



KTH Technology
and Health



Karolinska
Institutet

Kunskapsöversikt

Syn och belysning för äldre i arbetslivet

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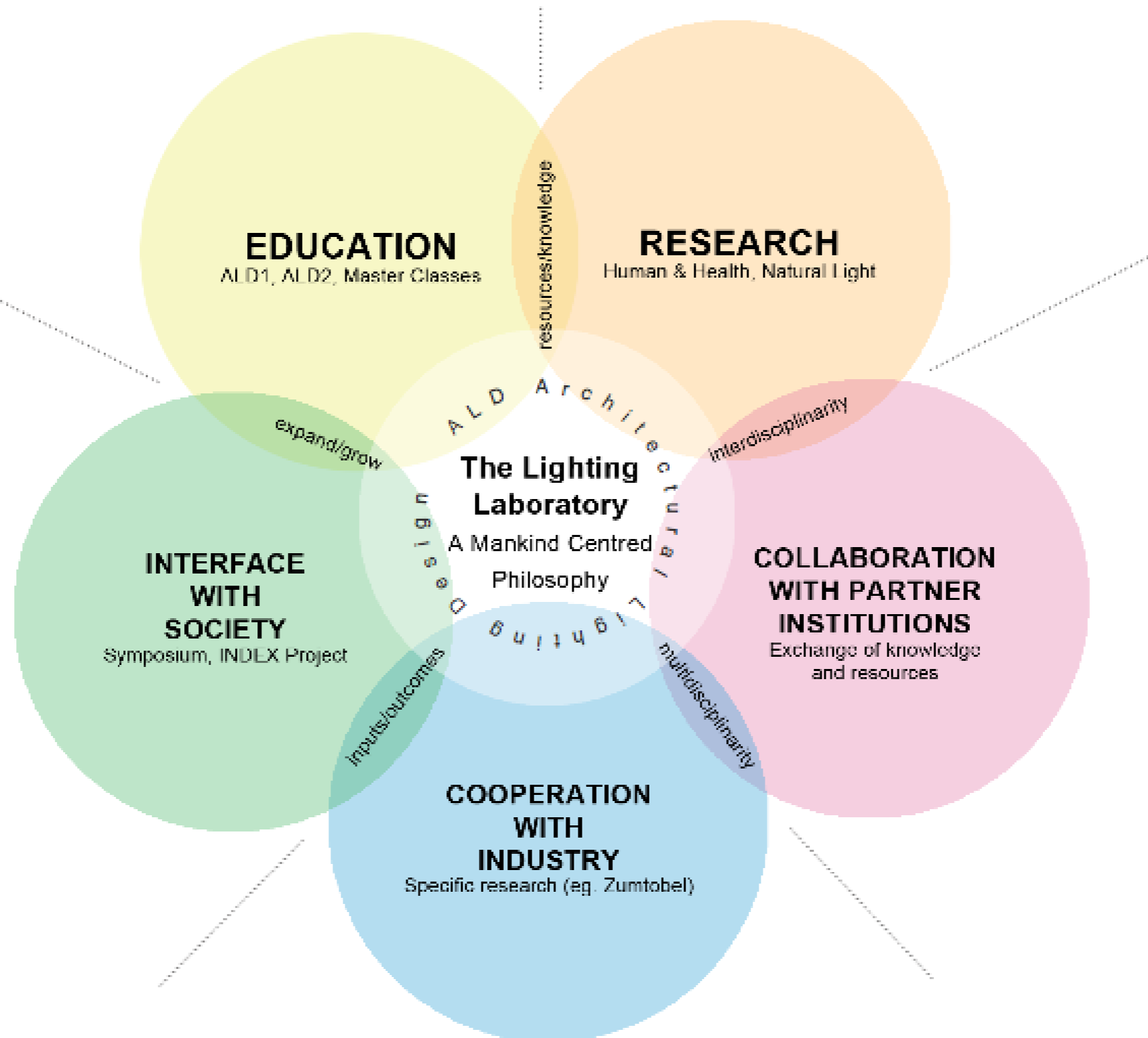
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Introduction

KTH STH - The Lighting Lab Structure



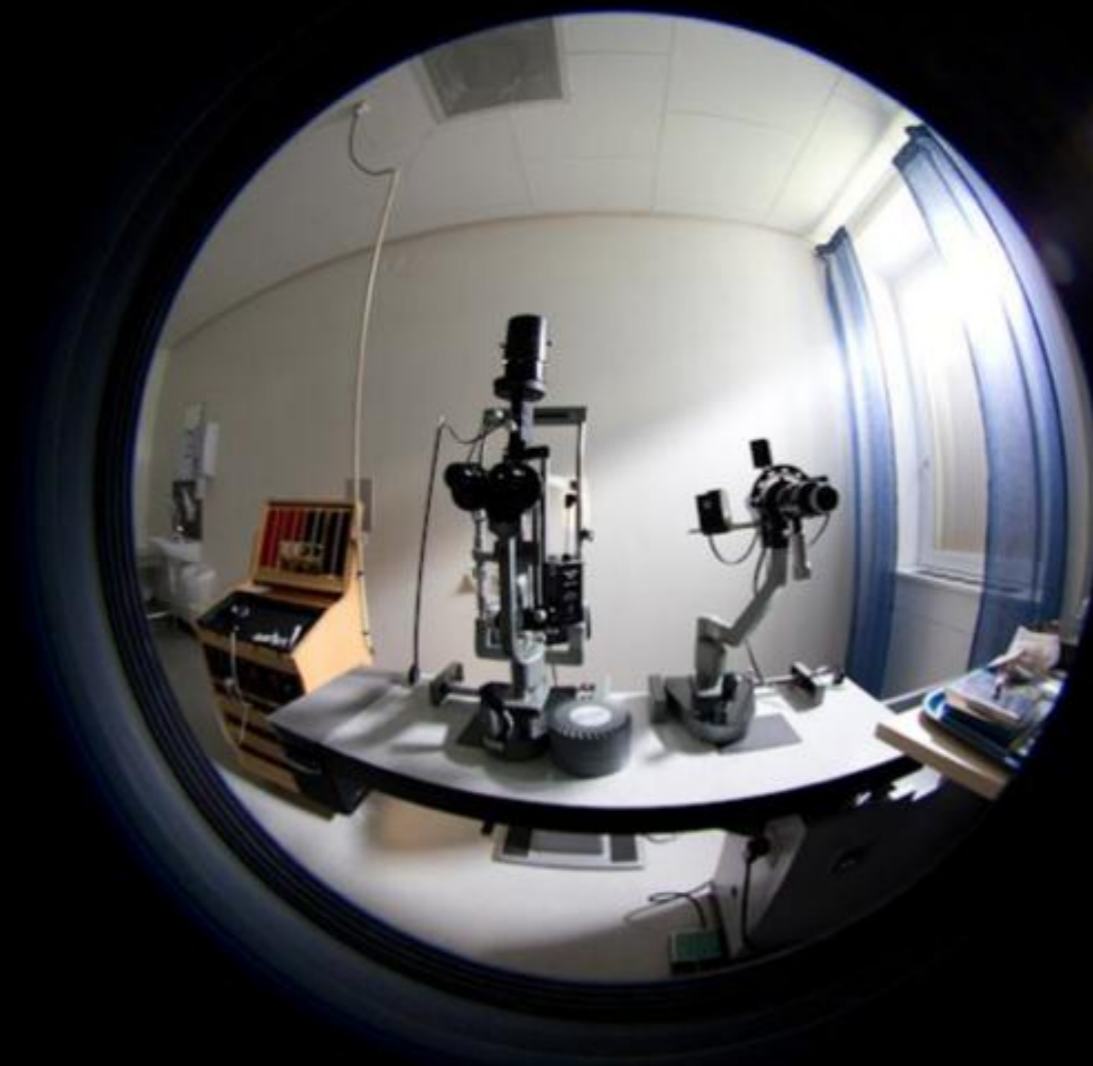
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The Lighting Lab Research activities



South Baltic Sea
Future LED outdoor lighting



St. Erik Eye Hospital + KTH / Swedish Energy Agency
Prototype examination rooms



Trafik Verket
Tunnel lighting evaluation

Picture by Andika Pradana

Index

Structure of the investigation

- Findings

Daylight and artificial light

- **Lighting impact:**
 - Visual, Perceptual, Biological systems

(Day-)Lighting and older adults

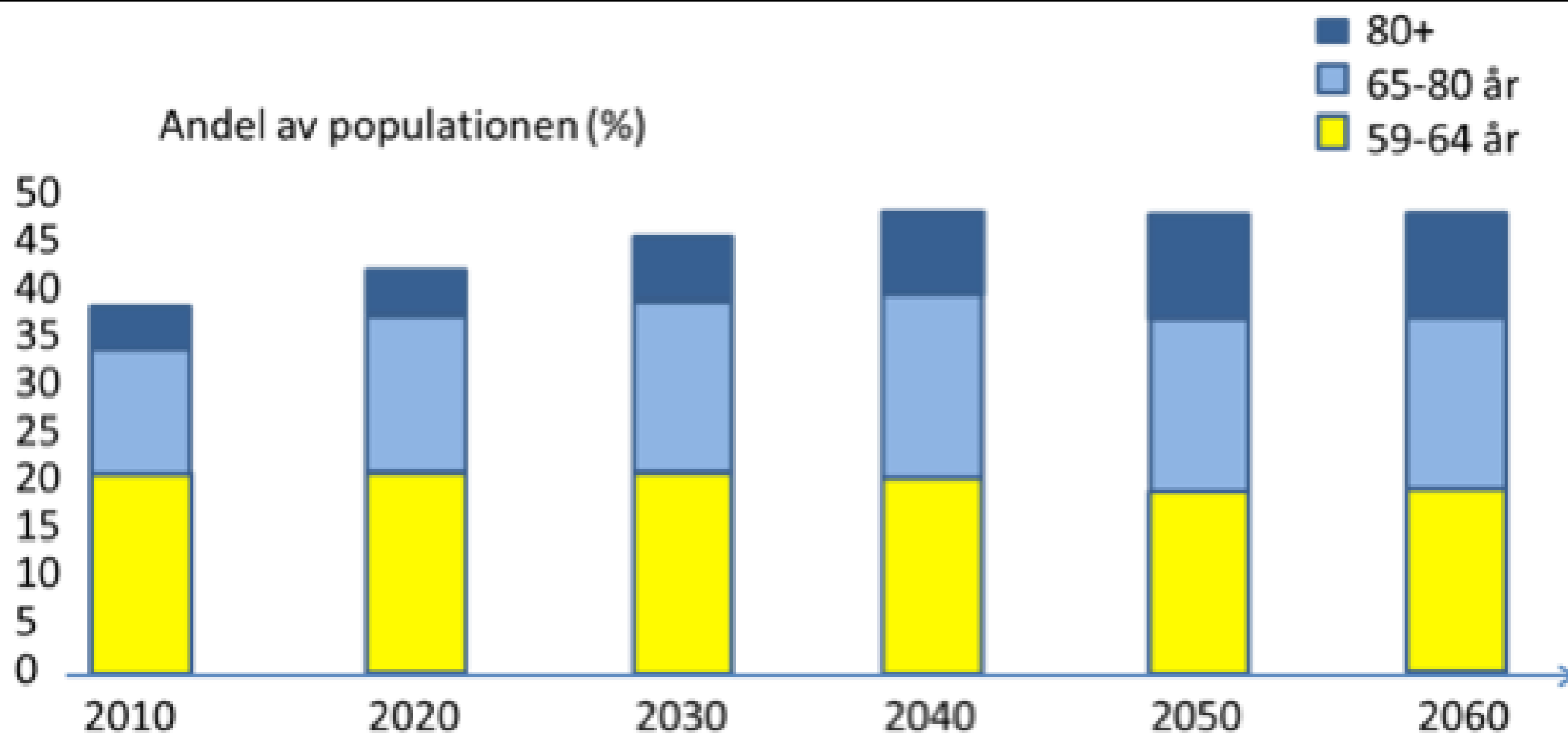
- Consequences on Visual, Perceptual,
Biological systems

Conclusions from this part

The world is getting older

<u>Year</u>	<u># 65+</u>
2006	500 million
2030	1 billion

(NAI, 2007).



Projected structure of the population by age group (estimates from 2010), figure based on report published by Eurostat in 2012.

Literature search

Research structure and findings

Keywords	Hits
Daylight + workplace + elderly/older/senior adults	0
Daylight + workplace, older adults + lighting	22
Science Direct	13
Lighting Research and Technology	8
PubMed	1

Research structure and findings

Relevant publications:

- CIE 196:2011 (2011). “Guide to increasing accessibility in light and lighting”
- ANSI/IESNA RP-08-27 (2008). “Recommended Practice for Lighting and the Visual Environment for Senior Living”.
- Edwards L, Torcellini P (2002). “A Literature review of the effects of Natural Light on Building occupants”, NREL
- ISO/IEC Guide 71 (2001). ”Guidelines for standard developers to address the needs of older person and persons with disabilities.”

Critical point

In many of the articles found,
**daylight = “artificially simulated
daylight”**

Thus, only indirect conclusions can
be drawn from most of the articles
found.

Daylight and artificial lighting

Daylight and artificial

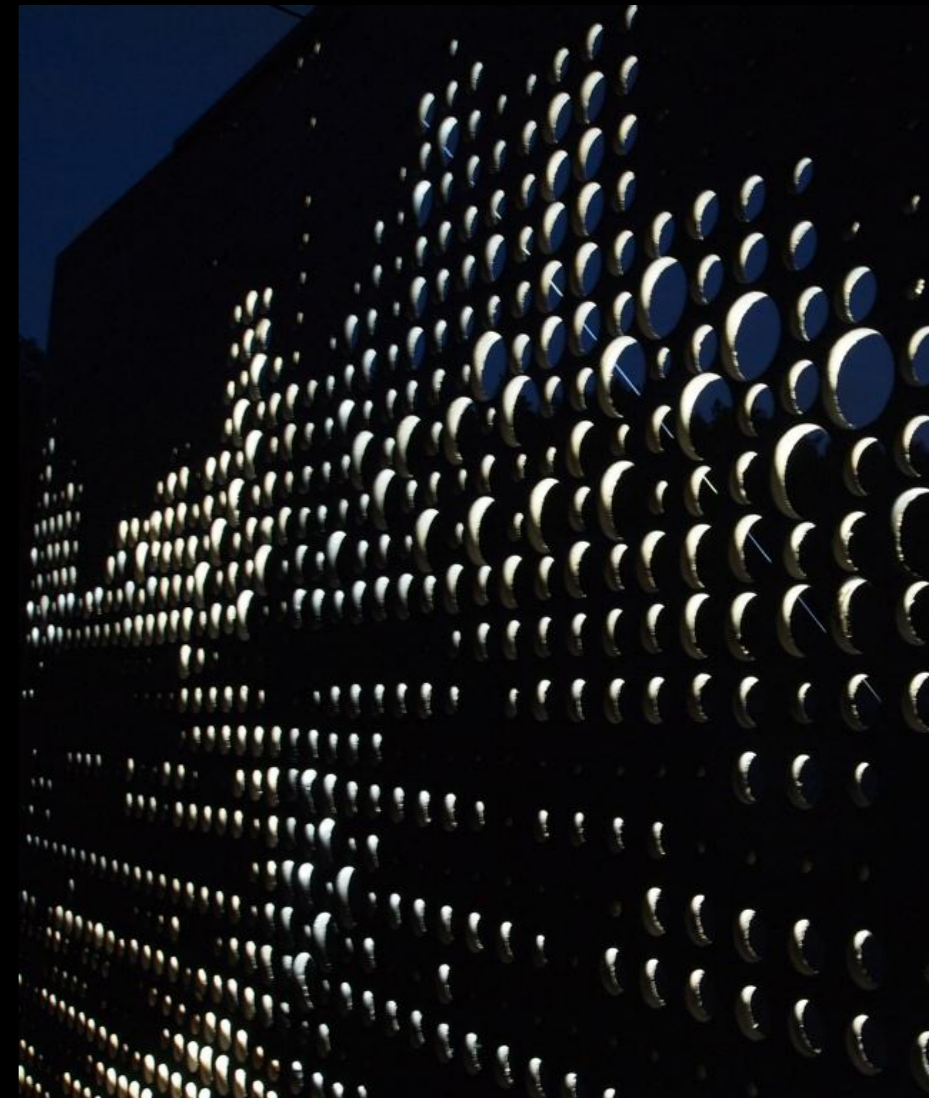
There is no difference between an artificial and a daylight photon,

Daylight and artificial

There is no difference between an artificial and a daylight photon, but the way they reveal space and time is very different

Daylight and artificial

there is no difference between an artificial and a daylight photon, but the way they reveal space and time is very different

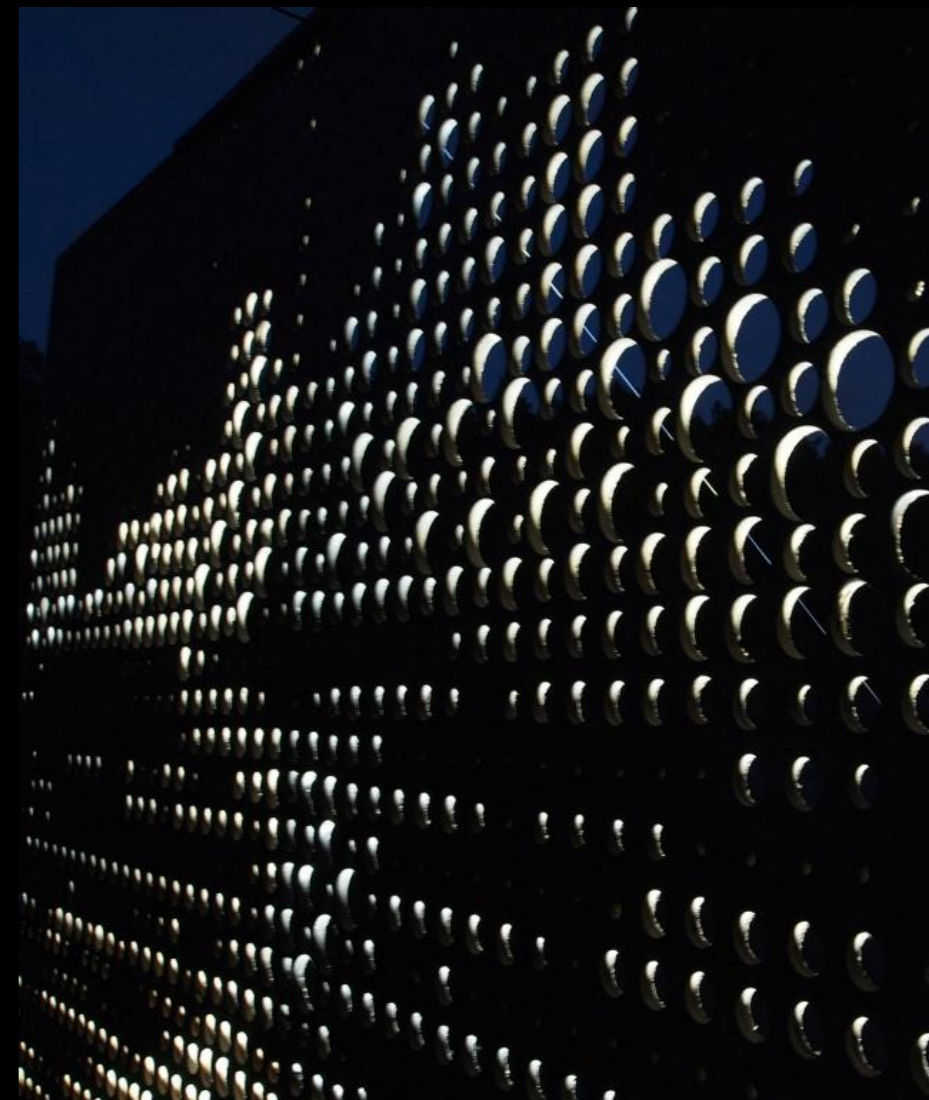


Daylight and artificial

there is no difference between an artificial and a daylight photon, but the way they reveal space and time is very different

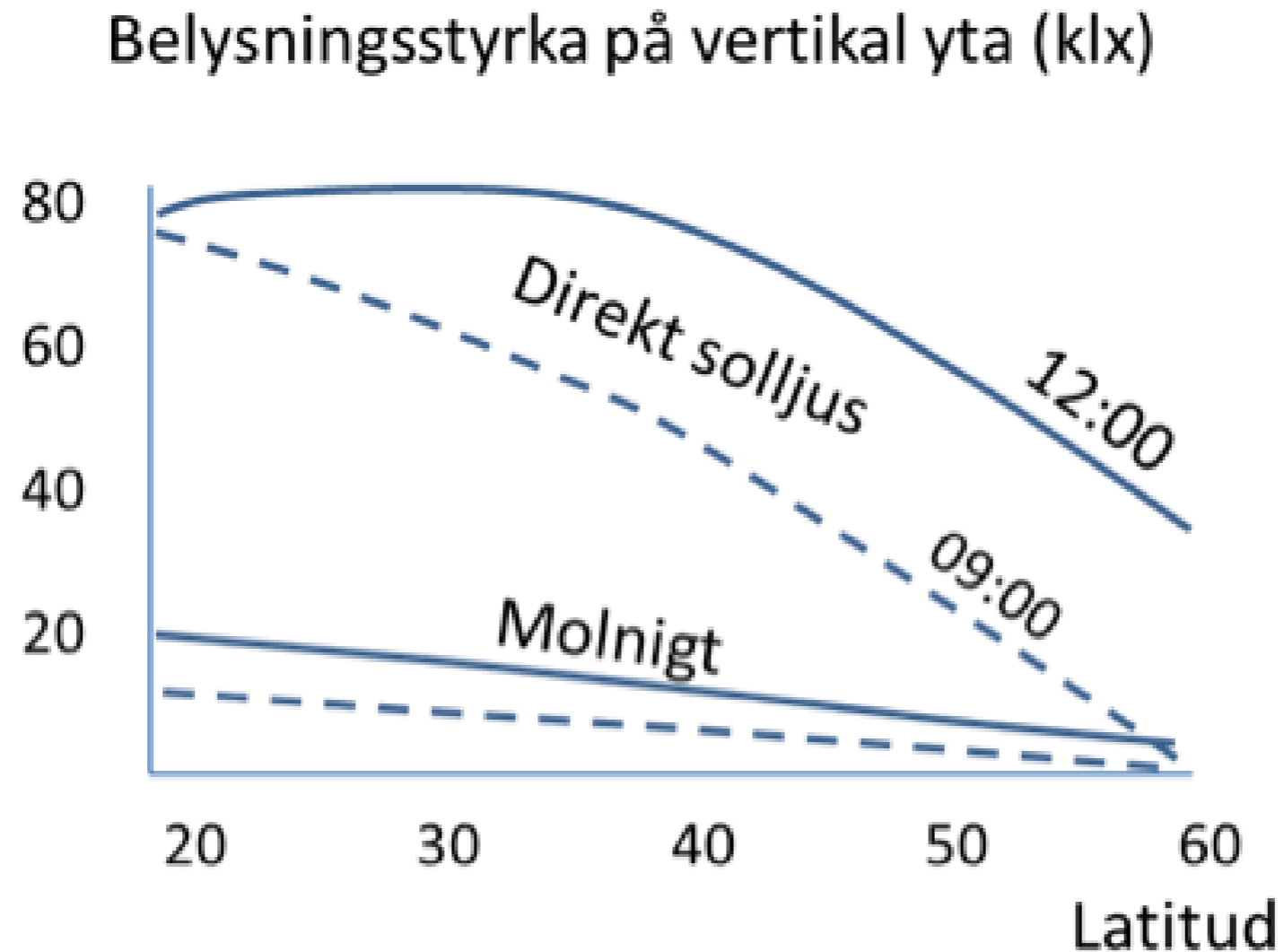


Variation
Direction
Colour
Intensity



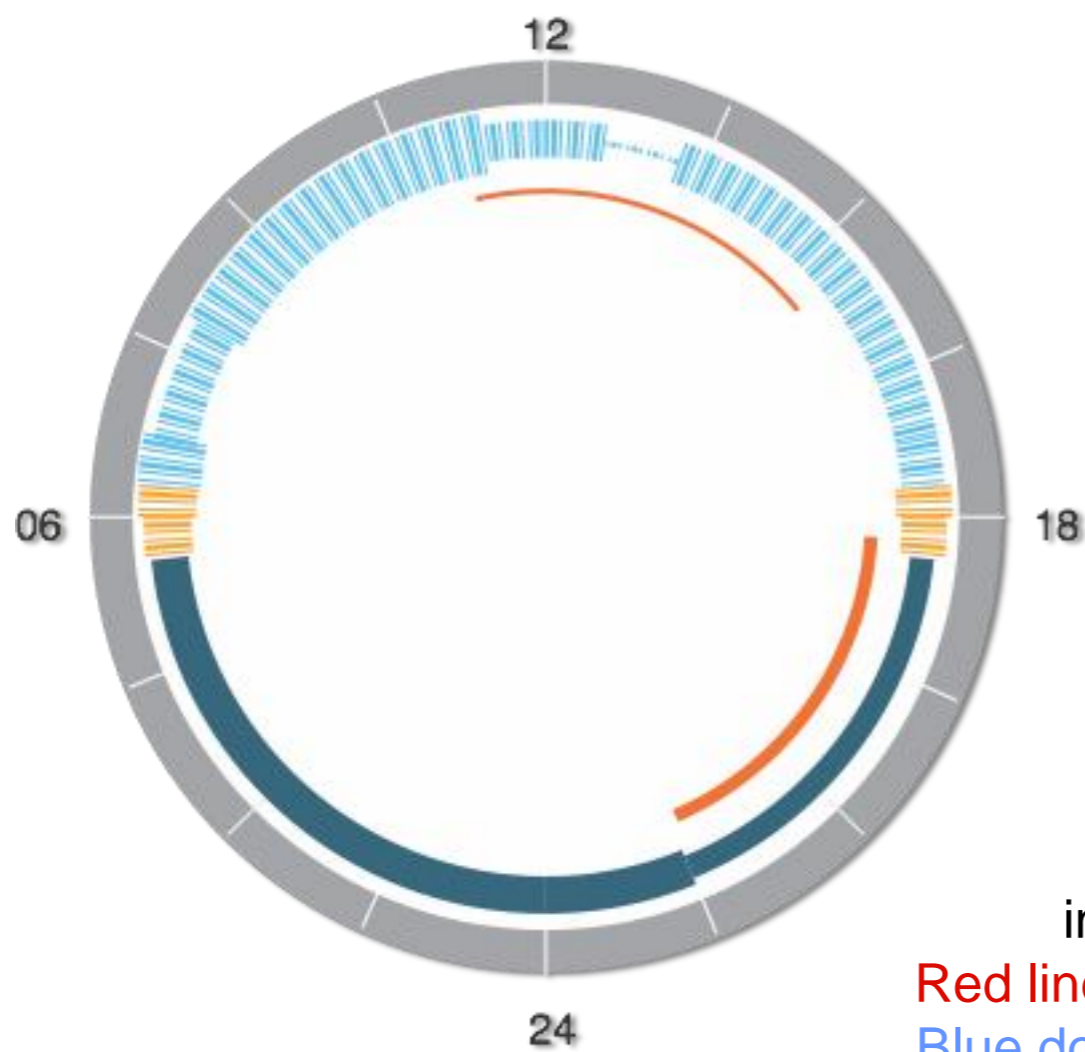
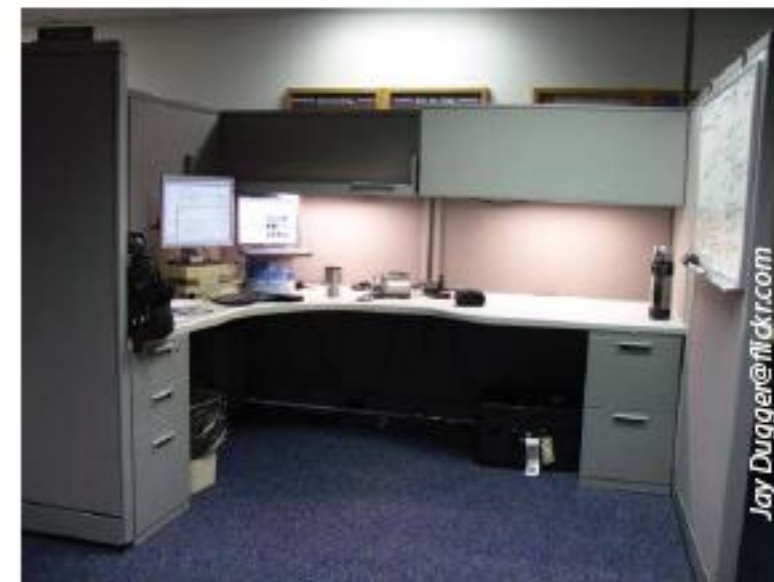
Daylight Luminaire, 2011
by Andri Reynisson, Efi Stragali, Eran Aronson

Daylight availability

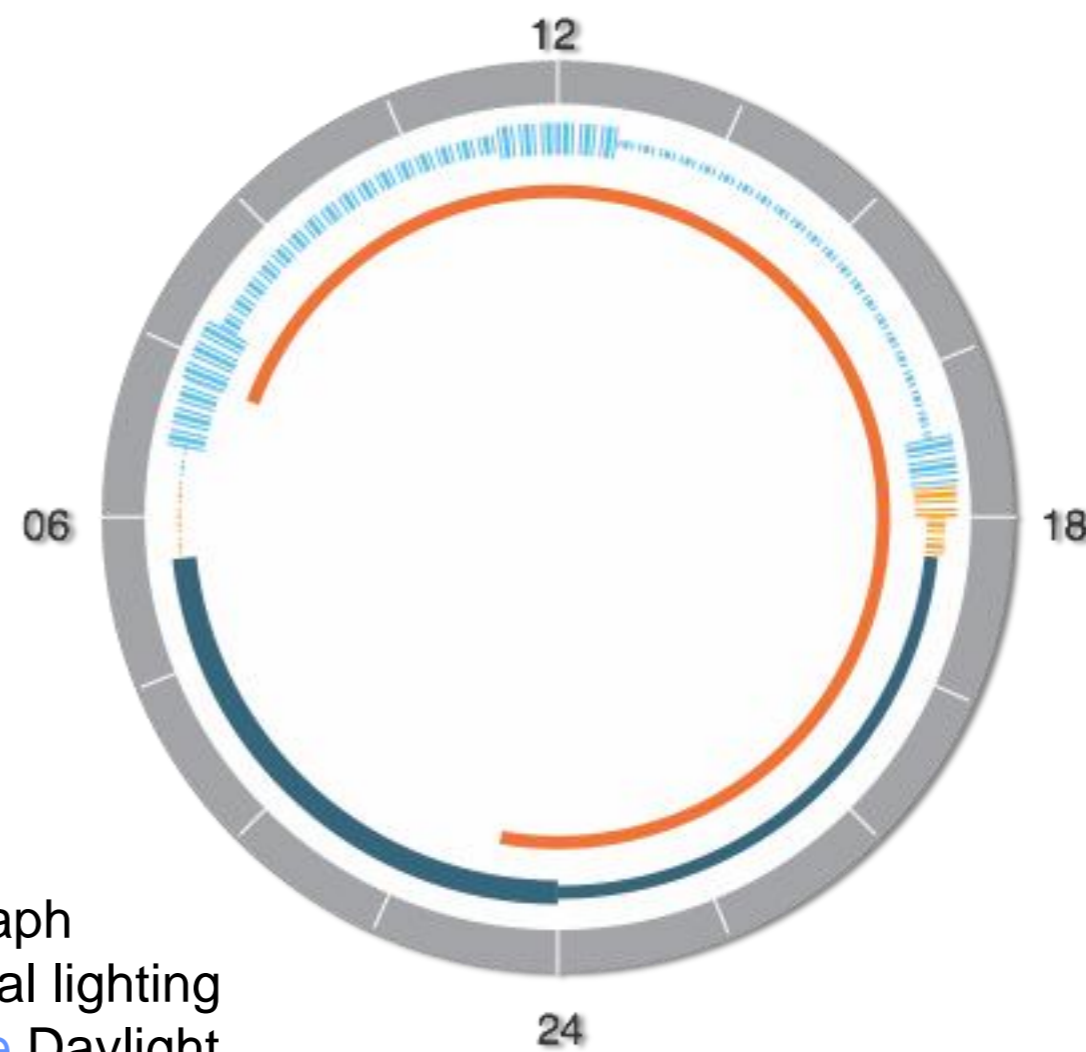


Based on the original from Torrington and Tregenza, 2007.

Light exposure



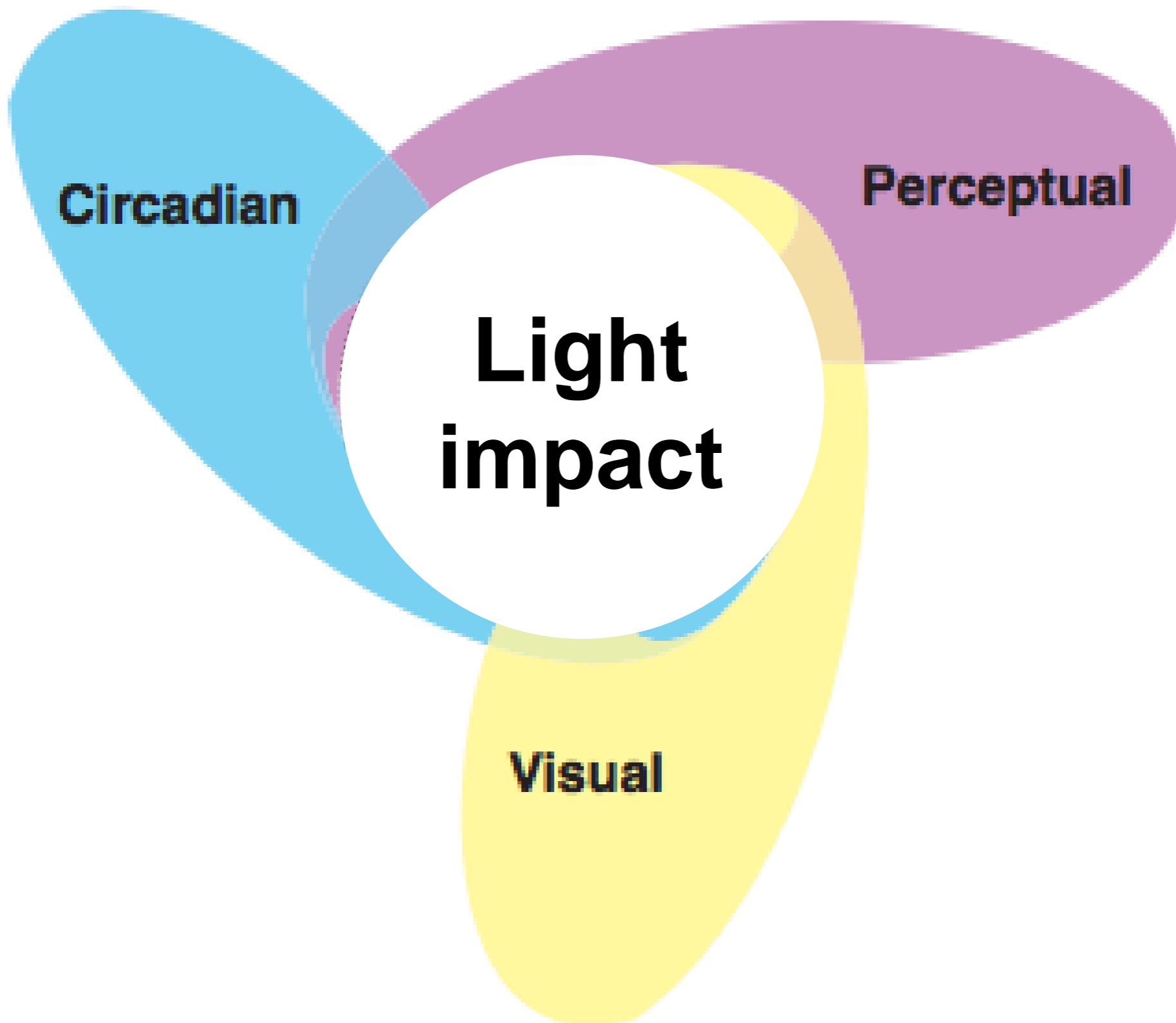
A day outdoor at the Equinox



and a day at the office

in the graph
Red line Artificial lighting
Blue dotted line Daylight

Visual, Perceptual, Biological Changes



Biological - Circadian impact

“Older adults have reduced optical transmission at short wavelengths, which is maximally effective for the circadian system, and it has been observed that they lead a more sedentary indoor life style with less access to bright light during the day” (Figueiro et al., 2008).

Biological – Circadian impact

“With increasing age, the amplitudes of the many circadian rhythms (...) have been shown to diminish. There is also evidence of a shortening of the period and a phase advance with increasing age.”
(Boyce, 2003)

Perceptual Impact



Perceptual impact - the role of experience

“Sensation itself has no ‘markers’ for size and distance, these have to be learned on the basis of experience” (Sacks, 1996)

Perceptual impact

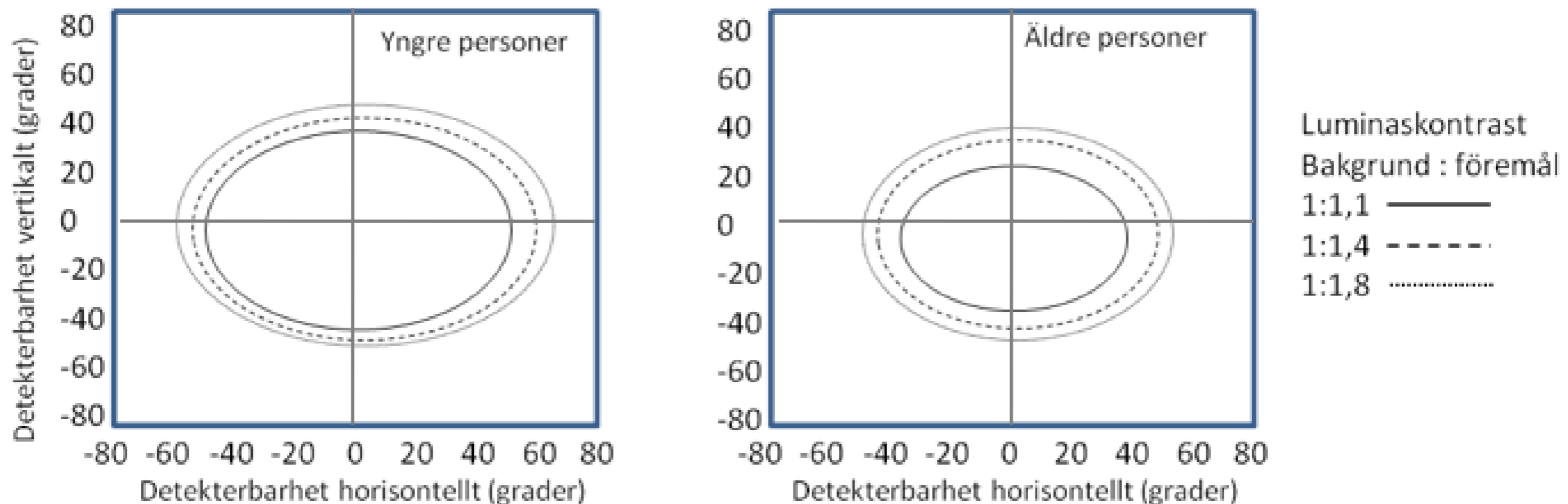
When a person **recognises a place**, he/she acquires all the **associations accumulated** from experience of that type of place, **therefore he/she “owns” that place; this determine whether there will be an action from the person**, for instance switching on or off the lights. (Torrington and Tregenza, 2007).

Perceptual impact

Neural weakness is confounded and amplified by optical changes in the eye (reduced retinal illuminance and spatial resolution) and, together, may contribute significantly to the increased incidence of falls found in older people”
(Figueiro et al., 2008).

Visual impact – visual field experiment

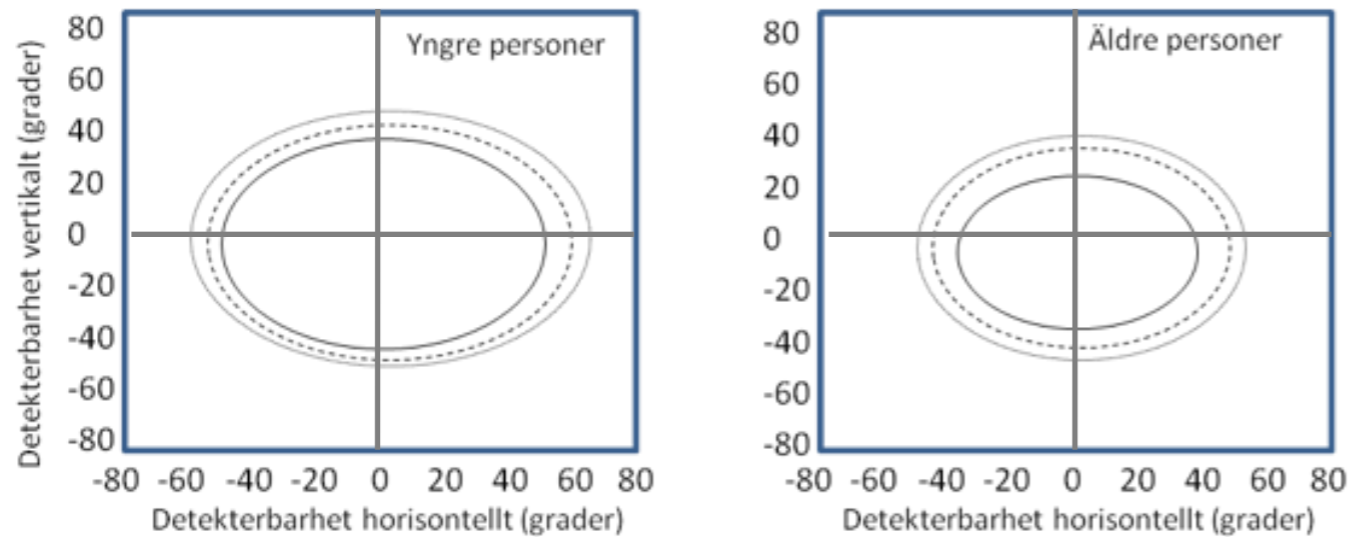
Funktionellt synfält för föremål med varierande luminanskontrast (detektionförmåga 50 %)



Based on the original from CIE 196:2011, page 25.

Visual impact - will the sign be visible?

Funktionellt synfält för föremål med varierande luminanskontrast



Based on the original from CIE 196:2011, page 25.



Study findings

All quality of life factors –general health, physical condition, appetite, contact with relatives, self-confidence, temper, depressed mood, loneliness, vitality, well being– have improved in the intervention group.

Evans et al., 2010 - A pilot study of lighting and low vision in older people

"Our results do not support the concept of 'one light fits all' but rather indicate that older people with reduced vision should be encouraged to participate in determining the light level that they find is best for them"

IES RP 28-07 - Guidelines for good daylight design

- Deliver **diffuse daylight** to the ceiling and vertical surfaces

- Provide **shaded exterior views**

- (...)

IES RP 28-07 - Lighting design recommendations

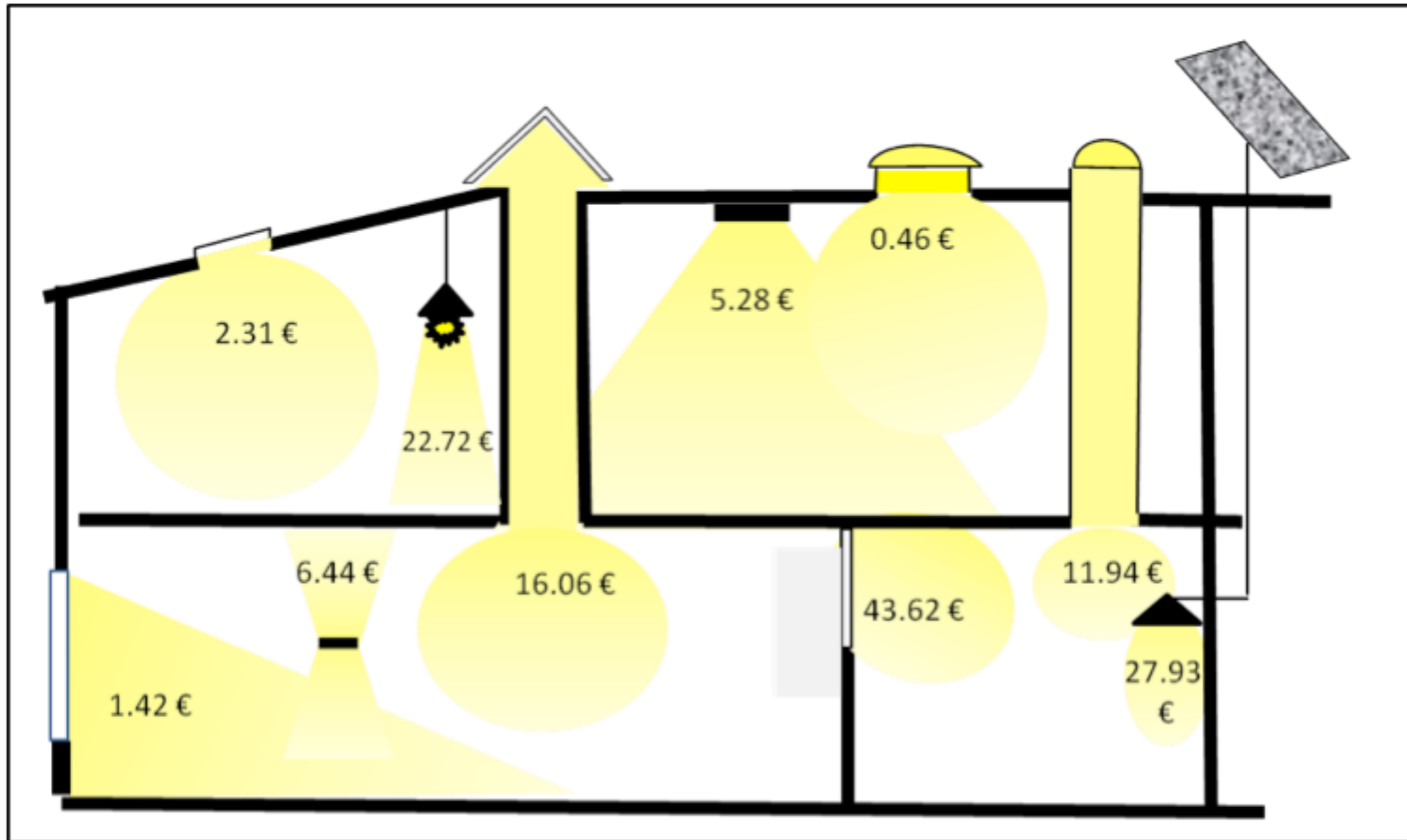
- Provide a minimum of **300 lx**

- Provide **lighting control** for ambient and task lighting

- Provide for an **increase of 50% on the recommended ambient illuminance**

- (...)

Economic impact



Total cost of ownership of various daylight and artificial lighting solutions unit: eur/
Mlm*hr year. Based on the original from Fontanyont, 2009.

Conclusions

In conclusion of this literature review, **it is evident that the aging process affects the perceptual and circadian systems of older adults.**

Conclusions

Better design of daylight solutions could contribute to reach healthy daylight doses.

Conclusions

Nevertheless, from testing on performance reviewed, there is evidence that higher light levels are not per se optimal but that conditions are relative to the task and to the person

Conclusions

Orientation and legibility of signs might be especially hard for older adults: new provisions could address the evidence that colour discrimination, visual acuity and the visual field decrease with age.

Suggestion for **AFS 2009:2** Workplace Design

Daylight only in § 9:

“... there shall normally be adequate daylight and the possibility of an outside view”.

Artificial lighting in §§ 10 to 15:

Include daylighting within these sections

AV would extend the control over lighting conditions in day-lit environments as well.

Conclusions

Providing solutions to the question **‘how older adults perform in daylight’** is a **design opportunity** and a **design issue**.

As such it should be taken in consideration from the start of the design process of a building; and **it should be offered new research opportunity**.



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