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# A Dose of Daylight

## Capturing the human response to natural light in workplace and healthcare settings

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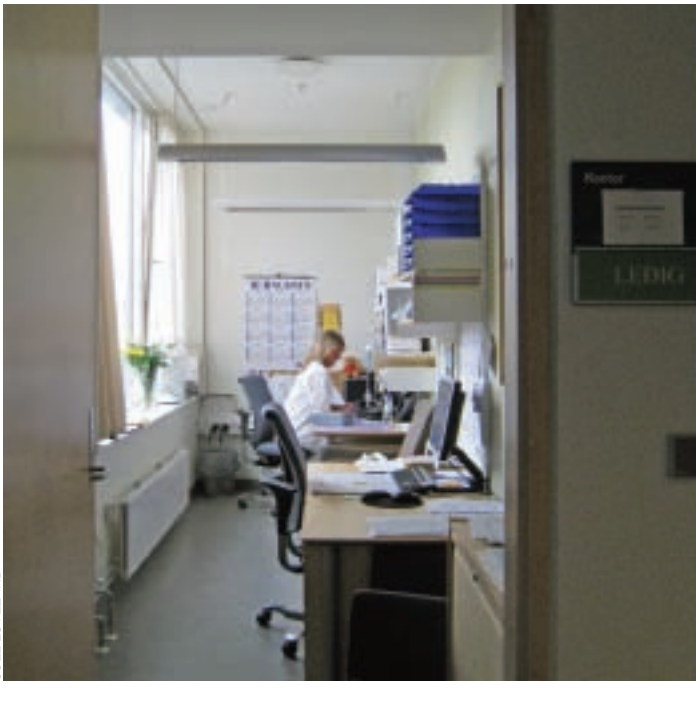

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In Puget Sound, as in all regions above 45° latitude, swings of daylight are extreme from season to season. Almost everyone visiting Alaska or Scandinavia around the summer solstice has felt the odd, almost timeless quality of days that never really end: sunsets after 10 p.m., the everlasting twilight, sunrise between two and three o'clock in the morning. One experiences the near-manic high of working or playing twenty-plus hours a day, sleeping two to four hours a night, for weeks on end! (photo above)

Lacking significant sources to illuminate the night, we humans evolved over millions of years to be active during daylight hours and asleep through the darkness of night. Daylight and its reciprocal, the dark, rule our cycles of being awake and asleep; we now know it also rules many of our physiological systems. We have been aware of this tether to light and dark, for the most part, only intuitively: a science of light (or, from an architect's point of view, of windows) as a dose/response metric for wellness and productivity in human systems has been slow to develop. But ask a developer of office buildings what area of a building's floor plate accounts for the most valuable real estate, or ask a manager of a large office to point out the most coveted

office spaces: the most common answer will be "close to the largest windows." The conscious justification for valuing a window highly is that, usually, it gives access to a view. The unconscious, physical response of our bodies to a window reveals that, like moths, we are attracted to light.

An exploration of the human response to doses of light leads, like any good scientific endeavor, to a conceptual framework of light's effects on our health, productivity, and sense of well-being. This work is provocative, but still in its infancy at the close of the first decade of the 21st century.

**Vision and the visible effects of light**

We are "ocular-centric" beings: as much as 80% of our perceptions come to us through our sight. To have the most productive and healthy environment, we vision-dependent creatures must have the right quantity and best quality of light.

An electric light fixture mounted on the ceiling or wall of a room can provide the equivalent of light received from a window twenty feet away. If lighting is considered only as the minimum amount of light required to accomplish a particular activity, then electric light and daylight might compare reasonably well. But considered more broadly, access to daylight provides other dimensions, visual and non-visual, that electric light does not: the ability to gaze upon a view for relief from chronic stress, for instance, or the environmental information gained from the light-source such as a sense of the hour, season, or weather. These dimensions—the spectral color of the light, how the light source varies over time and across a space, its appropriateness to a particular task—are critical in assessing lighting performance.

When designing a lighting system that uses daylight as the primary source of illumination, the designer should consider the following:

• Design windows and surrounding spaces as interior light sources—as if they were a "daylight fixture"—and as portals to the exterior environment. In this way, the interior and exterior space fuse, and the exterior space becomes a curative landscape (photo below left).

• in all spaces where people remain for long periods of time, enhance seeing and provide views, preferably of nature (photo below right).

• Program activities across the floor plate, keeping in mind the natural variation of daylight and the luminance of view corridors during different times of the day and year.

**Non-visual effects of light**

In 2002, a non-visual, light-receiving cell was discovered in the human eye (Berson 2002). This receptor, essential for regulating bodily rhythms and systems, is modulated primarily by cycles of light and dark. This non-optical receptor is connected through its own nerve pathway to the brain, which then communicates to other non-visual parts of the nervous system. This process acts as a clock, oscillating on daily, circadian, and seasonal rhythms. Thus, our eye mediates two parallel responses to light: one for vision and one for physiological regulation.

In a natural setting where we have access to natural light, the body synchronizes its internal clock to the changing quality of the daylight. Many physiological responses are activated and regulated by bright, "blue-shifted" light—daylight's characteristic color—which enters the eye and triggers this non-visual system. To list a few, body temperature and the hormones cortisol, serotonin, and melatonin are regulated through this process—hormones that play important roles in governing alertness, sleep, regulating blood sugar, and maintaining the immune system.

When the cycle of light/wakefulness followed by darkness/sleep is disrupted, our physiological processes can be thrown off balance. Darkened days—or its opposite, brightly-illuminated nights

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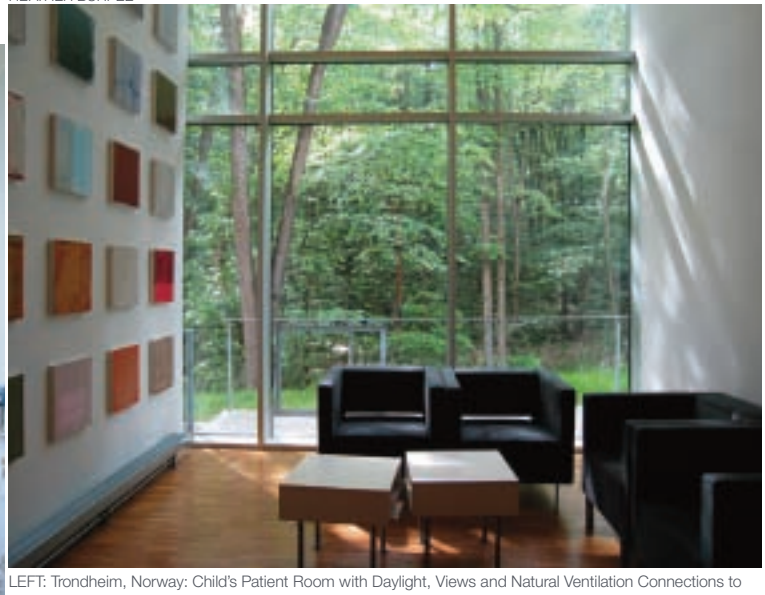

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LEFT: Trondheim, Norway: Child's Patient Room with Daylight, Views and Natural Ventilation Connections to the Outdoors, St. Olav's Children's Hospital ABOVE: Oslo, Norway: Waiting Room with View at Radium Hospital OPPOSITE PAGE TOP: Trondheim, Norway: Midnight, June 16, 2009 OPPOSITE PAGE BOTTOM: Trondheim, Norway: Nursing Station Work Room, St. Olav's Children's Hospital

over a long period—stress and exhaust the body, making it vulnerable to a variety of illnesses. In environments where we have less access to daylight—as is often the case in healthcare and office environments—biological systems can be disrupted significantly, as was found in a recent study of nurses that discovered a correlation between nightshift work and increased risk for cancer (Dimich-Ward, 2007). This suggests that exposure to light at times of day we humans are not used to can have a significant effect on our health and is potentially toxic over a long period of time.

Scientists have also discovered that the circadian system is stimulated by a different palette of light than is the visual system. Visual sensitivity is greatest in the yellow-green region of the light spectrum, whereas the non-visual system is stimulated more by light tending toward blue. Human beings evolved in daylight that shifted its color throughout the course of the day—from very blue in the morning, to less blue at noon, to reddened at sunset—and our normal physiological responses are synchronized to those colors, timings, and intensities. For optimal health, humans should perceive short-wavelength blue light during the morning and longer-wavelength, warmer light from midday through afternoon. Research has shown that (as an example of daylight's healing powers) patients in rooms facing east and exposed to morning light heal faster and have lower incidences of depression (Joseph, 2006).

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ABOVE: Florence, Italy: Deeply Plan-Imbedded Nurses' Station with Courtyard Providing Daylight, Views and Natural Ventilation Connections to the Outdoors, Meyer Childrens Hospital

The discovery of a non-visual, light-responsive receptor that regulates physiological processes prompts us to take into account the effects of lighting in the built environment, especially in healthcare settings. In hospitals, as in many work environments, employees may have little-to-no access to daylight during their workday. Workers in around-the-clock shifts can become out of sync with normal patterns of light/wakefulness, and dark/sleep—a danger in the hospital setting with its need for error-free work and its chronically stressful environment. For nightshift workers, exposure to light at night is a important issue; their tasks must be performed with enough light for critical task efficiency, yet if these lights are too bright and blue, this may disturb their circadian cycle.

**Let the natural light in**

We humans evolved under a cycle of daylight and darkness. Today we can assess the places we live in and build by whether those buildings, through their fenestration, give us access to the rhythms of the day and season. In the healthcare environment, the most beneficial environment for patients and workers would include as much daylight as possible during the day, reduced levels of electrical light during the evening, and fully dark sleeping rooms at night.

If work consistently places a person further than 25 feet from a windowed wall, she will probably not have a view of the outdoors, which can help relieve the chronic stress of the workplace. A lack of daylight in the morning may disrupt those hormonal cycles that allow workers and patients to sleep well at night. But with natural light, the healing process is aided, work quality improves, and the health and well-being of patients and workers is enhanced.

Our lives in these northern latitudes are carefully regulated by what we rarely notice: the light of day and its cohort, the darkness of night. The very best architecture—architecture that nurtures our health and supports our productive spirit—connects us to these natural rhythms of light and dark. An architecture built upon these windows of daylight and darkness embraces life in a manner that the extended and limitless days of electrically-illuminated space cannot. ■

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