APPLYING BIOPHILIC DESIGN

HEALTH & WELLBEING IN THE BUILT ENVIRONMENT

TERRAPIN BRIGHT GREEN

PROSPECT & REFUGE THEORY

People prefer unimpeded view of expanse with a covered back and canopy overtop.

Seminal Publications
The Experience of Landscape.
Appleton, 1975
The relation between perceived sensory dimensions of urban green space and stress restoration.
Granh & Stigsdotter, 2010

© TERRAPIN BRIGHT GREEN
ATTENTION RESTORATION THEORY

Viewing nature puts the brain into a state of soft fascination.

- Restores attention functioning capacity
- 40 seconds of viewing nature is enough

Seminal Publications
The Restorative Benefits of Nature Kaplan, 1995
40-second green roof views sustain attention: The role of micro-breaks in attention restoration Lee et al., 2015

FOREST BATHING

Spending time in nature vs. urban environments improves physiological outcomes.

- Reduced pulse rate and blood pressure
- Reduced stress hormones
- Increased immune function

Seminal Publications
The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing), Park et al., 2010
Visiting a forest, but not a city, increases human natural killer activity and expression of anti-cancer proteins Li et al., 2007

© TERRAPIN BRIGHT GREEN

ZPH session: Nature and Health. Green Indoor Infrastructure
**FRAC TAL FLUENCY**

Fractal patterns allow *easier visual processing*

- Visual Preference
- Mid-range complexity elicit *restoration & relaxation*
- High complexity can engender *stress*

**Seminal Publications**

*Investigations of human EEG response to viewing fractal patterns.* Hagerhall et al., 2008

*The Implications of Fractal Fluency for Biophilic Architecture.* Taylor et al., 2018

© TERRAPIN BRIGHT GREEN

---

**CONTOUR ORIENTATION**

Colinear, curvilinear, parallel and radial patterns are ubiquitous in nature.

Visual processing is facilitated by recognizable contour patterns.

**Seminal Publications**

*Neuroscience for Architecture.* Thomas Albright

© TERRAPIN BRIGHT GREEN
PSYCHOACOUSTICS & NATURE SOUNDS

Water and other nature sounds outperform white noise in:
- Perceived ability to mask noises
- Cognitive performance enhancement
- Perceived tranquility

Bird song promotes:
- Feelings of safety
- Positive consumer behavior

Seminal Publications
Effects of Five Speech Masking Sounds on Performance and Acoustic Satisfaction. Paavilango et al., 2011
Of cricket chirps and car horns: The effect of nature sounds on cognitive performance. Van Hedger et al., 2019
Sound and safe: The effect of ambient sound on the perceived safety of public spaces. Sayin et al., 2015

ALLIESTHESIA

Temperature differentials across the body can lead to a pleasure response.
Often preferrable to remaining in homeostasis

Seminal Publications
Revisiting an old hypothesis of human thermal perception: alliesthesia. de Dear, 2011
Perception of Transient Thermal Environments: pleasure and alliesthesia. Parkinson, de Dear, Candido, 2012
15 PATTERNS OF BIOPHILIC DESIGN

1. Visual Connection with Nature
2. Non-Visual Connection with Nature
3. Non-Rhythmic Sensory Stimuli
4. Thermal & Air Flow Variability
5. Presence of Water
6. Dynamic & Diffuse Light
7. Connection with Natural Systems
8. Biomorphic Forms & Patterns
9. Material Connection to Nature
10. Complexity & Order
11. Prospect
12. Refuge
13. Mystery
14. Risk/Peril
15. Awe

NATURE IN THE SPACE

1. Visual Connection with Nature
2. Non-Visual Connection with Nature
3. Non-Rhythmic Sensory Stimuli
4. Thermal & Air Flow Variability
5. Presence of Water
6. Dynamic & Diffuse Light
7. Connection with Natural Systems

NATURAL ANALOGUES

8. Biomorphic Forms & Patterns
9. Material Connection to Nature
10. Complexity & Order

NATURE OF THE SPACE

11. Prospect
12. Refuge
13. Mystery
14. Risk/Peril
15. Awe
## HEALTH OUTCOMES MATRIX

### Nature in the Space

<table>
<thead>
<tr>
<th>15 PATTERNS</th>
<th>STRESS REDUCTION</th>
<th>COGNITIVE PERFORMANCE</th>
<th>EMOTION, MOOD &amp; PREFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Connection with Nature</td>
<td>Heart rate</td>
<td>Parasympathetic</td>
<td>Attitude</td>
</tr>
<tr>
<td></td>
<td>Blood pressure</td>
<td>system activity</td>
<td>Motivation</td>
</tr>
<tr>
<td>Non-Visual Connection</td>
<td>Blood pressure</td>
<td>Cognitive performance</td>
<td>Perceived mental health</td>
</tr>
<tr>
<td>with Nature</td>
<td>Stress hormones</td>
<td>Creativity</td>
<td>Pain management</td>
</tr>
<tr>
<td>Non-Rhythmic Sensory Stimuli</td>
<td>Heart rate</td>
<td>Sympathetic</td>
<td>Deep time</td>
</tr>
<tr>
<td></td>
<td>Blood pressure</td>
<td>system activity</td>
<td>Attention</td>
</tr>
<tr>
<td>Thermal &amp; Airflow Variability</td>
<td>Comfort</td>
<td>Task performance</td>
<td>Exploration</td>
</tr>
<tr>
<td>Presence of Water</td>
<td>Overall stress</td>
<td>Cognitive performance</td>
<td>Positive emotional</td>
</tr>
<tr>
<td></td>
<td>Heart rate</td>
<td>Creativity</td>
<td>responses</td>
</tr>
<tr>
<td>Dynamic &amp; Diffuse Light</td>
<td>Circadian system</td>
<td>Cognitive performance</td>
<td>Tranquility</td>
</tr>
<tr>
<td></td>
<td>functioning</td>
<td>Behavioral performance</td>
<td>Preferences</td>
</tr>
<tr>
<td>Connection w/ Natural Systems</td>
<td>Overall health</td>
<td>Perceptual awareness</td>
<td>Alignment</td>
</tr>
<tr>
<td>Biomorphic Forms &amp; Patterns</td>
<td>Learning outcomes</td>
<td>View preference</td>
<td></td>
</tr>
<tr>
<td>Material Connection</td>
<td>Heart Rate Variability</td>
<td>Blood pressure</td>
<td>Aggregate preference</td>
</tr>
<tr>
<td>with Nature</td>
<td>Stress hormones</td>
<td>Task performance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Creativity</td>
<td>Cognitive performance</td>
<td></td>
</tr>
<tr>
<td>Complexity &amp; Order</td>
<td>Perceptual and</td>
<td>Environmental navigation</td>
<td>Neuro logical rumination</td>
</tr>
<tr>
<td></td>
<td>physiological</td>
<td>Learning outcomes</td>
<td>Future Discounting</td>
</tr>
<tr>
<td>Prospect</td>
<td>Overall stress</td>
<td>Brainwave response</td>
<td></td>
</tr>
<tr>
<td>Refuge</td>
<td>Comfort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystery</td>
<td>Pleasure response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk/Peril</td>
<td>Perseverance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awe</td>
<td>Stress related</td>
<td></td>
<td>Paternal behavior</td>
</tr>
<tr>
<td></td>
<td>symptoms</td>
<td></td>
<td>Overall happiness</td>
</tr>
</tbody>
</table>

### Natural Analogues

© TERRAPIN BRIGHT GREEN

## RESIDENTIAL

### Birchrunville Addition

- Refuge
- Visual Connection with Nature

© TERRAPIN BRIGHT GREEN

HELENA VAN VIJET ARCHITECT, 2006
BIRCHRUNVILLE, PENNSYLVANIA USA
PHOTOS: HELENA VAN VIJET
ZPH session: Nature and Health. Green
Indoor Infrastructure

**RETAIL**

**The Forest, Valextra**
- Olfactory Connection with Nature
- Natural Analogues
- Mystery

KENGO KUMA AND ASSOCIATES, 2018
MILAN, ITALY
PHOTO: KENGO KUMA AND ASSOCIATES
© TERRAPIG BRIGHT GREEN

**WORKPLACE**

**Interface Base Camp**
- Prospect
- Refuge
- Biomorphic Patterns

PERKING+WILL, 2018
ATLANTA, GEORGIA
PHOTOS: CATIE RYAN
© TERRAPIG BRIGHT GREEN
Green Street Academy
- Biomorphic Patterns
- Visual Connection with Nature
- Dynamic & Diffuse Light

The Garden School
- Non-Visual (Tactile) Connection with Nature
- Biomorphic Forms & Patterns
- Refuge
**HEALTHCARE**

**Mondzorg Middenmeer Dental Clinic**
- Views to nature
- Analogues of wildlife
- Ample daylight

ORGA ARCHITECT, 2014
MIDDENMEER, NETHERLANDS
PHOTO: RUBEN VISSE
© TERRAPIN BRIGHT GREEN

**HEALTHCARE**

**Ng Teng Fong Hospital**
- Visual & Physical Connection with Nature
- Thermal & Airflow Variability

HOK AND CPG ARCHITECTS, 2015
NG TENG FONG GENERAL HOSPITAL
JURONG, SINGAPORE
PHOTOS: BILL BROWNING
© TERRAPIN BRIGHT GREEN
**NATURE INSIDE CASE STUDY**

**HEALTHCARE**

**Maggie’s Centre Leeds**
- Visual Connection
- Diffuse & Dynamic Light
- Biomorphic Forms
- Mystery

HEATHERWICK STUDIO, 2020 WITH BALSTON AGUS LANDSCAPE ST. JAMES’S UNIVERSITY HOSPITAL YORKSHIRE, UNITED KINGDOM PHOTOS: HURTON + CROW © TERRAPIN BRIGHT GREEN

**URBAN PARK**

**Tanner Springs**
- Visual Connection with Nature
- Presence of Water
- Connection with Natural Systems

STUDIO DRESEITL & GREENWORKS, 2010 PORTLAND, OREGON USA PHOTOS: GREENWORKS © TERRAPIN BRIGHT GREEN
RECOMMENDED READING

NATURE INSIDE
WILLIAM D. BROWNING AND CATHERINE O. RYAN
RIBA A A BIOPHILIC DESIGN GUIDE

14 PATTERNS OF BIOPHILIC DESIGN
IMPROVING HEALTH & WELLBEING IN THE BUILT ENVIRONMENT

THE ECONOMICS OF BIOPHILIA
MARK DESCRIPED WITH NATURE IN MIND MAKES FINANCIAL SENSE

BIOPHILIA@TERRAPINBG.COM | TERRAPINBG.COM/PUBLICATIONS
© TERRAPIN BRIGHT GREEN

ZPH session: Nature and Health. Green Indoor Infrastructure