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How Room Designs Affect Your Work and Mood

Brain research can help us craft spaces that relax, inspire, awaken, comfort and heal

By Emily Anthes

In the 1950s prizewinning biologist and doctor Jonas Salk was working on a cure for polio in a dark basement laboratory in Pittsburgh. Progress was slow, so to clear his head, Salk traveled to Assisi, Italy, where he spent time in a 13th-century monastery, ambling amid its columns and cloistered courtyards. Suddenly, Salk found himself awash in new insights, including the one that would lead to his successful polio vaccine. Salk was convinced he had drawn his inspiration from the contemplative setting. He came to believe so strongly in architecture's ability to influence the mind that he teamed up with renowned architect Louis Kahn to build the Salk Institute in La Jolla, Calif., as a scientific facility that would stimulate breakthroughs and encourage creativity.

Architects have long intuited that the places we inhabit can affect our thoughts, feelings and behaviors. But now, half a century after Salk's inspiring excursion, behavioral scien-tists are giving these hunches an empirical basis. They are unearthing tantalizing clues about how to design spaces that promote creativity, keep students focused and alert, and lead to relaxation and social intimacy. Institutions such as the Academy of Neuroscience for Architecture in San Diego are encouraging interdisciplinary research into how a planned environment influences the mind, and some architecture schools are now offering classes in introductory neuroscience.

Such efforts are already informing design, leading to cutting-edge projects, such as residences for seniors with dementia in which the building itself is part of the treatment. Similarly, the Kingsdale School in London was redesigned, with the help of psychologists, to promote social cohesion; the new structure also includes elements that foster alertness and creativity. What is more, researchers are just getting started. "All this is in its infancy," says architect David Allison, who heads the Architecture + Health program at Clemson University. "But the emerging neuroscience research might give us even better insights into how the built environment impacts our health and well-being, how we perform in environments and how we feel in environments."

Higher Thought

Formal investigations into how humans interact with the built environment began in the 1950s, when several research groups analyzed how the design of hospitals, particularly psychiatric facilities, influenced patient behaviors and outcomes. In the 1960s and 1970s the field that became known as environmental psychology blossomed.

"There was a social conscience growing in architecture around that time," says John Zeisel, a Columbia University–trained sociologist who, as president of Hearthstone Alzheimer Care, specializes in the design of facilities for people who have dementia. Architects began to ask themselves, Zeisel adds, "'What is there about people that we need to find out about in order to build buildings that respond to people's needs?' " The growth of the brain sciences in the late 20th century gave the field a new arsenal of technologies, tools and theories. Researchers began to consider "how can we utilize the rigorous methods of neuroscience and a deeper understanding of the brain to inform how we design," says Eve Edelstein, a visiting neuroscientist at the University of California, San Diego, and adjunct professor

at the New School of Architecture and Design, also in San Diego.

Now research has emerged that could help illuminate Salk's observation that aspects of the physical environment can influence creativity. In 2007 Joan Meyers-Levy, a professor of marketing at the University of Minnesota, reported that the height of a room's ceiling affects how people think. She randomly assigned 100 people to a room with either an eight- or 10-foot ceiling and asked participants to group sports from a 10-item list into categories of their own choice. The people who completed the task in the room with taller ceilings came up with more abstract categories, such as "challenging" sports or sports they would like to play, than did those in rooms with shorter ceilings, who offered more concrete groupings, such as the number of participants on a team. "Ceiling height affects the way you process information," Meyers-Levy says. "You're focusing on the specific details in the lower-ceiling condition."

Because her earlier work had indicated that elevated ceilings make people feel physically less constrained, the investigator posits that higher ceilings encourage people to think more freely, which may lead them to make more abstract connections. The sense of confinement prompted by low ceilings, on the other hand, may inspire a more detailed, statistical outlook—which might be preferable under some circumstances. "It very much depends on what kind of task you're doing," Meyers-Levy explains. "If you're in the operating room, maybe a low ceiling is better. You want the surgeon getting the details right." Similarly, paying bills might be most efficiently accomplished in a room with low ceilings, whereas producing great works of art might be more likely in a studio with loftier ones. How high the ceiling actually is, Meyers-Levy points out, is less important than how high it feels. "We think you can get these effects just by manipulating the perception of space," she says, by using light-colored paint, for instance, or mirrors to make the room look more spacious.

Natural Focus

In addition to ceiling height, the view afforded by a building may influence intellect—in particular, an occupant's ability to concentrate. Although gazing out a window suggests distraction, it turns out that views of natural settings, such as a garden, field or forest, actually improve focus. A study published in 2000 by environmental psychologist Nancy Wells, now at Cornell University, and her colleagues followed seven- to 12-year-old children before and after a family move. Wells and her team evaluated the panoramas from windows in each old and new home. They found that kids who experienced the greatest increase in greenness as a result of the move also made the most gains on a standard test of attention. (The scientists controlled for differences in housing quality, which turned out not to be associated with attention.) Another experiment demonstrated that college students with views of nature from their dorm rooms scored higher on measures of mental focus than did those who overlooked entirely man-made structures.

Green play space may be especially beneficial for students with attention disorders. Landscape architect and researcher William Sullivan of the University of Illinois and his colleagues studied 96 children with attention deficit disorder (ADD). The scientists asked parents to describe their children's ability to concentrate—say, on homework or spoken directions—after the kids engaged in activities such as fishing, soccer and playing video games in which they were exposed to varying amounts of greenery. "The parents reported that their children's ADD symptoms were least severe after they'd been in or observing green spaces," says Sullivan, whose results were published in 2001.

Such findings may be the result of a restorative effect on the mind of gazing on natural scenes, according to an idea developed by psychologists Stephen Kaplan and Rachel Kaplan, both at the University of Michigan at Ann Arbor. By this theory, the tasks of the modern world can engender mental fatigue, whereas looking out at a natural setting is relatively effortless and can give the mind a much needed rest. "A number of studies have shown that when people look at nature views, whether they're real or projected on a screen, their ability to focus improves," Stephen Kaplan says.

Nature views may be more rejuvenating than urban scenes are, Sullivan adds, because humans have an innate tendency to respond positively toward nature—an explanation dubbed the biophilia hypothesis. "We evolved in an environment that predisposes us to function most effectively in green spaces," he says. In a December 2008 paper in *Psychological Science*, Stephen Kaplan also proposes that urban settings are too stimulating and that attending to them—with their traffic and crowds—requires more cognitive work than gazing at a grove of trees does.

Using nature to boost attention ought to pay off academically, and it seems to, according to a study that will be published in spring 2009 and that was led by C. Kenneth Tanner, head of the School Design & Planning Laboratory at the University of Georgia. In their analysis of more than 10,000 fifth-grade students in 71 Georgia elementary schools,

Tanner and his colleagues found that students in classrooms with unrestricted views of at least 50 feet outside the window, including gardens, mountains and other natural elements, had higher scores on tests of vocabulary, language arts and math than did students without such expansive vistas or whose classrooms primarily overlooked roads, parking lots and other urban fixtures.

Seeing the Light

In addition to greenery, the natural world has something else to offer building occupants: light. Daylight synchronizes our sleep-wake cycle, or circadian rhythm, enabling us to stay alert during the day and to sleep at night. Nevertheless, many institutional buildings are not designed to let in as much natural light as our mind and body need.

A lack of light can be a particular problem for schoolchildren. “You take a child who probably didn’t get enough rest, dump them off in front of a school where there’s very little natural light, and guess what? They have jet lag,” Tanner says. A 1992 study followed Swedish schoolchildren in four different classrooms for a year. The research showed that the kids in classrooms with the least daylight had disrupted levels of cortisol, a hormone that is regulated by the body’s circadian rhythms.

Adequate sunlight has also been shown to improve student outcomes. In 1999 the Heschong Mahone Group, a consulting group based in California that specializes in building energy-efficient structures, collected scores on standardized tests of math and reading for more than 21,000 elementary school students in three school districts in three states: California, Washington and Colorado. Using photographs, architectural plans and in-person visits, the researchers rated the amount of daylight available in each of more than 2,000 classrooms on a scale of 0 to 5. In one school district—Capistrano, Calif.—students in the sunniest classrooms advanced 26 percent faster in reading and 20 percent faster in math in one year than did those with the least daylight in their classrooms. In the other two districts, ample light boosted scores between 7 and 18 percent.

Retirement homes can also be too dark to keep circadian clocks ticking away normally. In a study published in 2008 neuroscientist Rixt F. Riemersma-van der Lek of the Netherlands Institute for Neuroscience and her colleagues randomly selected six of 12 assisted-living facilities in Holland to have supplemental lighting installed, bringing the luminosity to approximately 1,000 lux; the other six provided dimmer lighting of around 300 lux. On tests taken at six-month intervals over three and a half years, the residents of the more brightly lit buildings showed 5 percent less cognitive decline than occupants of the six darker buildings did. (The additional lighting also reduced symptoms of depression by 19 percent.) Other studies show that circadian rhythms keep the brain functioning optimally by calibrating hormone levels and metabolic rate, for example. Elderly people—especially those with dementia—often have circadian disruptions. Providing bright daytime light, the researchers believe, could have helped restore their proper rhythms and thus have improved overall brain function.

The wavelength of light is also crucial. Our circadian systems are primarily regulated by short-wavelength blue light; the photoreceptors that feed back to the suprachiasmatic nucleus, a part of the hypothalamus that regulates our daily rhythms, relay the most nerve impulses to the brain when they detect blue light. This short-wavelength light—present in sunlight—lets the brain and body know it is daytime. (In contrast, our rods and cones, which are responsible for vision, fire maximally when exposed to green or yellow-green light.)

Researchers recommend using blue light-emitting diodes (LEDs) and full-spectrum fluorescent lights in buildings during the day; both have enough blue light to trigger the circadian system and keep occupants awake and alert. After dark, buildings could switch to lamps and fixtures with longer-wavelength bulbs, which are less likely to emit light detected by the circadian system and interfere with sleep at night. “If you can give people a lighting scheme where they can differentiate between day and night, that would be an important architectural decision,” says Mariana Figueiro, program director of the Lighting Research Center at Rensselaer Polytechnic Institute.

A Room to Relax

Although bright light might boost cognition, recent work suggests it counteracts relaxation and openness—effects that might be more important than alertness in some settings. In a 2006 study counselors interviewed 80 university students individually in either a dim or a brightly lit counseling room. The students then completed a questionnaire about their reactions to the interview. The students questioned in the dim room felt more relaxed, viewed the counselor more positively and shared more information about themselves than those counseled in the brighter room did. The findings suggest that dim light helps people to loosen up. If that is true generally, keeping the light low during dinner or

at parties could foster relaxation and intimacy.

A room's contents can be similarly soothing—or the opposite. Neuroscientist Moshe Bar of Harvard Medical School and Maital Neta, then his research assistant, showed subjects photographs of various versions of neutral objects, such as sofas and watches. The examples of each item were identical except that some had curved or rounded edges, whereas others had sharp, squared-off perimeters. When asked to make snap judgments about these objects, subjects significantly preferred those with curves. Bar speculates that this preference exists because we associate sharp angles with danger. (The brain may sense a greater hazard, for instance, from a cave in which jagged rocks protrude from the walls than from one in which rounded rocks do the same.) "Maybe sharp contours are coded in our brains as potential threats," he says.

Bar provided some support for this theory in a 2007 study in which subjects again viewed a series of neutral objects—this time while their brains were scanned using functional magnetic resonance imaging. The neuroscientist found that the amygdala, which is involved in fear processing and emotional arousal, was more active when people were looking at objects with sharp angles. "The underpinnings are really deep in our brain," Bar explains. "Very basic visual properties convey to us some higher-level information such as 'Red alert!' or 'Relax, it's all smooth; there's no threat in the area.' " He acknowledges that an object's contour is not the only element that informs our aesthetic preferences, and his research is still in its early stages. But all other things being equal, filling a living room or waiting room with furniture that has rounded or curved edges could help visitors unwind.

Furniture choices can also influence human interaction. Some of the earliest environmental psychology research focused on seating plans in residential health care facilities; scientists discovered that the common practice of placing chairs along the walls of resident day rooms or lounges actually prevented socializing. A better plan to encourage interaction, researchers found, is organizing furniture in small groupings throughout the room. A 1999 study by psychologists at the Otto-von-Guericke University of Magdeburg in Germany and Uppsala University in Sweden examined seating in a different setting. Over eight weeks and more than 50 lessons, the researchers rotated a class of fourth-grade students between two seating arrangements: rows of desks and a semicircle of desks around the teacher. The semicircle configuration increased student participation, boosting the number of questions pupils asked. Other studies suggest that putting desks in rows encourages students to work independently and improves classroom behavior.

Carpeting can also grease the social wheels. In hospitals, carpet increases the amount of time patients' friends and families spend visiting, according to a 2000 study led by health care design expert Debra Harris, now president and CEO of RAD Consultants in Austin. Such social support may ultimately speed healing. Of course, carpeting is much harder to clean than traditional hospital flooring—and may present a health hazard in some settings—so it may not be appropriate for places such as an emergency room, where there is high patient turnover and plenty of mess. But rooms, buildings or wards that are home to long-term patients, such as assisted-living facilities, may benefit from carpets.

So far scientists have focused mainly on public buildings, such as hospitals, schools and stores. Thus, a homeowner interested in boosting his or her mind through design must do some extrapolating. "We have a very limited number of studies, so we're almost looking at the problem through a straw," Clemson's Allison says. "Now we need to find more general patterns. How do you take answers to very specific questions and make broad, generalized use of them? That's what we're all struggling with."

The struggle should pay off, experts believe, because when designers fabricate buildings with the mind in mind, the occupants benefit. Well-designed special care units for Alzheimer's patients reduced anxiety, aggression, social withdrawal, depression and psychosis, according to a 2003 study by Zeisel and his colleagues. And school design can account for between 10 and 15 percent of variation in elementary school students' scores on a standardized test of reading and math skills, suggests a 2001 report by investigators at the University of Georgia.

"Because of advances in neuroscience, we can begin measuring the effects of the environment at a finer level of detail than we have before," U.C.S.D.'s Edelstein says. "We can understand the environment better, we can understand our responses better, and we can correlate them to the outcomes. I just get chills when I think about it."

Note: This article was originally printed with the title, "Building Around the Mind".

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