Interaction of daylight and electric light on subjective light appraisals in office environments

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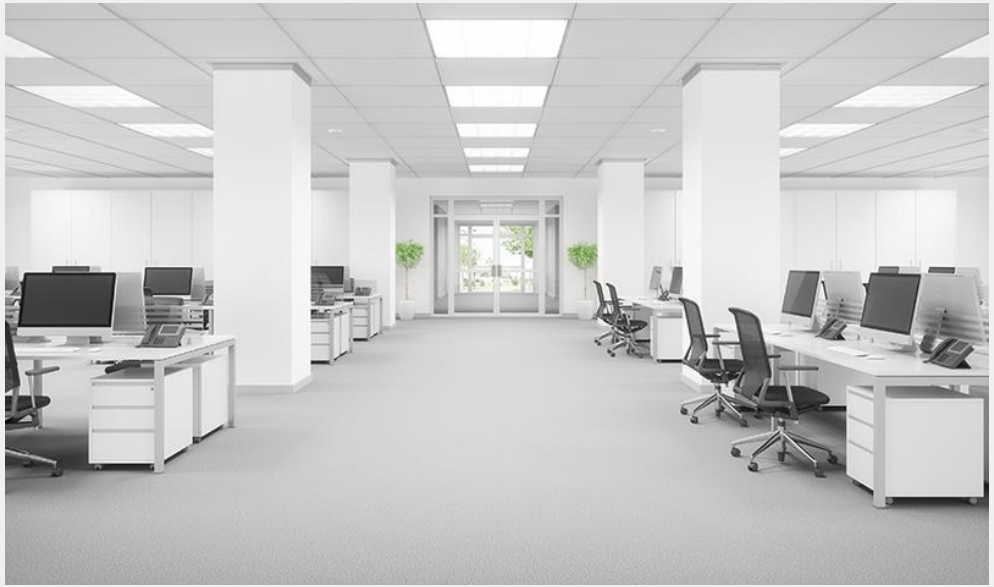
Healthy office environments

How can lighting improve human daytime functioning?

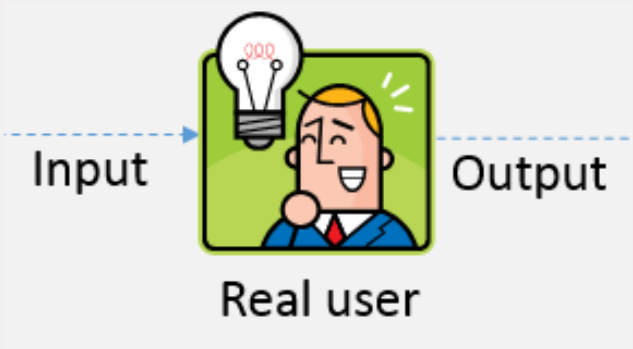


(Photo from Intheblack)

Optilight Project

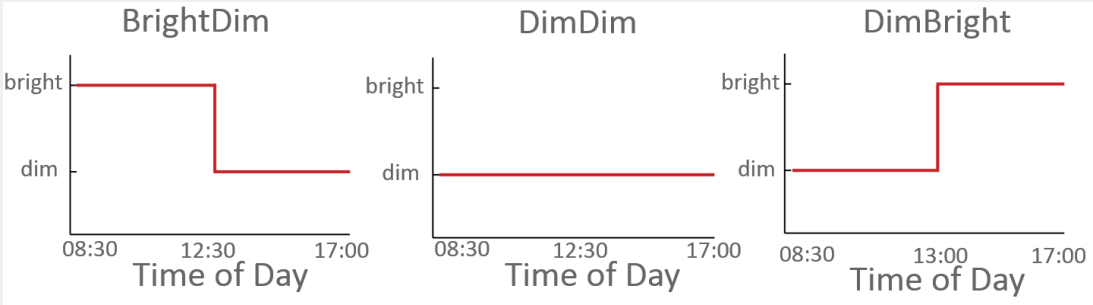
‘Quantifying the human needs in lighting’

- User centered system
- Gain insights in how humans experience and are influenced by light
- Translate knowledge into quantified models and optimization algorithms



Fieldstudy

- Multiple measurements over days and weeks
- Longer light exposures
- Daylight contribution (diverse patterns)
- Resulted in a rich dataset



Objective

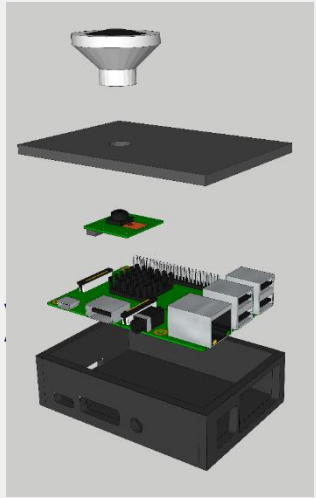
‘To explore the relationship between subjective light appraisals and objective light measures (using a simple measurement device) in a real life office environment’

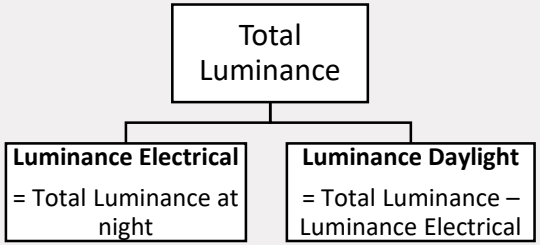
The data

Subjective light appraisals (pleasantness, brightness, colour temperature)

→collected with ESM application (8 times per day during workday)

Three light measures → BeeEye[1] (cheap and practical HDR camera, 10 min interval)





$$Daylight\ Ratio = 1 - \frac{Total\ L - Daylight\ L}{Total\ L}$$

$$Contrast = \frac{|\bar{L}_{desktop} - \bar{L}_{window}|}{\bar{L}_{desktop} + \bar{L}_{window}}$$

(1. T. Kruisselbrink et al., 2017)

Physical light attributes & perception

- Perceived brightness
  - Multiple measures have been found to predict well [1]
    - Vertical illuminance on the eye [2]
    - Mean luminance in 40 degree horizontal band [3]
    - Spectrally weighted irradiance at eye [4]
    - Indirect illuminance at eye [5]
- No such measures for predicting pleasantness

(Photo by Daniil Kuželev on Unsplash)

(1. Stokkermans, 2018 2. Hawkes et al., 1979 3. Loe et al., 2000 4. Rea at al., 2016 5. Noguchi et al., 2011)

Pleasantness

- Providing pleasant light conditions is a challenge
- Positive light rating improved mood, well-being and satisfaction [1,2,3]
- Daylight is preferred [4,5,6]
- Positive light appraisals = happy office workers?
- But…can we predict their light appraisals?

(Photo by unknown on Unsplash)

(1. Veitch et al., 2008 2. Veitch et al., 2013 3. Newsham et al., 2004 4. Veitch et al. 1993 5. Veitch et al., 1996) 6. Heerwagen & Heerwagen 1986

Results

Results have been omitted in this online version

Conclusion

- Main effect of the light measures on pleasantness, but
  - Trends seem subtle
  - Effect of luminance on pleasantness indicates a possible non-linear relationship
  - People seem to prefer more daylight

- These relationships might possibly not be linear
- First explorations

Thank you for your attention!

Questions?