

The Sky Factory, LC

A White Paper

Scientific Research and Sky Image Ceilings

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Executive summary

The Sky Factory designs, manufactures and sells sky image ceilings (SkyCeilings™) which it believes create functional illusions of real sky. Observations, testimonials, pilot studies, and related research indicate that these sky image ceilings have the ability to produce a physiological relaxation response in observers, to change subjective experiences of space in interior environments and to produce certain beneficial effects. The Sky Factory wishes to engage in cooperative scientific research to better understand possible mechanisms of action and benefits.

Hypothesis

Sky Factory sky image ceilings have an influence on people who view and spend time in environments where they are installed. We believe that they trigger the same psycho-physiological relaxation response as an experience of real sky. We also believe that they modify peoples' subjective experience of vertical space. Consequently, we believe that they contribute beneficial effects in healthcare, workplace, hospitality and residential environments. It is our belief that Sky Factory sky image ceilings achieve these beneficial results by producing an illusion of sky so realistic that people experience and automatically respond as if they were being exposed to actual sky.

Background

Pictures vs. Illusion

Pictures are experienced as what they are, visual representations of something else. Illusions are perceived as something *other* than what they are.

A simple way of understanding how we *know* things is:

- We experience a thing or event through one, or more, of our senses.
- Our mind deals with this raw information via the processes of cognition
- Cognition results in a perception – thoughts and/or feelings that identify the experience and our response to it.

Cognition is a complex and incompletely understood process that includes mental activity shaped by millions of years of human evolution, along with the influences of our conditioning, knowledge and memories acquired since birth. Cognition functions to create a *true* and useful picture of reality.

Pictures (pretty or beautiful) may be pleasing, attractive or interesting to an observer. Such images are photographic or painterly and are representative or abstract. Those that are representative provide sufficient information so that they recognizably correspond to previously experienced sensory inputs.

Illusions have an added dimension, they too provide information which references prior experience, however, they result in misperceptions or *mistakes* in the perception of the observer. They may be experienced as *something else* or as *real* but are typically surprising or misleading. Illusions are generally considered to be remarkable events, but are so only in relationship to what is accepted as *normal*, or unremarkable.¹

¹ According to Prof. Michael Bach, "Optical phenomena bring to light particular good adaptations of our visual system to standard viewing situations. These adaptations are 'hard-wired' in our brains, and thus under some artificial manipulations can cause inappropriate interpretations of the visual scene. As Purkinje put it: 'Illusions of the senses tell us the truth about perception.'" Excerpted from: <http://www.michaelbach.de/ot/>

Deliberate illusions are generally intended to trick the eye and/or confuse the process of cognition. Cognition, an important aspect of the process of knowing, is based on the activity of a complex arrangement of habits which are established and maintained by previous experience and are expressions of the mind's fundamental neural pathways. Basically, habits of perception function as efficient generalized solutions to the interpretation and perception of the large amount of data provided by the senses. However, efficiency gained through generalization may be accomplished at the expense of accuracy – hence the misperceptions of illusion.

There are many sorts of illusions. Magical illusions quickly come to mind, for example, a magician saws through the lady in the box. In spite of an intellect that *knows better* the eye and the mind of the observer are convinced, the pulse rises and younger or less sophisticated observers may even experience temporary emotional distress – followed by relief and wonder when she emerges intact. Magicians or illusionists understand our habits of perception and how to manipulate those habits and do so to produce a desired perception or experience that does not correspond to the actual or 'true' reality.

Looking at a photograph of the magician sawing the lady in half has little impact on our physiology, psychology or emotions. However, being led through the illusion by a master magician is a different matter. This is because a true illusion fully engages the interconnected functions of physiology, psychology and emotion in the same way that an actual or authentic event would.

Sky Factory sky image ceilings are crafted to create as convincing an illusion of sky as possible. Over 20 design parameters are carefully monitored to insure sensory support for what is actually an erroneous perception of real sky.²

That these illusions are effective is now well documented by dozens of testimonials and anecdotes and by the direct observation of thousands of prone and seated observers of SkyCeilings.³ The observations of physiological and psychological change in prone observers of SkyCeilings are of interest with reference to healthcare. Prone observers commonly report, or are observed to experience, spontaneous slowing of breath rate, relaxation of musculature including spontaneous smiling, marked psychological relaxation, reduction in

² Some of the more obvious of these parameters are discussed in Bill Witherspoon's paper, Awareness Engagement Technology: Healing with Nature, presented at the AIA Academy on Healthcare Design October 28, 2004, Omni Shoreham Hotel, Washington, D.C.

³ In addition to the normal feedback received from clients by an alert and questioning marketer, The Sky Factory operates a mobile showroom (SkyMobile) which includes a healthcare recliner situated beneath an 8'x6' elliptical SkyCeiling. Thousands of architects, designers and healthcare professionals have observed SkyCeilings from this vantage point and have reported their experience – both spontaneously and in response to questions. Virtually everyone experiences the sky as having a three-dimensional quality and roughly one third of observers' report that the clouds appear to be moving. These misperceptions serve to indicate that the mind is engaged in an illusion.

anxiety levels, increased sense of well being and refreshed alertness (physiological correlates of the *relaxation response*, discussed later).

Further, based on conversations with clients, staff operating MRI and other diagnostic radiological procedures routinely are able to schedule more patients per day after installation of SkyCeilings and attribute this to reduced body movement in more relaxed and less anxious patients. Prone observers commonly compare their experience to those of their childhood, lying under a tree and looking up into a beautiful sky. Some liken the experience to that of their personal meditation practice.

Prone or *captive* observers of sky image ceilings experience these illusions largely through their frontal (central) vision and, considering their vision is directed only toward the ceiling; have little choice about where their visual attention is directed. In such cases, (assuming optimal size and placement) the sky image ceiling typically occupies the observer's entire field of frontal vision (and some portion of the peripheral vision as well) and the patterns of clouds and vegetation become *visual elements*, the exploration of which is the subject of the observer's attention.

In other environments (typically non-healthcare), where the observer may be seated or standing beneath a sky image ceiling, their attention, and consequently their frontal vision, is typically directed elsewhere, toward some other activity. In such a case the sky image ceiling is experienced primarily through peripheral vision.⁴ However, because peripheral vision serves as our security or safety system, it appears that the constant stimulation of *sky* overhead, communicates important information about the condition of our physical environment that in turn triggers further erroneous or misperceptions.

Observers in a highly confined, windowless conference room space that includes a SkyCeiling typically respond to the illusion with surprise and even shock that instead of the space eliciting discomfort and claustrophobia, their experience is

⁴ Peripheral vision is good at detecting motion (a feature of rod cells), and is relatively strong at night or in the dark, when the lack of color cues and lighting makes cone cells far less useful.

The distinctions between central (frontal) and peripheral vision are reflected in subtle physiological and anatomical differences in the visual cortex. Different visual areas contribute to the processing of visual information coming from different parts of the visual field, and a complex of visual areas located along the banks of the interhemispheric fissure (a deep groove that separates the two brain hemispheres) has been linked to peripheral vision. It has been suggested that these areas are important for fast reactions to visual stimuli in the periphery, and monitoring body position relative to gravity

Excerpted from Wikipedia article on Peripheral Vision,
http://en.wikipedia.org/wiki/Peripheral_vision

characteristic of the ease and comfort of an outdoor space.⁵ These *peripheral only* subjective reports are so consistent (nearly all observers) and strongly stated (includes confirmed claustrophobics) that they suggest the investigation of different routes of cognition stemming from the different frontal and peripheral visual inputs to the cognitive process may provide access to an important avenue for better understanding of the mechanisms involved in the psycho-physiological impact of such illusions and the associated brain functions.

Light and the Illusion of Sky

Arguably, light is one of the two dominant experiences of sky, the other being the more abstract experience of space. Sky-light (i.e. light coming from the sky) has two essential components – the light itself which is a combination of wavelength and intensity and the ‘information’ carried by that light, namely color which corresponds to time of day, atmospheric conditions associated with weather or man made influences such as pollution, and image (principally, cloud patterns).

Day light deprivation results, for some, in the seasonal affective disorder syndrome (SAD). While not yet conclusive, research indicates that SAD can be treated with artificial light⁶ – where color temperature (Kelvin), intensity and treatment time (as related to circadian rhythms) are relevant factors. From this research, and direct experience using light of different color temperatures and color rendering indices (CRI), it appears that illusions of sky can best be created using artificial light in the 6500K range. This, we suggest is due to the mind’s inability to clearly distinguish between 6500K high CRI artificial light and true mid-day light from the sky.

⁵ The SkyMobile also contains a 7.5 ft. x 12 ft x 9 ft. high conference space and conference-table above which is a 4 ft. x 6 ft. SkyCeiling installed so as to uniformly stimulate the peripheral vision of those seated at the table.

⁶ Ulrich and Zimring, et al, present the case that “several studies strongly support that bright light—both natural and artificial—can improve health outcomes such as depression, agitation, sleep, circadian rest-activity rhythms, as well as length of stay in demented patients and persons with seasonal affective disorders (SAD). At least eleven strong studies suggest that bright light is effective in reducing depression among patients with bipolar disorder or SAD.” They also enumerate studies that show that: exposure to morning light is more effective than exposure to evening light in reducing depression; that exposure to bright morning light has been shown to reduce agitation among elderly patients with dementia; that exposure to bright light improves sleep and circadian rhythms; that patients in brightly lit rooms have a shorter length of stay compared to patients in dull rooms; that patients exposed to an increased intensity of sunlight experienced less perceived stress, less pain, took less analgesic medication and had less pain medication costs.

The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity – Roger Ulrich*, Xiaobo Quan, Center for Health Systems and Design, College of Architecture, Texas A&M University; Craig Zimring*, Anjali Joseph, Ruchi Choudhary, College of Architecture, Georgia Institute of Technology, published by The Center for Health Design, September 2004, Funded by the Robert Wood Johnson Foundation.
http://www.healthdesign.org/research/reports/pdfs/role_physical_env.pdf

Of further interest is recent research that has demonstrated inner retinal photoreceptors sensors in the eye other than rods and cones which appear to have peak sensitivity in blue wavelengths. These melanopsin photoreceptors are linked to a wide range of non visual light-mitigated responses such as circadian cycles, hormone secretion and regulation of rest and activity cycles. As a matter of *aesthetic policy* all Sky Factory images include a significant percentage of blue sky with elements such as trees and clouds composed so as to direct attention to these blue fields⁷.

Nature as the Subject of Illusion⁸

In predicting or eliciting a desired response, content is important. Human beings respond differently to different content. In a healthcare context, nature is an advantageous subject because it's universal accessibility and its ability to generate an influence consistent with the healing process.⁹

⁷ Since 2002, Philips Electronics has been involved in many research projects at the Universities of Jefferson (USA), Surrey (UK), Monash (Australia), Eindhoven and Groningen (NL) to study the effects of lamps with an increased blue light content. These tests and other field trials have driven the introduction of new lighting products that contain an optimized amount of high-wavelength blue light to maximize the effect on the third receptor. The third receptor allows for the so-called non-visual, biological effects of light. All humans need these effects for general well-being and adjustment of their 24 hour rest-activity pattern. The general conclusions of the research supports the hypotheses that the high-wavelength blue light positively effects workers alleviation of fatigue, improved energy, concentration and self-reported work performance and productivity.

http://www.lighting.philips.com/gl_en/activiva_club/sci_research_1_activiva_explained.php?main=special_section_activiva&parent=19487263063&id=&lang=en

⁸ In healthcare, The Sky Factory recommends and generally uses "wild" natural images as opposed to "manicured" or "controlled" images of nature. Images of unmodified nature tend to be more expressive of the mechanics and laws by which nature operates while images that exhibit human intervention (such as gardens) are expressive of precisely that – human intervention. These criteria applied to choice of image are consistent with the underlying philosophy of western medicine as stated by Hippocrates in 400 BC, "Natural forces within us are the true healers of disease." "Only Nature heals if given the opportunity to do so."

⁹ There is a substantial body of research beginning with Roger Ulrich's landmark 1984 study, *View through a window may influence recovery from surgery* (*Science*, 224, 42-421), that supports the use of images of nature as adjuncts to healing protocols, and as important elements in the design of healthcare architecture. The meta-study, *The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity* (cited above), reviews over 600 studies related to improving the physical environment in hospitals and includes reviews of a large body of research that shows that viewing nature or images of nature: has stress-reducing or restorative benefits such as positive emotional and physiological changes; that stressful or negative emotions such as fear or anger diminish while levels of pleasant feelings increase; that viewing nature produces stress recovery quickly evident in physiological changes, for instance, in blood pressure and heart activity; can serve as positive distractions for patients; can help reduce the use of pain medications.

In *Healing Spaces: Elements of Environmental Design That Make an Impact on Health* (THE JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE, Volume 10, Supplement 1, 2004, pp. S-71–S-83 © Mary Ann Liebert, Inc.), authors Schweitzer, Gilpin, and Frampton cite numerous studies that confirm the benefits of views to nature, actual or artificial, as beneficial not

As a natural subject, for the crafting of an architectural illusion the sky has several features to recommend it.

- Sky is the largest and most pervasive experience of nature experienced by humans.
- Evolution beneath a blue sky has left its mark in our physiology / cognition: for example as the impressionists discovered, blue (cool) colors recede in space and red (warm) colors press forward (had we evolved under a red sky it is likely that traffic stop lights would be green). Blue light receptors seem to be critical to the regulation of a wide range of physiological and psychological functions.
- Further, an illusionary sky in a ceiling (unlike a landscape picture on the wall) is consistent with basic laws of nature such as gravity and is not site-specific as is a landscape. (Interestingly, even though wall-oriented, a row of virtual clerestory windows which cannot reference horizon and do not reference unfamiliar vegetation appear to have a significant capacity to generate illusion).
- Finally, whatever other aspects of nature; mountains, deserts or oceans that individuals may be partial toward, it seems that we universally appreciate the sky as an expression of natural beauty and inspiration.

only to healing outcomes of patients, but to the general satisfaction and productivity of office workers. Their meta-study points to the need for, among other recommendations, views to nature as an important aspect of architectural design in the service of creating 'healing spaces.'

The Relaxation Response¹⁰

The relaxation response, the opposite of the fight or flight response, is triggered by a wide range of relaxation and meditative techniques including contemplative experiences of nature. It is characterized by the following physiological correlates:

- Metabolic rate decreases
- Heart beats slower and muscles relax
- Breathing becomes slower
- Blood pressure decreases
- Levels of nitric oxide are increased
- Brain wave patterns change in specific ways

The relaxation response is widely considered to be an antidote for stress and an important element in maintaining stable health as well as creating conditions supportive of the healing process.

Pilot Research on Sky Factory SkyCeilings

1. Pilot study performed at Westminster College, Salt Lake City, Utah in 2005

Management students undertook a pilot study at a local business to determine how strongly the Sky Factory SkyTiles influence employee's overall satisfaction in relation to other important aspects of satisfaction, as well as how they affected employee's perceived productivity and commitment to the organization.

The study concluded that The Sky Factory can and should claim in their marketing campaigns that Sky Factory SkyTiles contribute to employee's perceived productivity and improved the attitude of employee's, as well as increased employee's commitment to the organization.

2. Impact of perspective and geometry in creating illusory sky image ceiling installations: an informal study carried out by The Sky Factory (Bill Witherspoon)

¹⁰ The term *relaxation response* was coined by Herbert Benson, M.D. based on his research with Dr. Robert Keith Wallace on practitioners of transcendental meditation. They found that several physiological indicators of stress were changed by the practice of meditation – proving to be an effective alleviator of the deleterious effects of stress. Benson went on to characterize the universal components of a practice to systematically produce the relaxation response and promote its practice. Dr. Benson is currently Director Emeritus of the Benson-Henry Institute for Mind Body Medicine and the Mind/Body Medical Institute Associate Professor of Medicine, Harvard Medical School. Based on hundreds of studies undertaken over the past four decades by Benson and others, the characteristics and benefits of the relaxation response are well understood and accepted.

Hypothesis: Habits of perception related to viewing the sky are highly refined, responsive to subtle cues and independent of intellectual discrimination. Successful illusion relies on proper stimulation of such perceptual habits.

Background

- A sky image with clouds was photographed with a near-normal lens on a 6 x12 cm transparency. The enlarged displayed portion of the image was a 1:3 aspect ratio segment which corresponded to a 2'x 6' ceiling opening. One end of the displayed image recorded the zenith and the other end of the image recorded information about 40 degrees above the horizon – the entire displayed information spanned about 50 degrees of sky. This photographic view corresponded closely to what would actually be seen if a 2'x 6' hole were cut in an eight-foot ceiling and the observer were prone (about 20" above the floor) with the head positioned directly beneath one end of the ceiling image. The ceiling image was not back-lit but rather was an opaque image lit by ambient light.
- About two feet at each end of the image, recorded a portion of cumulus white cloud, while the middle two feet were of uniform open blue sky. Because of the geometry of the photography, one end of the image showed white cloud as seen from the perspective of looking straight up and therefore displayed only the bottom of the cloud. At the other end of the image, the bottom of the cloud was visible (obliquely) but also the view included the side of the cloud.

Phase 1

- Thirteen observers were placed prone on a chiropractor's adjustment table directly and symmetrically beneath the 2'x 6' ceiling mounted sky image.
- The observers' first viewings were with their feet beneath the zenith – in other words oriented incorrectly.
- All observers were pleased with the image, commented on its novelty, and indicated that it was a 'good idea'.

Phase 2

- In the second phase of the experiment which followed immediately, the image was installed correctly, i.e. with the head of the observer beneath the zenith. The change was not immediately obvious because of the symmetrical masses of white cloud at each end of the ceiling image.
- In all thirteen cases, the experience was reported as being considerably different, with many of the observers puzzled by what had caused the change. Only two people noticed that the image had been rotated 180 degrees.
- All participants expressed their changed experience in terms of a greater perception of space or depth, and increased realism.
- Each observer indicated that something significant had changed in their subjective experience as well. They became quieter, were more absorbed in the experience, looked longer, and described a more prominent subjective inner experience.

- Most related this illusion to the childhood experience of lying on their back and looking up into the sky. In some cases, the experience was likened to the inner experience of peacefulness that occurs in meditation.
- After the second viewing, the prevailing remarks shifted from discussion of the *idea* of a sky image ceiling to that of the *experience* of a sky image ceiling

Suggestions for Future Research

Below are some of the research ideas we and others have proposed. The Sky Factory is happy to consider all relevant research possibilities.

Basic physiological research

1. Do sky image ceilings elicit a physiological response identical or similar to those that characterize the relaxation response?
2. fMRI studies to determine areas of brain associated with:
 - a. Experience of illusion vs reality
 - b. Function of frontal (central) vision vs. peripheral vision in cognition and perception

Use of sky image ceilings in healthcare environments (Outcome-related)

1. Modification of self-administered pain medication
2. Modification of hospital stay duration
3. Modification of anxiety levels prior to administration of anesthesia
4. Modification of surgical outcomes and healing times
5. Modification of diagnostic and therapeutic radiological suite utilization
 - a. MRI
 - b. Linear Accelerator
 - c. PET/CT
 - d. Other
6. Changes in patient comfort and attitudes (these have been done in the context of patient satisfaction surveys and sky image ceilings figure importantly in patient responses)
7. Changes in staff attitudes, comfort and efficiency
8. Use of programmable sky image ceilings in healthcare. [In programmable systems, light levels can 'rise' and 'set' with the sun (including color changes if desired) and do so according to the sun's seasonal changes. In this way we feel a sky image ceiling may contribute to the maintenance or reestablishment of circadian rhythms.]
 - a. ICU - circadian rhythm reestablishment and maintenance
 - b. Nurse Station – reversal of circadian rhythms to promote night-time alertness
9. Use of sky image ceilings in the workplace
 - a. Productivity
 - b. Absenteeism
 - c. Job satisfaction

- d. Attitudes toward management
- 10. Use of sky image ceilings in retail establishments
 - a. Modification of time spent by customers in areas influenced by sky image ceilings
 - b. Modification of spending patterns

Request for Cooperation

The Sky Factory believes that there are valuable opportunities for research in the area of illusory sky image ceilings. We believe that such research would help to establish the validity of our products but we also believe that such research could reveal understandings that will be valuable to the entire architectural and design community. For example: investigation of illusion, as applied to architecture and interior design, may hold great promise for the future of these disciplines.

Further, there is the distinct possibility that basic physiological and brain studies involving illusory sky image ceilings could add to our understanding of how mind and body function and interact with the environment.

We respectfully request that those who find interesting notions in this paper contact us for further discussion. We also request those who identify flaws in our ideas and/or expressions contact us to aid in increasing the correctness and clarity of our thinking and understandings.

Relevant Research Studies

Excerpts and citations from:

The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity

Roger Ulrich*, Xiaobo Quan, Center for Health Systems and Design, College of Architecture, Texas A&M University, Craig Zimring*, Anjali Joseph, Ruchi Choudhary, College of Architecture, Georgia Institute of Technology

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Craig Zimring, Ph.D.: craig.zimring@arch.gatech.edu.

Report to The Center for Health Design for the Designing the 21st Century Hospital Project. This project is funded by the Robert Wood Johnson Foundation. September 2004

Provide Nature and Positive Distraction

Positive distractions refer to a small set of environmental features or conditions that have been found by research to effectively reduce stress. Distractions can include certain types of music, companion animals such as dogs or cats, laughter or comedy, certain art, and especially nature (Ulrich, 1991). The focus here is on the last, nature. (There is an additional large research literature on music, but this is not covered in this review.)

As background relevant to assessing the credibility of nature findings in healthcare environments, it should be mentioned that many studies of populations other than hospital patients have produced strong evidence that even fairly brief encounters with real or simulated nature settings can elicit significant recovery from stress within three minutes to five minutes at most (Parsons & Hartig, 2000; Ulrich, 1999). Investigators have consistently reported that stress-reducing or restorative benefits of simply viewing nature are manifested as a constellation of positive emotional and physiological changes. Stressful or negative emotions such as fear or anger diminish while levels of pleasant feelings increase. Laboratory and clinical studies have shown that viewing nature produces stress recovery quickly evident in physiological changes, for instance, in blood pressure and heart activity (Ulrich, 1991). By comparison, considerable research has demonstrated that looking at built scenes lacking nature (rooms, buildings, and parking lots) is significantly less effective in fostering restoration and may worsen stress.

Questionnaire studies have found that bedridden patients assign especially high preference to having a hospital window view of nature (Verderber, 1986). Mounting research is providing convincing evidence that visual exposure to nature improves outcomes such as stress and pain. For example, a study in a Swedish hospital found that heart-surgery patients in ICUs who were assigned a picture with a landscape scene with trees and water reported less anxiety/stress

and needed fewer strong doses of pain drugs than a control group assigned no pictures (Ulrich, 1991). Another group of patients assigned an abstract picture, however, had worsened outcomes compared to the control group. Ulrich (1984) found that patients recovering from abdominal surgery recovered faster, had better emotional well-being, and required fewer strong pain medications if they had bedside windows with a nature view (looking out onto trees) than if their windows looked out onto a brick wall.

Recently, strong studies using experimental designs have produced additional convincing evidence that viewing nature reduces patient pain as well as stress. These investigations also support the interpretation that nature serves as a positive distraction (Ulrich, 1991) that reduces stress and diverts patients from focusing on their pain or distress. A randomized prospective investigation found that adult patients undergoing a painful bronchoscopy procedure reported less pain if they were assigned to look at a ceiling mounted nature scene rather than a control condition consisting of a blank ceiling (Diette, Lechtzin, Haponik, Devrotes, & Rubin, 2003). Another controlled experiment that used volunteers in a hospital assessed the effect on pain of viewing a soundless nature videotape in contrast to a static blank screen (Tse, Ng, Chung, & Wong, 2002). Subjects who watched the nature scenes evidenced a higher threshold for detecting pain and had substantially greater pain tolerance. Two studies of female cancer patients have shown that taking a virtual reality nature walk while in bed or a hospital room (through a forest with bird sounds) reduced anxiety and symptomatic distress (Schneider, S. M., Prince-Paul, Allen, Silverman, & Talaba, 2004).

Research on patients suffering intense pain because of severe burns found that exposing patients to a videotape of scenic nature (forest, flowers, ocean, waterfalls) during burn dressing changes significantly reduced both anxiety and pain intensity (Miller, Hickman, & Lemasters, 1992).

The possibility that nature can improve outcomes even in patients with late-stage dementia, including Alzheimer's disease, has received some support from a quasi experimental study that found reduced levels of agitated aggressive behavior associated with a shower bath when recorded nature sounds (birds, babbling brook) and color pictures were present (Whall et al., 1997). A well-controlled study of blood donors in a waiting room found that blood pressure and pulse were lower on days when a wall mounted television displayed a nature videotape, compared to days with continuous daytime television programs (Ulrich, Simons, & Miles, 2003). More research is needed to identify conditions under which television can either be a stress-reducing positive distraction or a stressor in hospitals.

Art in healthcare environments: A small number of studies on art in hospitals have yielded findings parallel to those from nature research. Results suggest a consistent pattern wherein the great majority of patients respond positively to representational nature art, but many react negatively to chaotic abstract art (Ulrich & Gilpin, 2003). For example, Carpman & Grant (1993) studied the preferences of 300 randomly selected inpatients and concluded that the patients consistently preferred nature images but disliked abstract art. Although nature

pictures and other emotionally appropriate art elicit positive reactions, there is also evidence that inappropriate art styles or image subject matter can increase stress and worsen other outcomes (Ulrich, 1991). It should not be expected that all art is suitable for high-stress healthcare spaces, as art varies enormously in subject matter and style, and much art is emotionally challenging or provocative. The pitfalls of displaying emotionally challenging art in healthcare environments are revealed by a study of psychiatric patients (Ulrich, 1991). The unit was extensively furnished with a diverse collection of wall-mounted paintings and prints. Interviews with patients indicated strongly negative reactions to artworks that were ambiguous, surreal, or could be interpreted in multiple ways. The same patients, however, reported having positive feelings and associations with respect to nature paintings and prints.

Diette, G. B., Lechtzin, N., Haponik, E., Devrotes, A., & Rubin, H. R. (2003). Distraction therapy with nature sights and sounds reduces pain during flexible bronchoscopy: A complementary approach to routine analgesia. *Chest*, 123(3), 941-948.

Leather, P., Pyrgas, M., Beale, D., & Lawrence, C. (1998). Windows in the workplace: Sunlight, view, and occupational stress. *Environment & Behavior*, 30(6), 739-762.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224(4647), 420-421.

Ulrich, R. S. (1991). Effects of interior design on wellness: Theory and recent scientific research. *Journal of Health Care Interior Design*, 3(1), 97-109.

Ulrich, R. S. (1999). Effects of gardens on health outcomes: Theory and research. In C. Cooper Marcus & M. Barnes (Eds.), *Healing Gardens* (pp. 27-86). New York: Wiley.

Ulrich, R. S., & Gilpin, L. (2003). Healing arts: Nutrition for the soul. In S. B. Frampton, L. Gilpin & P. Charmel (Eds.), *Putting patients first: Designing and practicing patient-centered care* (pp. 117-146). San Francisco: Jossey-Bass.

Ulrich, R. S., Lawson, B., & Martinez, M. (2003). *Exploring the patient environment: An NHS estates workshop*. London: The Stationery Office.

Ulrich, R. S., Lunden, O., & Eltinge, J. L. (1993). Effects of exposure to nature and abstract pictures on patients recovering from heart surgery. Paper presented at the thirty-third meeting of the Society for Psychophysiological Research, Rottach-Egern, Germany. Abstract in *Psychophysiology*, 30(Suppl. 1), 7.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, 11(2): 201-230.

Ulrich, R. S., Simons, R. F., & Miles, M. A. (2003). Effects of environmental simulations and television on blood donor stress. *Journal of Architectural & Planning Research*, 20(1), 38-47.

Excerpts and citations from:

Healing Spaces: Elements of Environmental Design That Make an Impact on Health, MARC SCHWEITZER, M.Arch.,¹ LAURA GILPIN, M.F.A., R.N.,² and SUSAN FRAMPTON, Ph.D.³, THE JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE

Volume 10, Supplement 1, 2004, pp. S-71–S-83 © Mary Ann Liebert, Inc.

Viewing nature

Ulrich's "Theory of Supportive Healthcare Design" includes a design guideline to "Provide Access to Nature and other Positive Distractions."⁷⁴ A working definition of "positive distractions" is "environmental-social conditions marked by a capacity to improve mood and effectively promote restoration from stress."⁷⁵⁻⁷⁷ Ulrich pays particular attention to views of nature in his research, but identifies comedy or laughter, caring or smiling human faces, music, and companion animals as others.^{19,76}

Both workers and patients rate having a window as very desirable, preferably with a view of a natural setting.⁷⁶ Furthermore, studies of students and office workers on behalf of the California Energy Commission's Public Interest Energy Research program find that for both groups an "ample and pleasant view" improved performance.^{60,78} Employees with a window view of nature report less stress, better health status, and higher job satisfaction.⁷⁹ Studies on hospital inpatients have concentrated on critical or intensive care units. Such studies have linked the lack of windows with high rates of anxiety, depression and delirium.^{80,81} A view of nature has been correlated with shorter postoperative hospital stays, higher satisfaction with nursing care, and decreased use of potent analgesics in cholecystectomy patients compared to patients with obstructed views.⁸²

Ulrich postulates that the lack of a window may act negatively by reducing positive stimulation and aggravating the negative effects of sensory deprivation, particularly in a clinical environment with such conditions as repetitive sounds of respirators.⁷⁵ In addition, he has found that views of nature can reduce anxiety and pain and have a restorative effect on patients as well as staff (e.g., mood improvement, lower blood pressure, and reduced heart rates). He postulates an evolutionary theory predisposing humans to find scenes of nature restorative.¹⁹

Office workers with access to natural light and views of greenery are more productive and have higher job satisfaction.⁸³ National Aeronautics and Space Administration studies have found that a sense of perceptual distance and expansiveness, either with distant views, internal view corridors with interesting focal points, or even the design of vertical surfaces, promote "cognitive

tranquility,” which aids mental functioning.⁸⁴ Providing patients, families and staff with access to nature by providing indoor and outdoor gardens, views of nature through windows, and artwork of nature scenes can relieve stress.¹⁹ In one study, surgical patients in postoperative units with no windows to the outside developed twice as many cases of postoperative delirium during a 72-hour period as those with windows.⁸⁵ In addition, patients in units without windows developed more symptoms of depression.

Citations from the preceding excerpt

19. Ulrich R, Gilpin L. Healing arts—nutrition for the soul. In: Charmel PM, Frampton SB, Gilpin L, eds. *Putting Patients First—Designing and Practicing Patient-Centered Care*. San Francisco: Jossey-Bass, 2003; 117–146.
60. Heschong L. *Windows and Classrooms*. Fair Oaks, CA: Heschong Mahone Group. 2003.
74. Ulrich R. Effects of healthcare environmental design on medical outcomes. In: *Design & Health—The Therapeutic Benefits of Design*. Proceedings of 2nd International Congress on Design and Health. Karolinska Institute Stockholm, Sweden, June 2000: 49–59.
75. Ulrich RS. Effects of health facility interior design on wellness: Theory and recent scientific research. *J Health Care Des* 1991; 3:97–109. Reprinted in Marberry SO, ed. *Innovations in Healthcare Design*. New York: Van Nostrand Reinhold, 1995.
76. Ulrich RS. Effects of gardens on health outcomes: Theory and research. In: Marcus CC, Barnes M, eds. *Healing Gardens: Therapeutic Benefits and Design Recommendations*. New York: John Wiley & Sons, 1999:27–86.
77. Ulrich RS. Evidence based environmental design for improving medical outcomes. Proceedings of the Healing by Design: Building for Health Care in the 21st Century Conference. Montreal, Quebec, Canada, March 1–10, 2000.
78. Heschong L., *Windows and Offices*. Fair Oaks, CA: Heschong Mahone Group, 2003.
79. Leather P, Pyrgas M, Beale D, Lawrence C. Windows in the workplace: Sunlight, view, and occupational stress. *Environ Behav* 1997; 30: 739–762.
80. Keep PJ, James J, Inman M. Windows in the intensive therapy unit. *Anesthesia* 1980; 35:257–262.
81. Parker DL, Hodge JR. Delirium in a coronary care unit. *JAMA* 1967; 201:702–703.
82. Ulrich RS. Benefits of nature: View from a hospital bed. *Science* 1984; 224: 420–421.

83. Clay RA. Green is good for you. *Monitor on Psychology*. 2001; 32: 1–16.
84. Heerwagen JH, Johnson JA, Brothers P, Little R, Rosenfeld A. Energy Effectiveness and the Ecology of Work: Links to Productivity and Well-Being, 1998. Online document at:
www.sustainableportland.org/grn_rethink_heerwagen_5-9-03.pdf
85. Wilson LM. Intensive care delirium: The effect of outside deprivation in a windowless unit. *Arch Intern Med* 1972; 130: 225–226.

Excerpts from:

How Design Impacts Wellness

R.S. Ulrich. "How Design Impacts Wellness." *Healthcare Forum Journal* (September-October, 1992)

ABSTRACT: In research on patient anxiety in a dental fears clinic, patients felt less stressed when a large mural depicting a natural scene was hung on a wall of the waiting room, in contrast to when the wall was blank.

Link:

<http://www.scenicflorida.org/lscwellness.html>

Positive distractions

Striking scientific evidence regarding negative human consequences of poor design has emerged from studies of patients exposed to sensory deprivation – the lack of positive environmental distractions – in health facilities. Research on intensive-care units has shown that windowlessness appears to aggravate the deleterious effects of low levels of environmental stimulation such as unvarying lighting and the repetitive sounds of respirators and other equipment.

The concept of a positive distraction implies that certain types of environmental features are especially effective in reducing patient stress and promoting wellness. A positive distraction is an element that produces positive feelings, effortlessly hold attention and interest, and therefore may block or reduce worrisome thoughts. A growing number of studies indicate that the effects of positive distractions also involve desirable physiological changes such as reduced blood pressure.

The most effective positive distractions are mainly elements that have been important to humans throughout a million years of evolution: (1) nature elements such as trees, plants, and water; (2) happy, laughing, or caring human faces; (3) benign animals such as pets.

Nature is restorative

Over the last decade, scientific studies of nonpatient groups such as university students have shown that for stressed individuals, restorative influences of

viewing nature scenes or elements involve a broad shift in feelings toward a more positive state and desirable changes in activity levels in different physiological systems. These changes appear to be accompanied by sustained attention that probably blocks or reduces worrisome thoughts.

In laboratory research, my associates and I have found that visual exposure to everyday nature scenes produces significant recovery from stress within only about five minutes, as indicated by reduced blood pressure and muscle tension.

In research on patient anxiety in a dental fears clinic, patients felt less stressed when a large mural depicting a natural scene was hung on a wall of the waiting room, in contrast to when the wall was blank. And in a study of patients about to undergo dental surgery, visual contemplation of an aquarium with fish reduced anxiety and discomfort, and increased scores for patient compliance during surgery.

While such short term exposures to nature can foster impressive stress recovery, potential wellness benefits may be greatest for patients who must spend long periods in a confined setting. In these situations, prolonged visual contact with nature may have persistent positive effects on psychological, physiological, and possibly behavioral components of stress that may be manifested in higher levels of wellness and health.

I found that patients recovering from gallbladder surgery had more favorable postoperative courses if their windows overlooked a small stand of trees rather than a brick wall. Compared to patients with the wall view, those with the natural window view had shorter postoperative hospital stays, elicited far fewer negative comments ('patient is upset') in nurses' notes, tended to have lower scores for minor postsurgical complications such as persistent headache or nausea, and needed fewer doses of narcotic pain drugs.

All art is not created equal

Many health facility executives and designers apparently assume that nearly any type of wall-mounted painting or other visual art is a positive distraction for patients. But given that the style and content of paintings is strongly emotional, it seems more likely that some types of art will have a positive influence on patients, whereas others might be stressful.

In a small-scale exploratory study, I assessed effects of wall art on patients in a psychiatric ward at a Swedish hospital. The ward was extensively decorated with paintings and prints reflecting a wide variety of styles and subject matter. Patients expressed positive feelings about paintings dominated by nature content (rural landscapes or vases of flowers, for example). By contrast, there were many negative comments about abstract paintings and prints where the content was ambiguous or completely unclear.

Patients even physically attacked a group of seven abstract paintings (they tore the pictures from the wall and smashed the frames).

Outi Lunden and I conducted a study in Sweden to ascertain whether exposure to visual stimulation in intensive-care units, including views of nature, reduces stress and has other positive effects on recovery. Patients who had undergone open-heart surgery were randomly assigned a nature picture (dominated either by water or trees), or one of various abstract pictures, or no picture (control group).

Those exposed to the nature with water picture experienced less postoperative anxiety than either the patients exposed to other types of pictures or the control group. Patients exposed to abstract pictures had higher anxiety than patients without any picture.

Also, four days after surgery, patients who had been exposed to any type of visual stimulation were able to complete a visual-perceptual functioning test faster than patients in the control group. This latter finding is important because it suggests that by providing early exposure to visual stimulation, it might be possible to foster more rapid recovery from the mild brain impairment commonly associated with heart surgery involving a heart pump.

It's important to remember that, if visual art is to play a role in reducing stress and promoting wellness, it must be placed where it can be seen by patients. For a patient whose condition or treatment prevents sitting up, consideration should be given to placing a visual distraction on the ceiling in the individual's line of sight.

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