be observed in a real office building" concluded that the mean weighted performance effects in single factor studies are. (figure 8)

For more information and to work through an example of how these data can be applied and multiple factors considered, please read Oseland and Burton's study at: [workplaceinsight.net](http://workplaceinsight.net)

Factor	Unweighted	Weighted Effect
Lighting	9.5%	1.1%
Noise	27.8%	1.4%
Temperature	17%	1.2%
Ventilation	9%	1.4%
Control	8%	1.2%
Furniture	15.7%	2.1%
Space	24.1%	3.5%
General (average)	15.9%	2.7%

figure 8

**Engaging all  
sensory experiences  
leads to a high  
performing place**



Sights

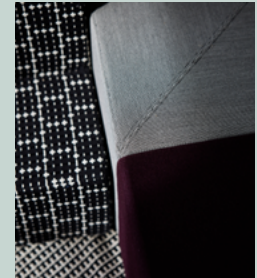


Sounds



Smells

Biophilic Design



Tactile Experiences

Many factors influence someone's experience in their workplace, their emotional response to that workplace, and their ultimate performance in it.

We combine all of our experiences via a system reminiscent of some of the first math we learn, addition. Research cited above indicates that sensory information that people receive through one of their sensory channels is added to the material that flows into their brains via others and the "total" of all of those inputs determines overall emotional state. It is like a journey. Every experience we have during the journey affects us as we travel, and combines to create our end experience.

Architects and Designers who are aware of how workplace design influences mood and

the implications of emotional state can more effectively manage design related resources and can also create environments in which client resources—human, financial, and otherwise—are efficiently and effectively utilized. Design elements that optimize mood for professional performance can be prioritized, those that don't support desired cognitive states can be eliminated.

Knowledge of design's effects on emotional state can boost the likelihood of desired outcomes without decimating budgets. Selecting mood- and performance-enhancing surface and light colors can significantly affect performance, without influencing development budgets, for example. The cognitive implications of individual sensory experiences combine to create an overall response to a space. Mood-enhancing sensory experiences

can thus, to some extent, compensate for those that have negative implications and cannot, realistically, be changed.

When applying the material in this report, it's important to remember that the form of the physical environment and the emotional consequences of that form can influence how people think and behave but can not determine how they do so, as many factors shape professional outcomes besides space design. For example, design can encourage the sort of positive mood that has been linked to enhanced creative performance, but it cannot "guarantee" creative thinking on topics about which users are uninformed. Space is an influencer, not a magic potion.

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She has appeared in publications such as The New York Times, Forbes and Huffington Post, and is an accomplished author, providing bylined articles for the Harvard Business Review and Metropolis, and writing three books, “Place Advantage: Applied Psychology for Interior Architecture,” (Wiley, 2009), “The Designer’s Guide to Doing Research: Applying Knowledge to Inform Design,” with Cindy Coleman, (Wiley, 2012) and “Designology: How to Find Your Placetype and Align Your Life With Design”, (Mango 2019).

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