Access to Nature for Human Health & Sustainability

Nature of Place Symposium
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Erich Fromm used Biophilia to describe the psychological orientation of being attracted to all that is alive and vital.

EO Wilson and Stephen Kellert described the links that human beings subconsciously seek with the rest of life as the Biophilia Hypothesis.
Access to Nature for Human Health & Sustainability

Views
Circadian Light
Solar Heat
Thermal Variability – Alliesthesia
Natural Ventilation
Access to Nature – Active Design

Sounds of Nature
Smells of Nature
Sensory Feel of Nature
Natural Materials
Nature’s Complexity and Order
Community

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Biophilia and Human Health?
How important are Views of Nature and Community to human health?
**Views = Health**

**Pennsylvania Hospital / Ulrich 1984**

In a 1984 observational field study at a Pennsylvania hospital, Ulrich identifies an **8.5% reduction in post-operative hospital stay** (7.96 days vs 8.7) for gall bladder surgery patients who had a **view of a natural scene** from their hospital room, as compared to those with a view of a brick wall. Patients with a view of nature also received fewer negative evaluations from nurses and took fewer strong analgesics.

First cost increase: $1,000 / bed  
Annual productivity savings:$884 / bed  
ROI: 88%

In a 2003 study of the SMUD Call Center, Heschong et al identify a 6% to 7% faster Average Handling Time for employees with seated access to views through larger windows with vegetation content from their cubicles, as compared to employees with no view of the outdoors.

Maximize Views

First cost increase: $1,000 /employee
Annual productivity savings: $2,990 /employee
ROI: 299%
How important is Circadian Daylight and Sunshine to human health?

Daylight circadian spectrums and intensity, sunshine heat, sterilization and (bad) microbial reduction?
In a 2005 building case study of Inha University Hospital in Korea, Choi identifies a 26% reduction in average length of stay among surgery ward patients in SE daylit rooms, as compared to those in low daylit rooms, during spring and fall seasons.

First cost increase: $1,000 / bed
Annual health savings: $10,000 / bed / year
ROI: 1,000%
+28% Alertness
+36% Concentration
+14% Mental Wellbeing
In a 2005 4-month longitudinal study, researchers identified statistically significant improvements in self-reported alertness (28.1%), work performance (19.4%), vitality (28.4%), and mental well-being (13.9%), (Mills, Tomkins, & Schlangen, 2007).

+6.8% Typing Speed
A 2013 study discovered “subjects performed significantly better in terms of typing speed under CW light and Daylight than WW light”, typing an average 269 words per minute under WW light conditions and 287 words per minute under DL conditions. (Shamsul, Nur Sajidah, & Ashok, 2013).

+3.3% Information Processing
A study in Germany measured a 3.3% increase in speed of information processing after switching from yellowish to bluish light (Lehrl, et al., 2007).
In a 2010 study of sleep cycles of 8th grade students in the Smith Middle School in Chapel Hill, Figuero and Rea identify that student exposure to short-wavelength morning light significantly regulates their circadian clock and improves sleep times by as much as 30 minutes.

Wolfson and Carskadon (1998) identified that poor performing students obtained about 25 minutes less sleep per night and went to bed on average 40 minutes later on school nights than those who were good performers.

Lack of short-wavelength light during the school day delays dim light melatonin onset (DLMO) in middle school students.
In a 2005 study of 89 patients undergoing elective cervical and lumbar spinal surgery at Montefiore Hospital in Pittsburgh, PA, Walch et al identify a 22% reduction in analgesic medication use after surgery among patients in bright, sunny rooms, as compared to patients located in dim rooms.
How important is Dynamic Thermal Conditions (Alliesthesia) to human health?

Outside air circadian temperatures, radiant temperature variability, relative humidity and vapor pressure variability for human health.
In a 1996 controlled experiment and meta-analysis study, Wyon identifies that providing individual temperature control over a range of 6 C (10.8 F) results in performance improvements of 2.7% on thinking and decision-making tasks, 7% on typing tasks, and 3.4% on skilled manual tasks.

First cost increase: $800 / employee
Annual productivity savings: $1,035 / employee
ROI: 129%
How important is Natural ventilation and increased outside air to human health?

Outside Air (OA) variability and content
(is outdoor air microbially worse than indoors?
Do outdoor fine particulates increase indoor microbialis?
Is dilution key to reducing human bacteria and viruses)
In a 2006 multiple building study of 54 elementary schools, Shaughnessy et al identify a **14.4% improvement in standardized math** test scores in classrooms with a **ventilation rate higher than 4.5 l/s-person**, as compared to classrooms with a ventilation rate lower than 2.25 l/s-person.

**First cost increase:** $13 / student  
**Annual funding gain:** $158 / student  
**Annual energy cost increase:** $2 / student  
**Net savings:** $156  
**ROI:** 1200%
Outdoor air is cognitive and strategic

Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments

Joseph G. Allen, Piers MacNaughton, Usha Satish, Suresh Santanam, Jose Vallarino, and John D. Spengler, Environmental Health Perspectives • volume 124 | number 6 | June 2016
In a 2004 multiple building study in France, Preziosi et al identify a **57.1% reduction in sickness absence** and a **16.7% reduction in doctor visits** among workers with **natural ventilation** in their workplace, as compared to those with air conditioning.

First cost increase: $1,000 / employee  
Annual health savings: $181 / employee  
Annual productivity savings: $85 / employee  
**ROI:** 27%
How important is increased access to outdoor spaces and community to human health?

Microbial diversity and probiotics of the outdoors?
Lung activity and outdoor exercise?
Biophilia as air cleaner, humidifier, thermal regulator...
Dynamic sounds, smells, biophilic and sensory cues
Landscape design = Individual Productivity

Georgia Schools / Tanner 2000 (School)

In a 2000 multiple building study of 14 schools in Georgia, Tanner identifies a statistically significant relationship between quality and functionality of a school’s outdoor space and students’ academic achievement, indicating a 14.5-point (7%) increase in standardized test scores for each one-point improvement in rating of outdoor space on a scale from 1-10.

First cost increase: $84 / student
Annual O&M cost increase: $5 / student
Annual productivity savings: $176 / student
ROI: 204%

In a 2000 study of 14 schools in Georgia, Tanner identifies a statistically significant relationship between the quality and functionality of a school’s outdoor space and students’ academic achievement, with a 7% increase in standardized test scores for each one-point improvement in rating of outdoor space on a scale from 1-10.
In a 2004 Chicago field study of 17 children professionally diagnosed with ADHD, Kuo and Faber Taylor et al identified a 17% improvement in performance (digit span backwards test) after a 20 minute walk in a park as compared to built urban settings.
Unknowns?
Sounds of Nature
Smells of Nature
Sensory Feel of Nature
Natural Materials
Nature’s Complexity and Order
Craft – the Human Hand
Art – Nature’s Imagery
Community
Dynamics of Culture, Time and Place
When in doubt, default to nature.
Mixed Mode: Daylight & Electric Light

GHD Theater - Daylit & Naturally Ventilated Theater, University of Queensland Australia (Richard Kirk, Hassell)

Bullitt Center Daylit & Naturally Ventilated Offices, Seattle (Miller Hull, PAE Eng)
Mixed Mode: Natural Cooling & Mechanical

H.E.B. Retail in Texas (Lake Flato and Arup)
Natural Cooling + A.C. (Side by Side & Changeover)

Terry Thomas Offices in Seattle (SmithGroup and DPR)
Natural Cooling only with demand controlled ventilation
Mixed Mode: Natural Ventilation & Mechanical

Walgreens Retail in Illinois (Camburus, GI Energy)
Natural Ventilation + A.C. (Changeover)

The Leala Hotel in Kovalam India (Charles Correa)
Natural Ventilation + A.C. (Side by Side or Zoned)
Institute of Building Research Offices in Shenzhen, China (Ye Qing)
Natural Cooling + A.C. (Changeover)

Ng Teng Fong Hospital in Singapore (Studio 505, HOK, CPG Eng)
Natural Cooling 70% patient rooms, each bed with garden

Mixed Mode: Outdoor & Indoor Work/Learn/Play/Heal
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