TUNE INTO YOUR BIOLOGICAL RHYTHMS

Light for life

HUMAN CENTRIC
LIGHTING IN PRACTISE
TUNE INTO YOUR BIOLOGICAL RHYTHMS

• A look at our biological responses to lighting

• Uses in Education
  - Research
  - Case study

• Uses in Health
  - Research
  - Case study

• Practical look at how easy it is to incorporate Human Centric lighting into a project
Over millions of years, people have conducted their life according to natural daylight.

We have become accustomed to sunlight and the natural day/night rhythm through our evolution.
DYNAMIC LIGHT

Natural light changes in intensity, colour temperature and direction...
TUNE INTO YOUR BIOLOGICAL RHYTHMS

- High alertness: 10:00
- Highest testosterone secretion: 10:00
- Bowel movement likely: 08:30
- Melatonin secretion stops: 07:30
- Sharpest rise in blood pressure: 06:45
- Lowest body temperature: 04:30
- Deepest sleep: 02:00
- Noon: 12:00
- Best coordination: 14:30
- Fastest reaction time: 15:30
- Greatest cardiovascular efficiency and muscle strength: 17:00
- 18:00
- 18:30: Highest blood pressure
- 19:00: Highest body temperature
- 21:00: Melatonin secretion starts
- 22:30
- 00:00: Bowel movements suppressed
- 02:00: Deepest sleep
- 06:00
- 06:45: Lowest body temperature
- 07:30: Melatonin secretion stops
- 08:30: Bowel movement likely
- 10:00: High alertness
The biological clock is triggered daily via specific receptors in the retina.

Dynamic lighting can support the biological rhythm.
BIOLOGICAL RESPONSE

Cortisol
Melatonin

03.00
09.00
Cones for day/colour vision

Rods for night vision

Third receptors: Ganglion cells send signals to the biological clock
BIOLOGICAL RESPONSE

Suprachiasmatic Nucleus
Visual Cortex
Pineal Gland
Superior Cervical Ganglia
Preganglionic Sympathetic Neurons

LIGHT
DYNAMIC LIGHT

Natural light changes in intensity, colour temperature and direction...
DYNAMIC LIGHT

... and so we should try to reproduce it with flexible artificial light.
Dynamic light can affect concentration or well-being...

in a meeting room
EDUCATION
JOINT RESEARCH IN HAMBURG SCHOOLS 2011-2012

• Trilux was involved in several research projects at schools in Hamburg, Dresden and Berlin.
• For the research project in Hamburg, 39 schools were modified with dynamic light from Trilux and Philips.
• The modified schools had the opportunity to switch their lighting to suit the situation.

300 lux 4.000 K (traditional light),
1.000 lux 6.000 K (concentration),
650 lux 12.000 K (activate)
300 lux 2.700 K (calm).
CASE STUDY: HAMBURG-EPPENDORF

**Energy**
- for a fresh start in the morning and after lunch

**Calm**
- to calm down when the children are over-active

**Normal**
- for regular classroom activities

**Focus**
- for concentration, such as for tests
CASE STUDY: HAMBURG-EPPENDORF

The study comprised of 166 students and 18 teachers over the course of 1 year. The students were between 7 and 16 years of age. Conducted by the Hamburg UKE clinical centre for child and youth psychosomatic research.
CASE STUDY: HAMBURG-EPPENDORF

Reading performance +34.8%

Number of Words Read

<table>
<thead>
<tr>
<th>Module</th>
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CASE STUDY: HAMBURG-EPPENDORF

Errors relating to concentration -44.9%
CASE STUDY: HAMBURG-EPPENDORF

Restlessness -76.6%

Optical measurement of motoral restlessness

Module

0 25 min 5 min 75 min 10 min

1437 712 336 445
**Attainment and Progress**

In August 2013, the Academy received its second full set of GCSE examination results and its first set of AS results.

- 63% of students gained 5 A*-C GCSEs with English and Maths. 78% achieved an A*-C in Maths and 67.2% achieved an A*-C in English.

- 21.1% of GCSE grades were A/A* compared with a national figure of 21.3%, despite the fact that Bridge students arrive with lower than national attainment.

- The gap between the attainment of students on free school meals (FSM) and those without free school meals was only 12%, as compared to a national figure of 26%.

- At AS Level 81.2% of entries resulted in A-E grades with 20.5% at A-B. This translated into an ALPs score of 3 placing the Academy in the top 25% of schools adding value.
University of Essex - School of Business

Lighting Stage D Report

Issue: Stage D
Blow: ...
Date: February 2012

School of Business
University of Essex

Lighting by
BDP

Zero carbon
Lamp Colour Temperature

Giving focus to the lamp colour temperature means that artificial light will mimic daylight throughout the day allowing the artificial lighting to appear neutral to the space. This also plays a key part in how we react to light.

Daylight is cool white 4000k to 6500k that is associated with work activity and concentration, whilst evenings and relaxation are associated with warm white colour temperature of 2700k. Allowing for this difference in temperature will make clear distinctions between areas of work and rest, as well as day and night. These subtle changes to the spaces work with the user’s natural reactions to light (circadian rhythm) and help encourage focus and relaxation at appropriate times of the day.

The above diagram is a chart showing the ratio of illuminance between morning and evening and the comparison of colour temperature through out the day compared to natural light.

It also shows how the positioning of the light should be similar to that of the sun. The main source of lighting in the day, when the sun is higher in the sky, should come from above the eye line, alternately when the sun begins to set, artificial lighting should be below the eye line to aid relaxation.
HEALTH
The ageing eye

- Increased absorption in the lens
- Smaller pupil
- Slower reaction of iris
- Reduction in blood supply to the choroid
- Cone density falls
- Loss of neuron density in the optic nerve and visual cortex
THE AGEING EYE

25 years

47 years

60 years

70 years

82 years

91 years
A DARKER, MORE HAZY WORLD

Older people experience

- A reduction in vividness of the colours of images e.g. reds begin to look like pinks
- A reduced ability to discriminate blues
LATEST RESEARCH

Dementia Services Development Centre
Sterling University

Thanks to
Kristina Allison BA (Hons), MA, MSLL, MILP
Lighting Enterprises Consultancy & Associates Ltd.
WHAT WE SEE DEPENDS ON

Light Quantity
   Luminaires, Fire, Sun

Reflection
   The light we actually see reflecting off objects and making them visible

Contrast
   The key to vision including light colours against dark colours
DEMENTIA FRIENDLY LIGHTING

Primary elements

Use daylight wherever possible

Choose the right light source and high light levels

Use sufficient ‘domestic’ style fittings

Expose people to the 24-hour cycle of light and dark.
# Recommended light levels
(sample page from the DSDC lighting book)

<table>
<thead>
<tr>
<th>Area</th>
<th>Maintained average horizontal illuminance (in lux) not less than</th>
<th>Minimum overall colour rendering index $(R_\text{a})$</th>
<th>Minimum lamp colour rendering index $(R_\text{L})$</th>
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<tbody>
<tr>
<td>Living rooms</td>
<td>300</td>
<td>85</td>
<td>80</td>
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<tr>
<td>Ensure high lighting levels at activity tables and seats for reading by positioning lights nearby</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Recreation</td>
<td>300 supplemented by 300</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Provide 300 lux from artificial lighting. Supplement by 300 lux daylight when available and 300 lux from free-standing units when daylight is not available</td>
<td></td>
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<tr>
<td>Kitchens</td>
<td>600</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Ensure high lighting levels at worktops, sinks and server counters by positioning lights nearby</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bathrooms and toilets</td>
<td>300</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Ensure high lighting levels at wash-hand basins and WCs by positioning lights nearby</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bedrooms</td>
<td>200</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Ensure high lighting levels at headboards and dressing tables by positioning lights nearby</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dining rooms</td>
<td>300</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Ensure high lighting levels at dining tables by positioning lights directly above them</td>
<td></td>
<td></td>
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<tr>
<td>Other areas</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Corridors – at night</td>
<td>No activity 20-50</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Activity</td>
<td>100-150</td>
<td></td>
<td></td>
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<tr>
<td>Corridors - daytime</td>
<td>No activity 50</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>Activity</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corridors – mid point of relevant doors¹</td>
<td>200 (vertical)</td>
<td>85</td>
<td>80</td>
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<tr>
<td>Offices</td>
<td>500</td>
<td></td>
<td></td>
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<tr>
<td>Lifts</td>
<td>175</td>
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</tbody>
</table>

¹ A relevant door is one that is meant to be identified and operated by people with dementia
Why should we bother?

- We all fall down – or do we?

Courtesy of Morningside Care Homes
Why should we bother?

- Things appear to be improving!

Courtesy of Morningside Care Homes
Why should we bother?

Elmhurst, Cumbria
Average No. of slips, trips and falls

Apr-09 | May-09 | Jun-09 | Jul-09 | Aug-09 | Sep-09 | Oct-09 | Nov-09 | Dec-09 | Jan-10 | Feb-10 | Mar-10 | Apr-10 | May-10
---
0.5 | 1 | 1.5 | 2 | 2.5 | 2 | 1.5 | 1 | 0.5 | 0 | 0 | 0 | 0 | 0

2014/ HELEN LOOMES
The King's Fund

Improving the patient experience

Developing Supportive Design for People with Dementia

The King's Fund’s Enhancing the Healing Environment Programme 2009-2012
• Ipswich Hospital was chosen to create a pioneering care environment in conjunction with the Kings Fund.

• Haughley Ward has had additional improvements including human centric lighting.

• Grundisburgh Ward and Saxmundham have now just been finished.
If we could only change three things, these would be:

- Signposting using accent colours
- Creating a central social space
- Improving the lighting

Senior nurse, dementia care and adult safeguarding
MARIA-HILF HOSPITAL, BRILON, GERMANY

Human centric lighting has been installed in the geriatric department in all patient rooms and corridors.

All LED lighting is controlled via a central management system to give 600 lux at eye level and 300 lux at floor level in corridors and between 600 to 1,500 lux during the day in patient rooms.
Dynamic light can affect well-being...

Helping with medical therapy in hospitals
Dynamic light can calm anxiety during a visit to the dentist.
Dynamic light can bring the outside in........
Dynamic light can mark the passage of time
PRACTICALITY

- Active luminaires
- Mixing 2,700K and 6,500K lamps
- DALI
- Built in timer +TLM
Active – colour and luminance sequence during the day
Thank you for your attention