

# Daylightful indoors

**Daylightful  
indoors**  
what we see and  
what we perceive

**Prof. Marilyne Andersen**

*EPFL professor and Head of LIPID lab  
Academic Director of Smart Living Lab  
Co-Founder of OCULIGHT dynamics*

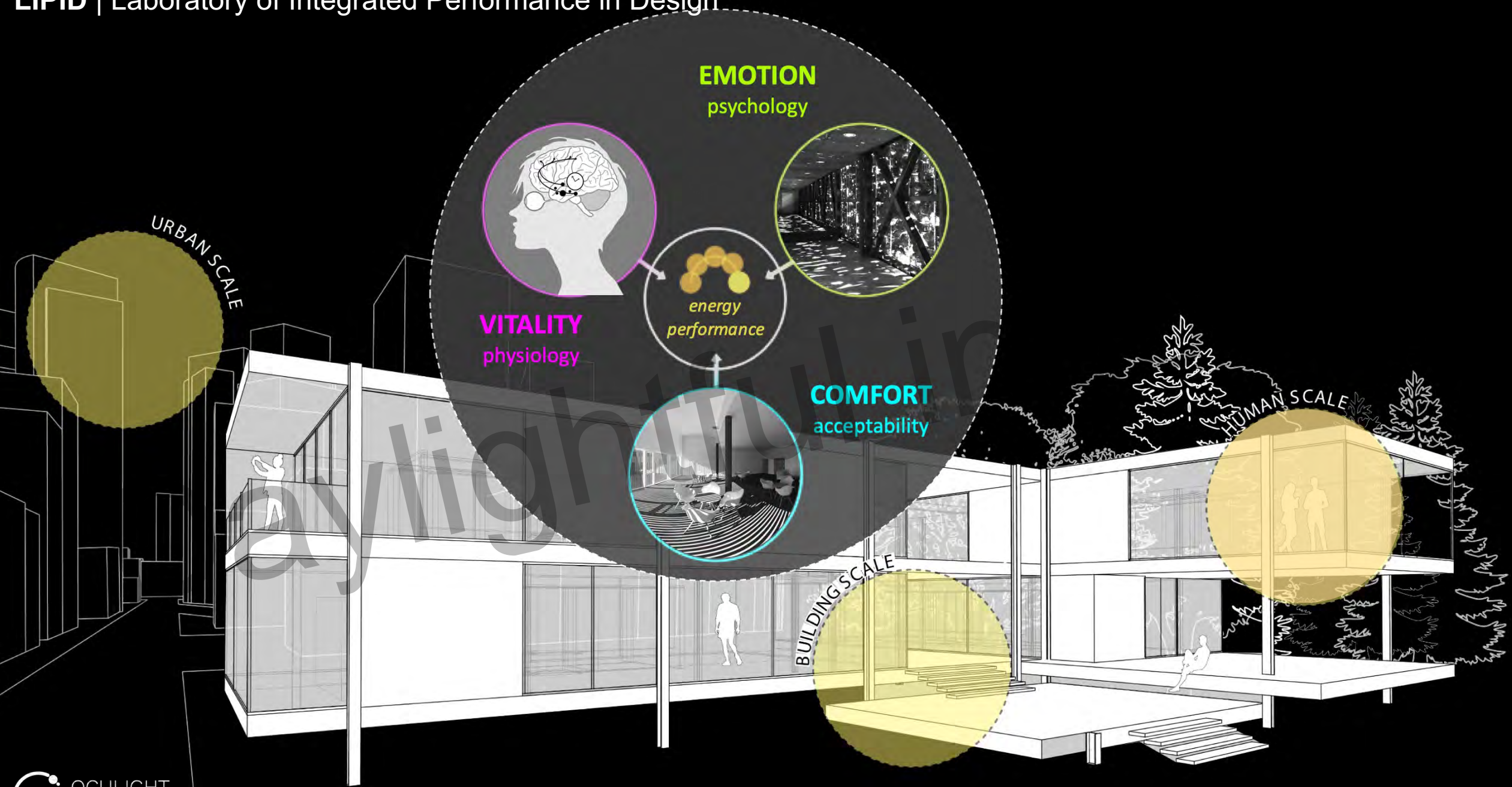
Lund University | CHIE seminar

LTH Faculty of Engineering | April 27, 2023



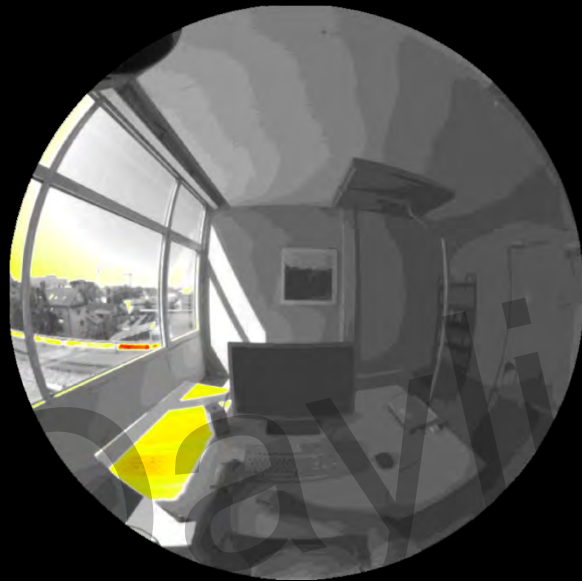


Daylightful indoors



# visual discomfort and gaze dynamics

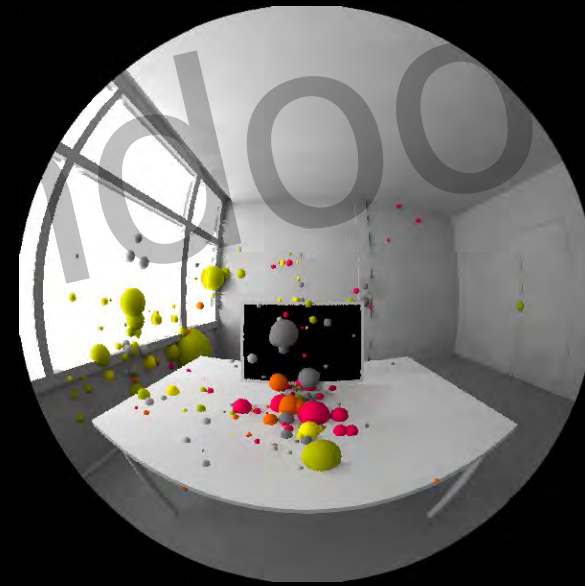
Prof. Mandana Sarey Khanie  
LIPID PhD+PostDoc alumna  
Asst. Prof. at DTU, Denmark



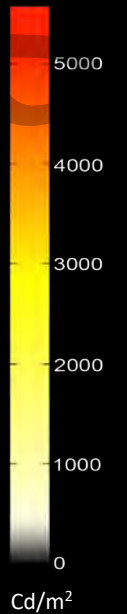
perceived light



field of view



talking on the phone



Dr. Jan Wienold  
Senior Scientist at LIPID, co-advisor

# visual and thermal comfort interactions



Prof. Giorgia Chinazzo  
*LIPID PhD+PostDoc alumna*  
*Asst. Prof. of Instruction at Northwestern U, USA*



- does thermal perception depend on **color of light**?

Your Rainbow Panorama by Studio Olafur Eliasson



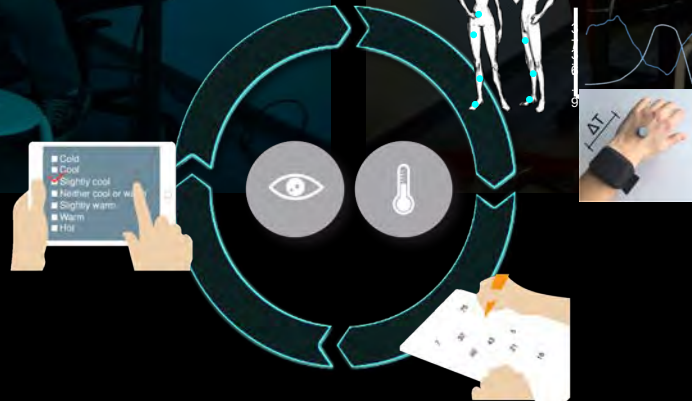
# visual and thermal comfort interactions



color of light & temperature



light quantity & temperature



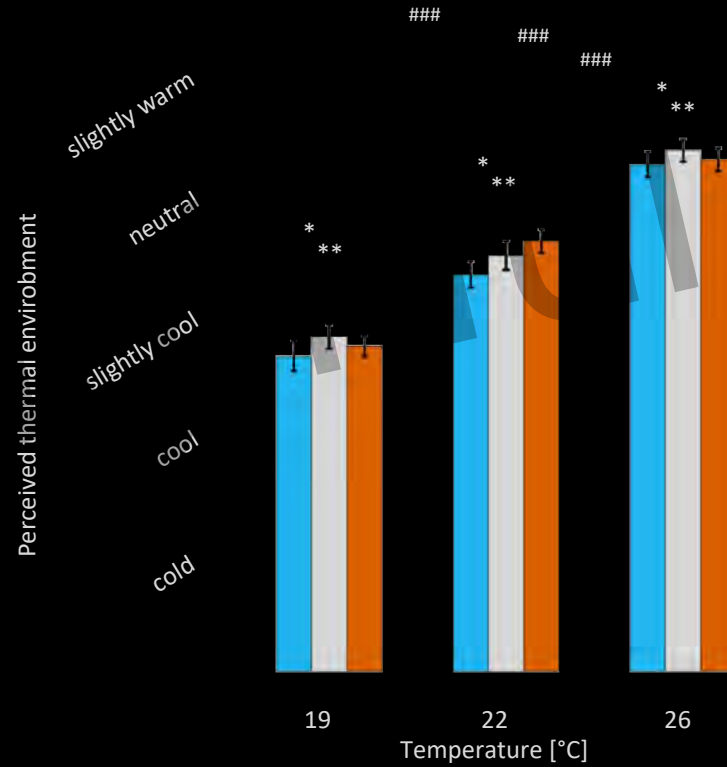
# visual and thermal comfort interactions



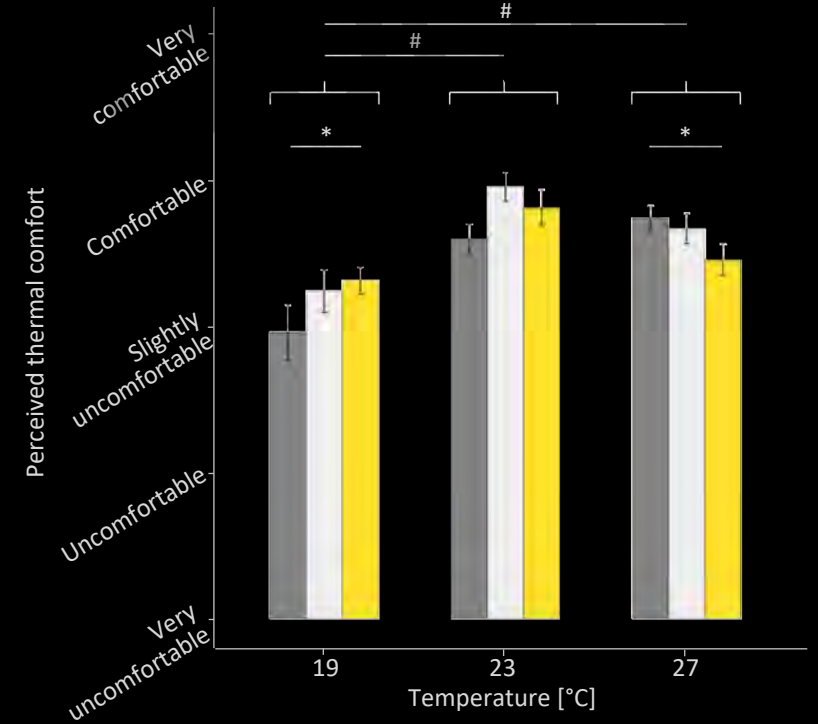
impact of visual environment on thermal perception

impact of brightness on thermal comfort

color of light & temperature



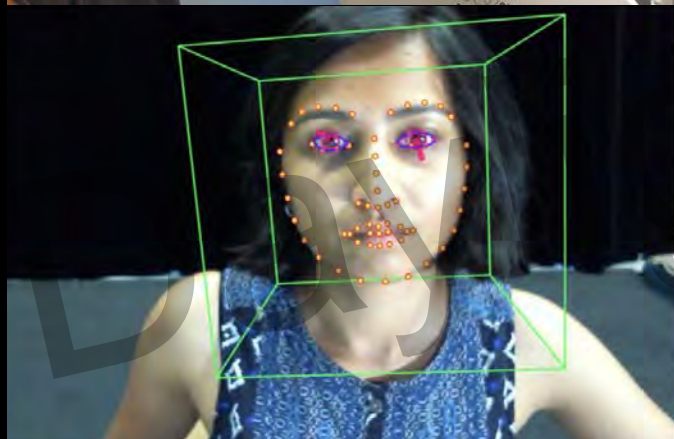
light quantity & temperature



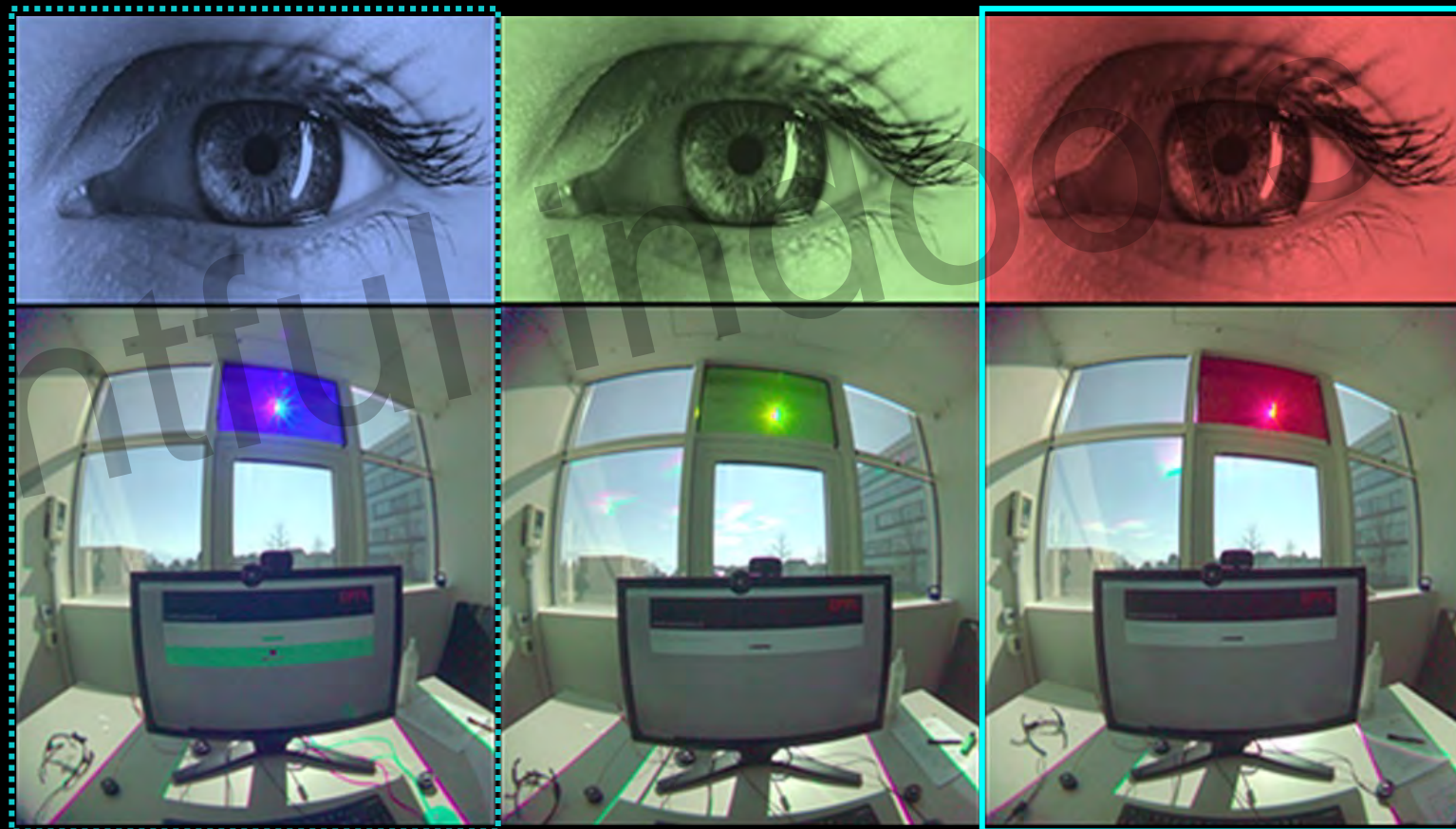


# visual discomfort and color

Sneha Jain  
PhD Candidate



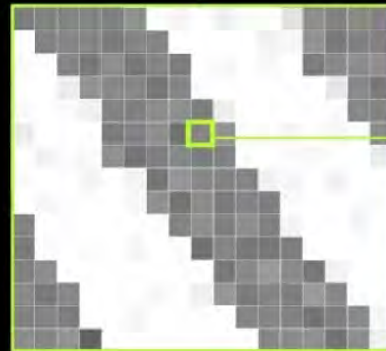
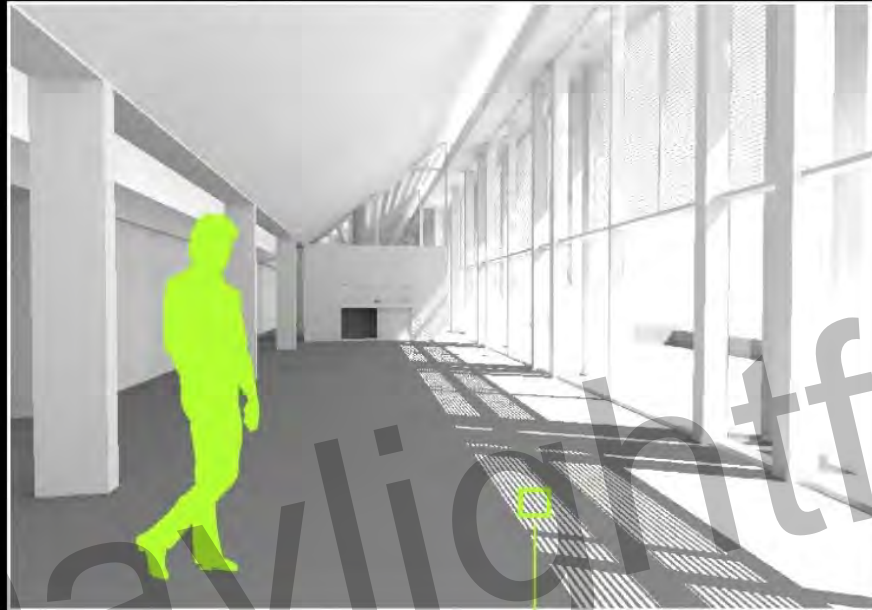
macular pigmentation (MPOD)  
and light-induced eye responses



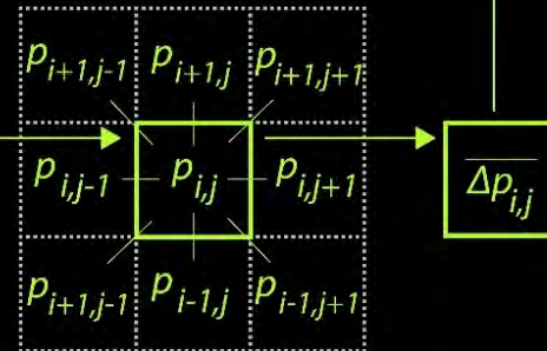
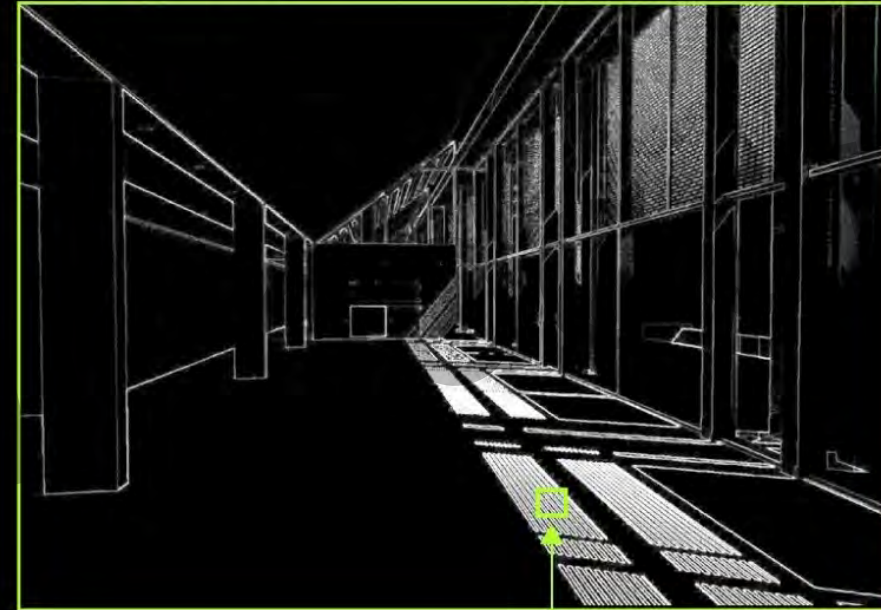
# spatial contrast



luminance map



spatial contrast



# spatial contrast

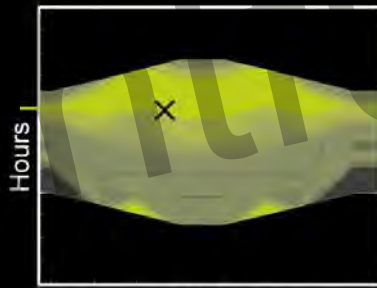
dynamic spatial and temporal qualities of daylight



Serpentine Pavilion  
Toyo Ito



exciting

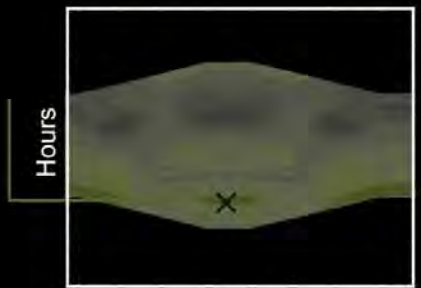


Days

First Unitarian church  
Louis Kahn

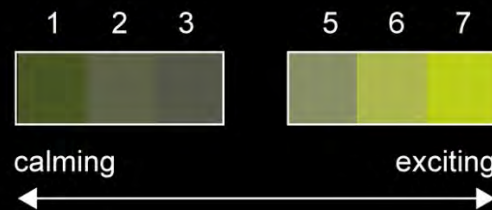


calming



Days

rating scale



# daylight patterns

Prof. Kynthia Chamilothoni  
*LIPID PhD alumna*  
Asst. Prof. at TU Eindhoven, NL



regular pattern



irregular pattern



stripes



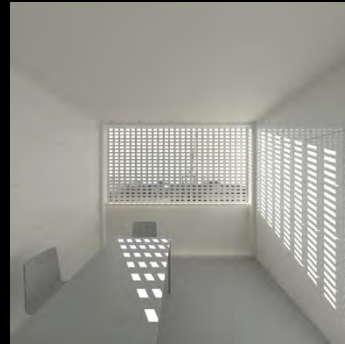
Demonstration of the experimental setup by G. Chinazzo



# daylight patterns



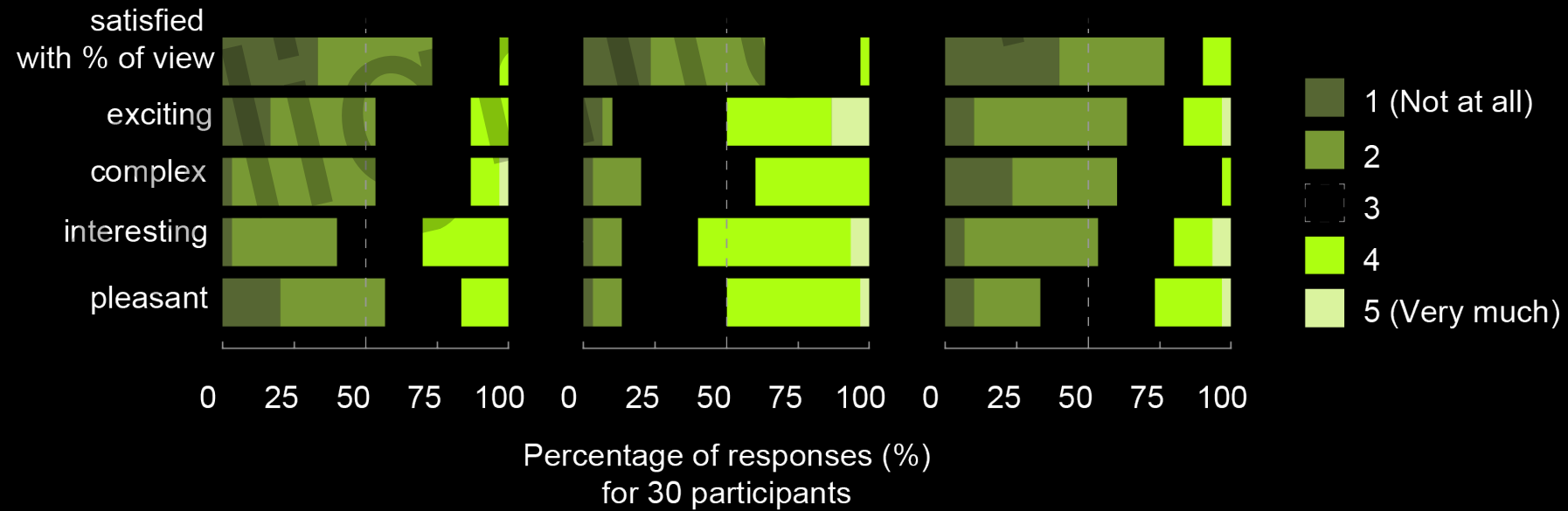
regular pattern



irregular pattern



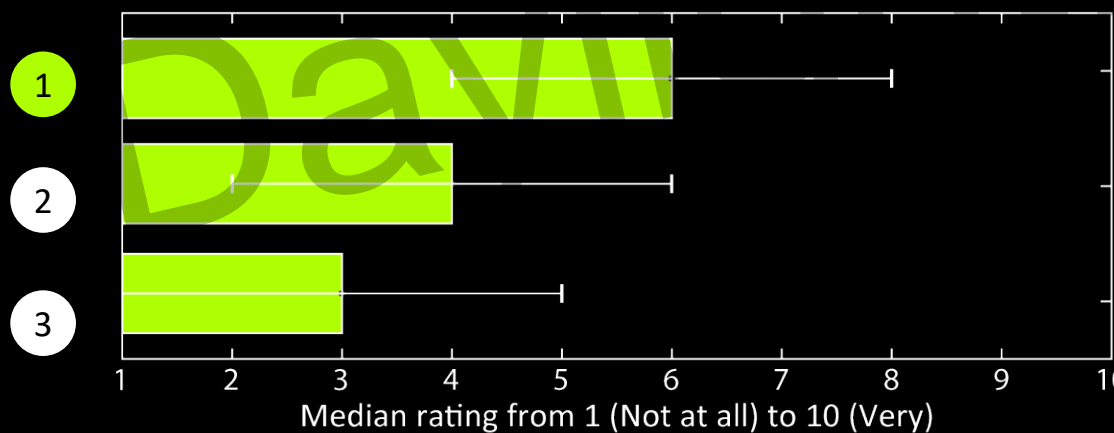
stripes



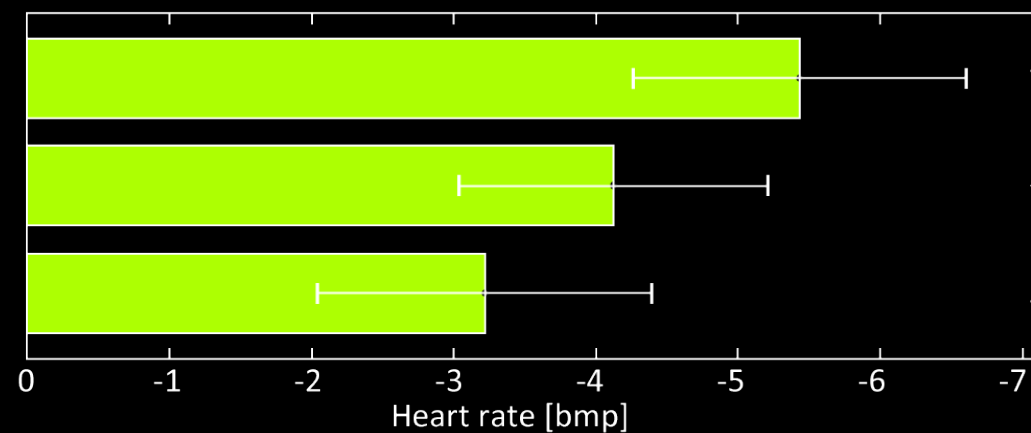
# daylight patterns



How interesting is this space?

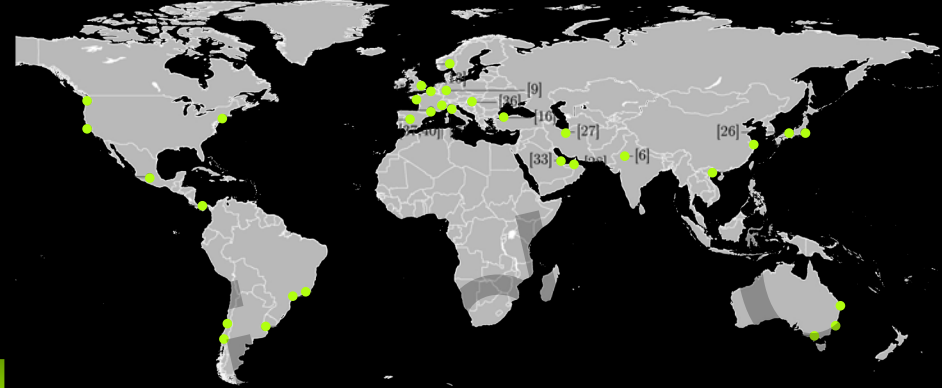


Mean heart rate [measurement - baseline]



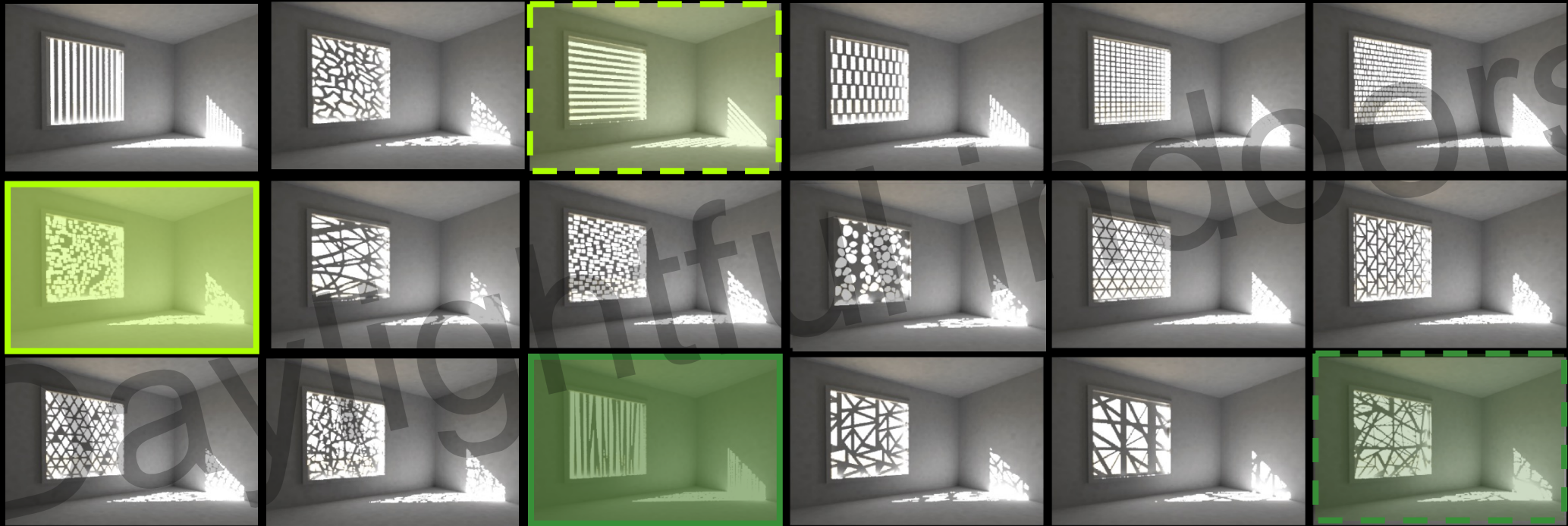
# façade patterns

*inspiration from worldwide architecture*



# façade patterns and daylight composition

consensus on pattern attributes (from designers)



POSITIVE



most exciting



most calming

NEGATIVE



least exciting



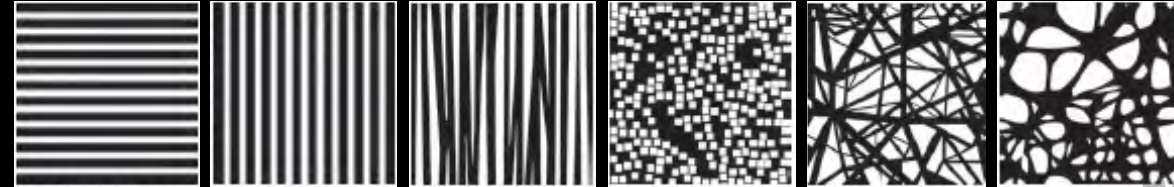
least calming



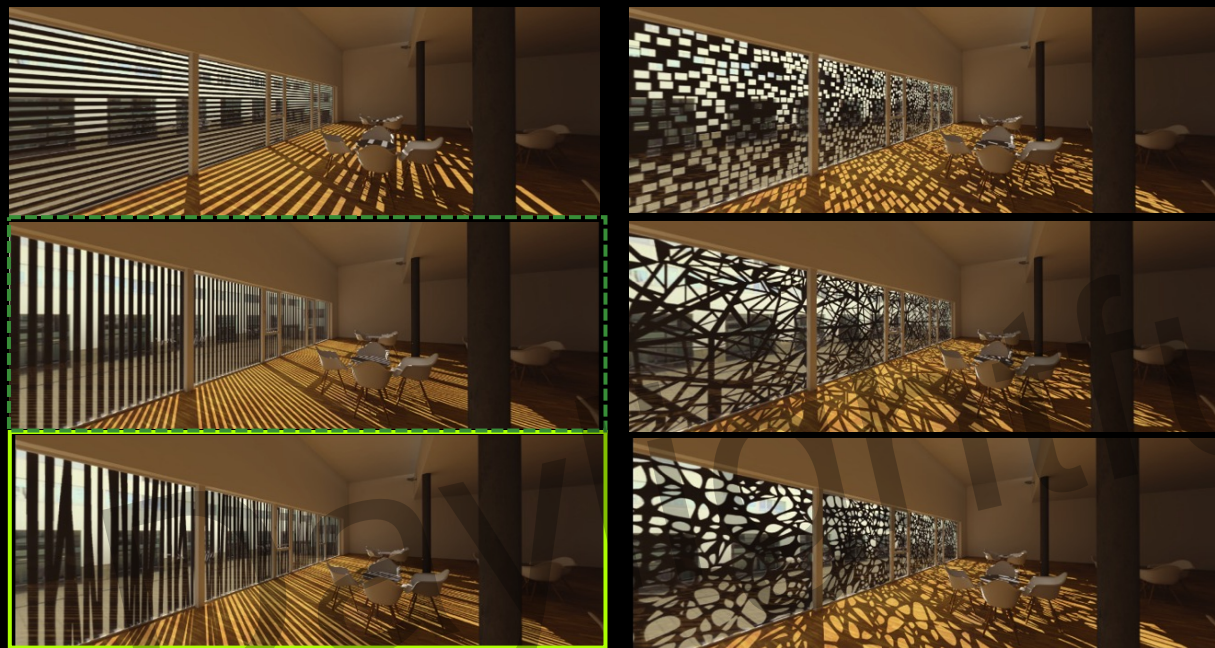


# assessing human response to daylight patterns

VR immersion

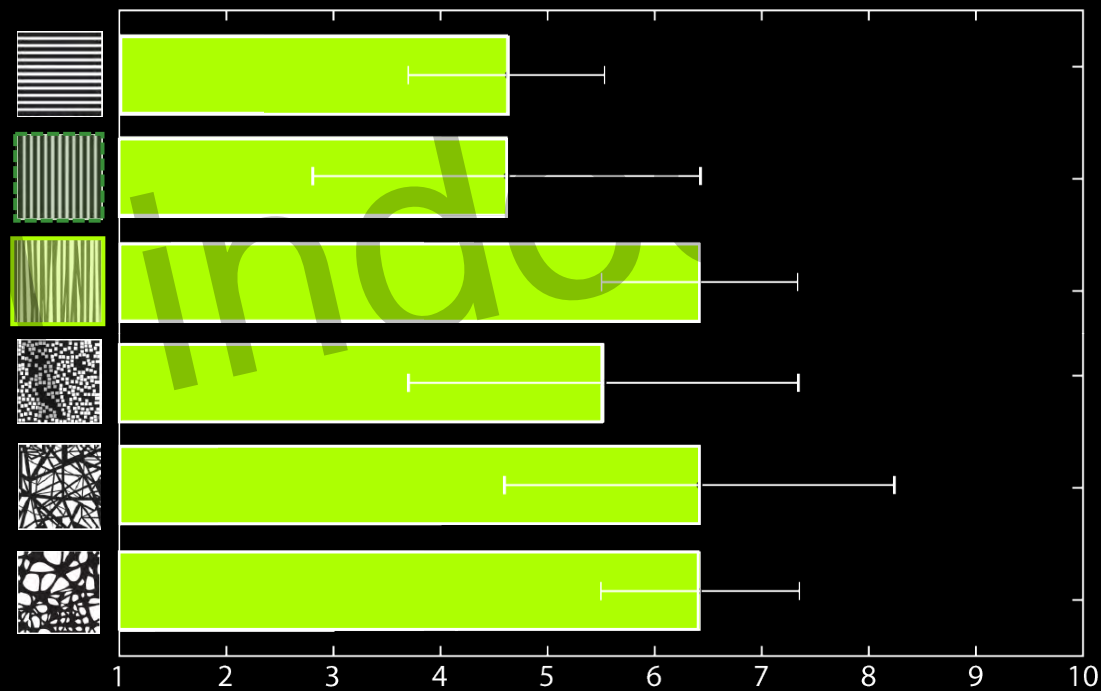


# daylight patterns



■ one of the most exciting

■ one of the least exciting



Median rating from 1 (Not at all) to 10 (Very)  
by 415 participants from Greece, Switzerland, and Norway



# perception and appraisal of views out

Yunni Cho | Stella Z. Zhang  
PhD Candidates

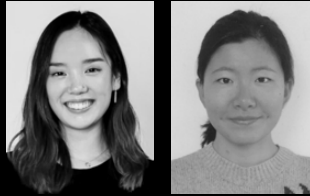


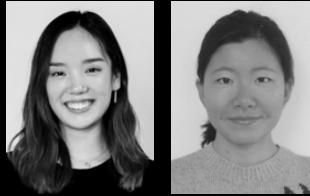
Image by: Yunni Cho, 'biophilia (noun)', SciFilmIt Hackathon 2021



**Prof. Caroline Karmann**  
Assoc. Prof at KIT, Germany  
LIPID PostDoc alumnus, co-advisor

# perception and appraisal of views out

*influence of naturalness and dynamics*



Yunni Cho | Stella Z. Zhang  
*PhD Candidates*



movement and daylight changes



Komorebi-inspired patterns and view enhancement





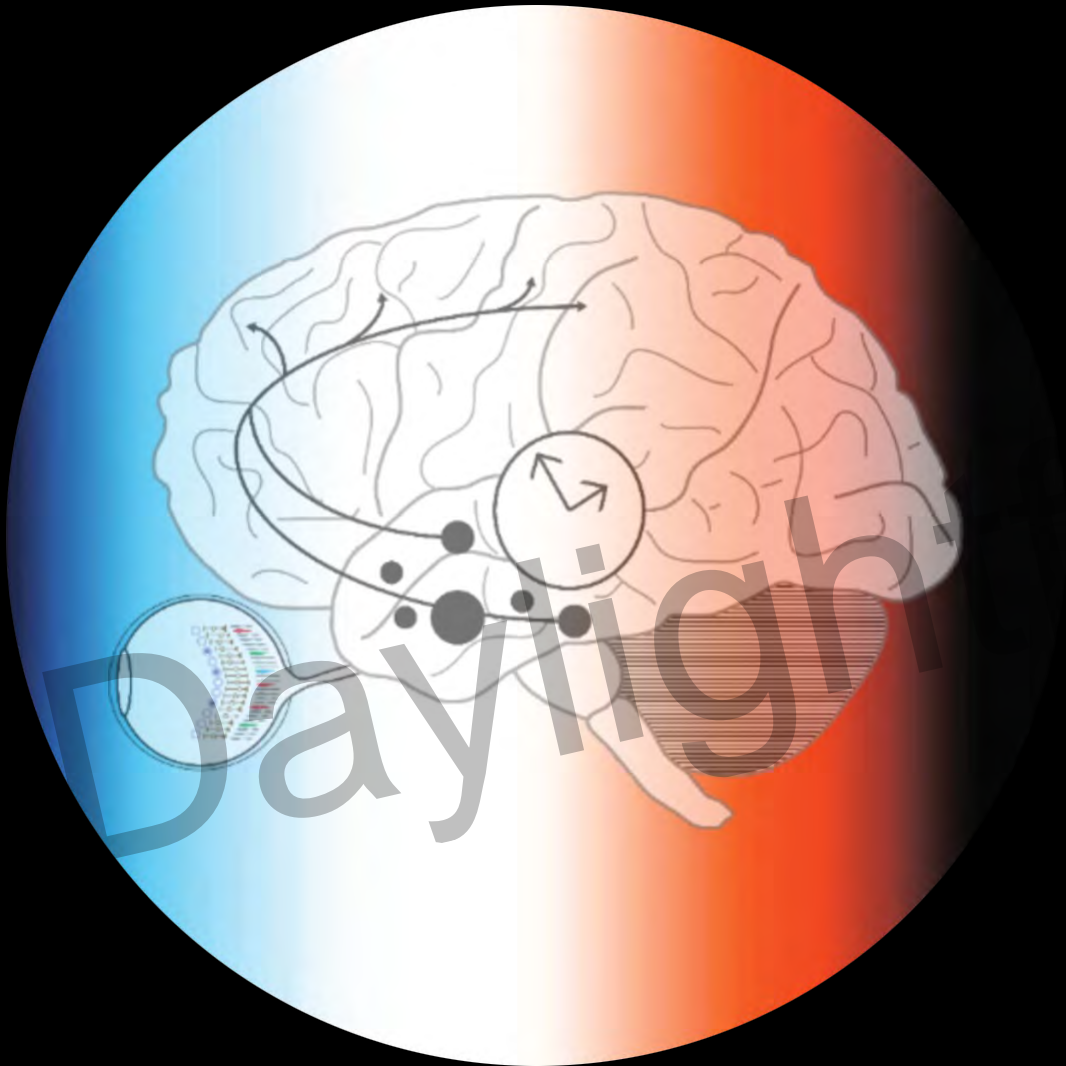


# HEALTH IMPACTS

Images credit: Megan Danell, EPFL-LIPID



photobiology



SENSITIVITY

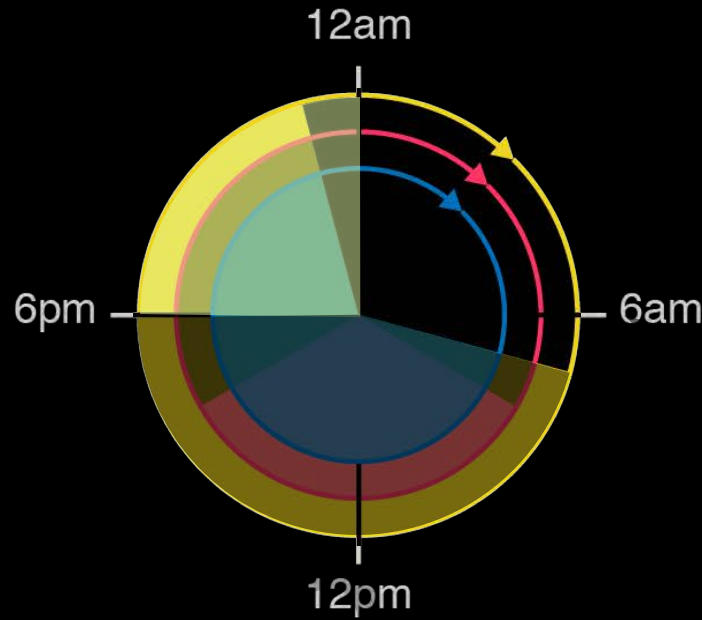


CIRCADIAN RHYTHMS

Images credit: Megan Danell, EPFL-LIPID

# biological clock

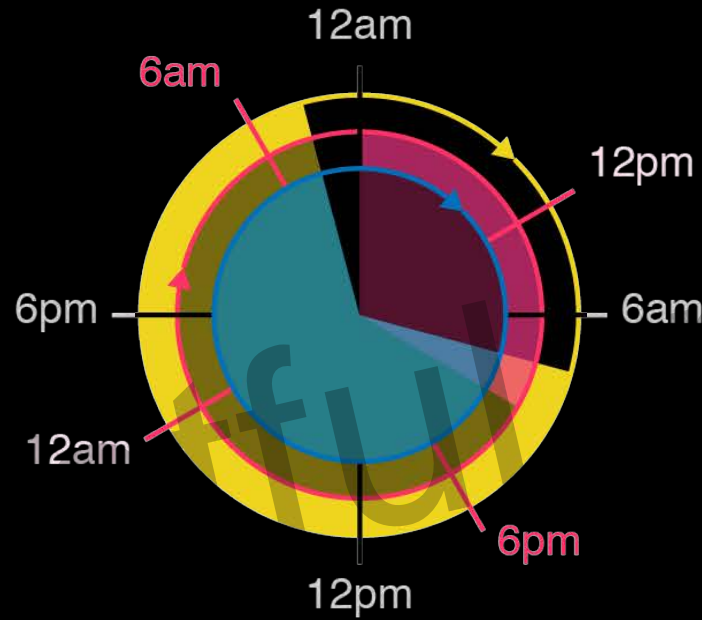
Dr. Maria L. Amundadottir  
LIPID PhD alumna  
Co-founder of OCULIGHT, data scientist



**Entrained clocks**



solar clock

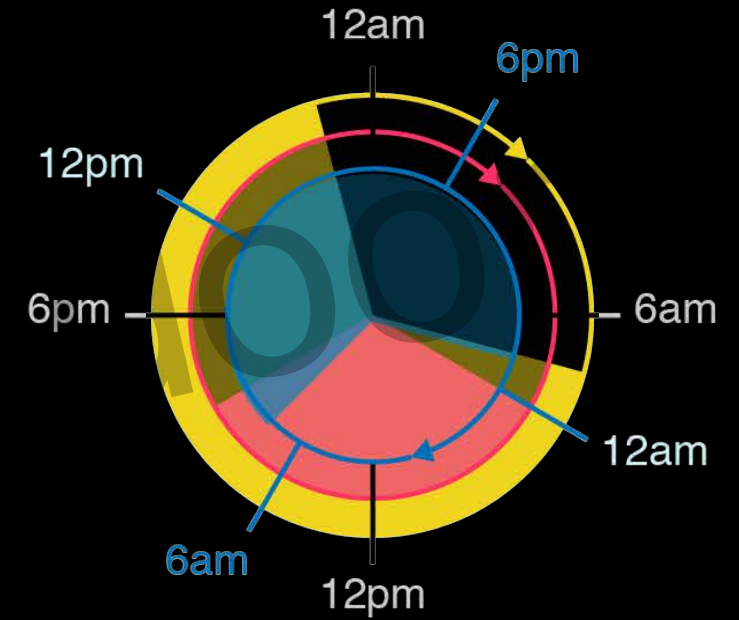


**Shift work**

- work schedule not regulated with internal clock



social clock



**Jet lag**

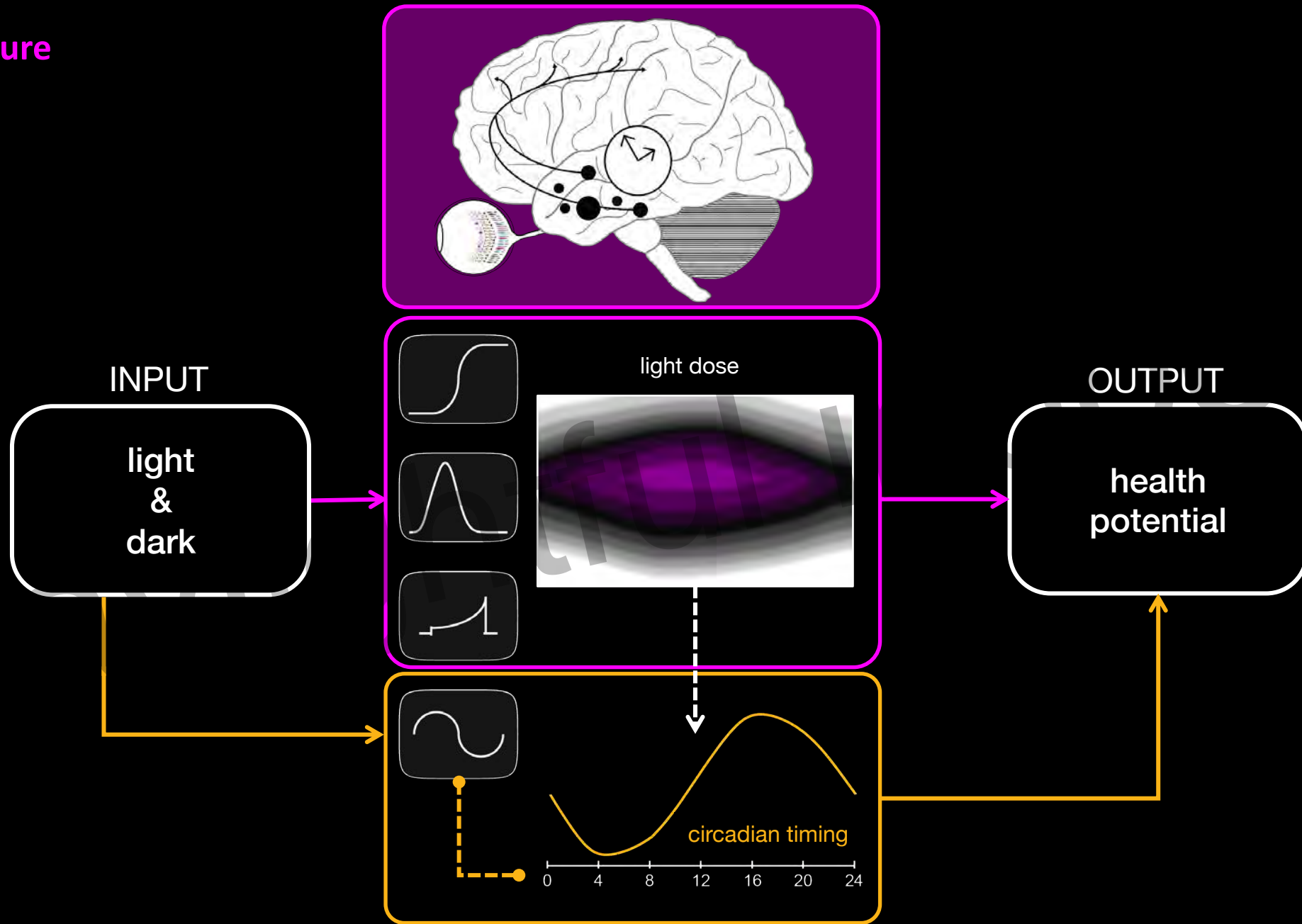
- internal clock not regulated with external clock



circadian clock



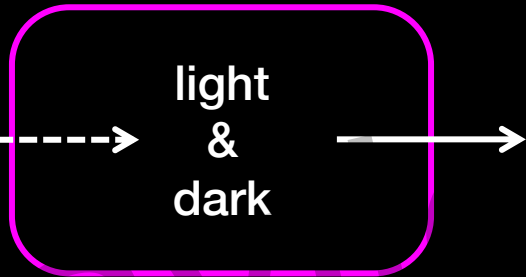
# light exposure



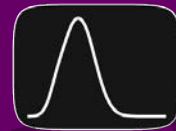
# light exposure



- intensity
- wavelength
- duration
- timing
- history



higher levels are more effective



blue light is more effective



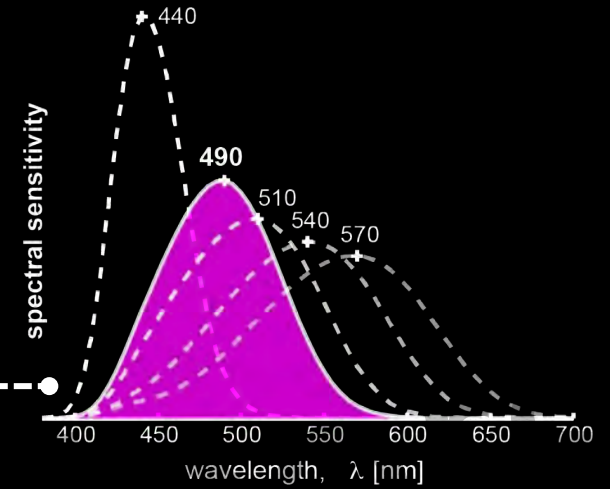
brief intermittent pulses are also effective



timing of circadian rhythms



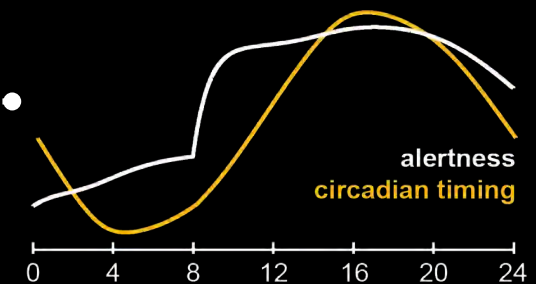
adaptation to changes in light exposure



continuous

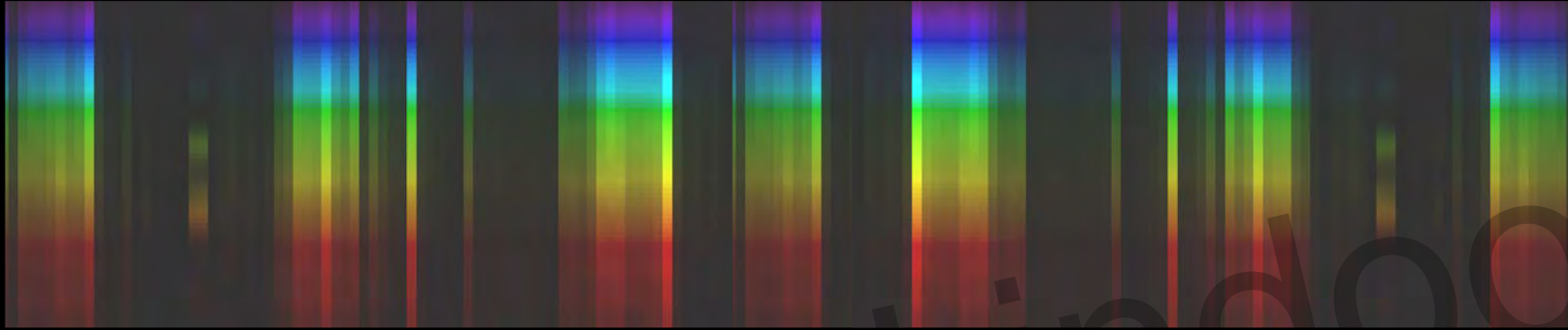


intermittent



# light hygiene

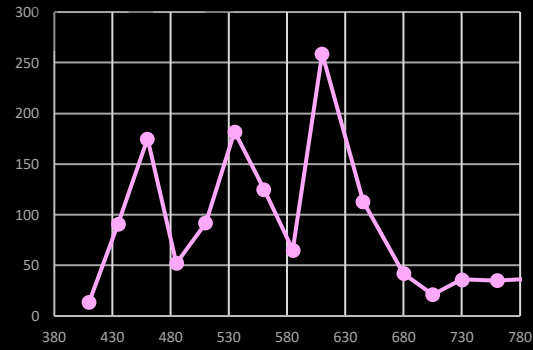
Dr. Forrest Webler  
*LIPID PhD alumnus*  
*then CTO at LYS Technologies*



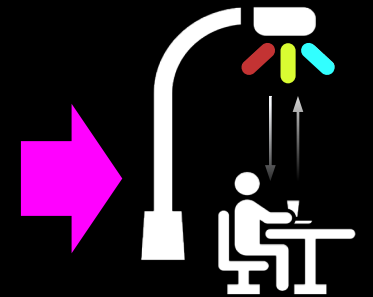
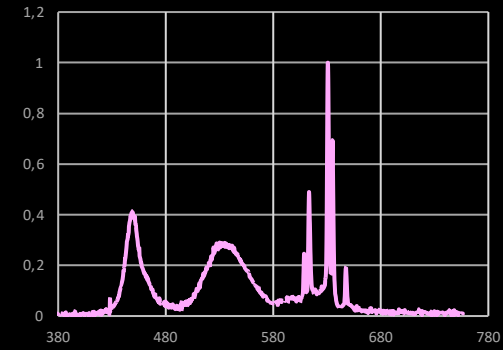
'hyperspectral' scenes



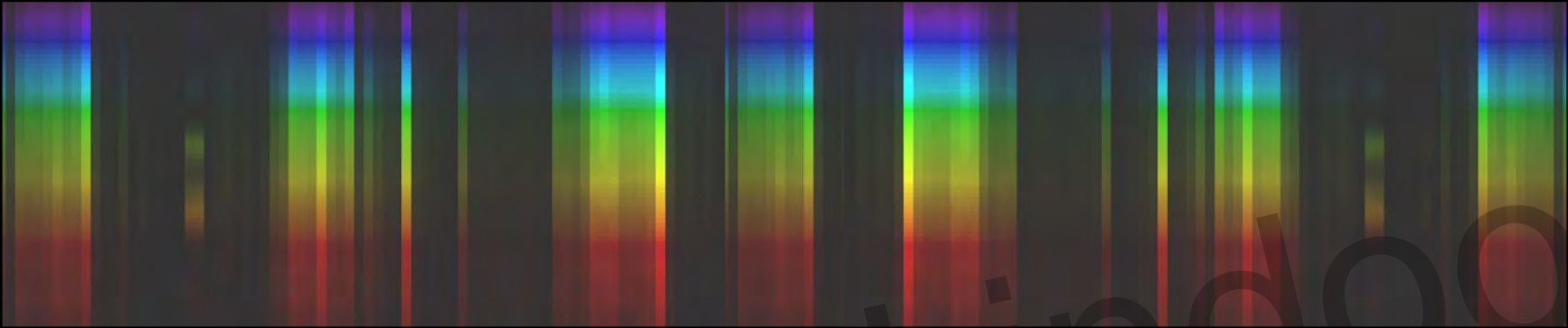
spectral monitoring



SpecRA™



light hygiene



exposure to (day)light... in time and space



Steffen Hartmeyer  
PhD Candidate



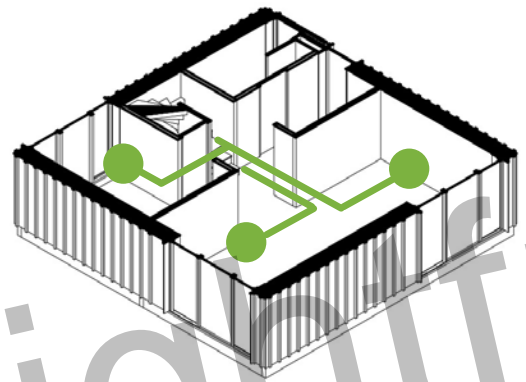
$S(\lambda)$



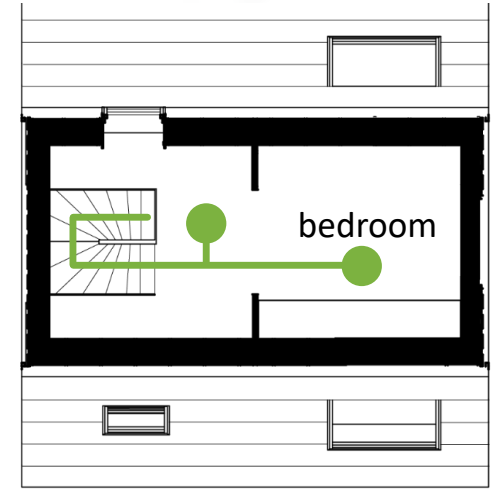
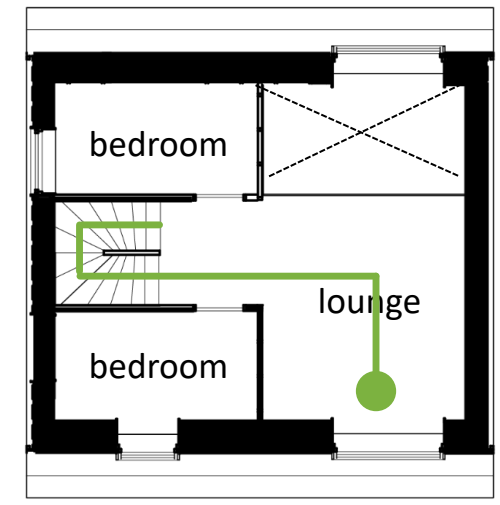
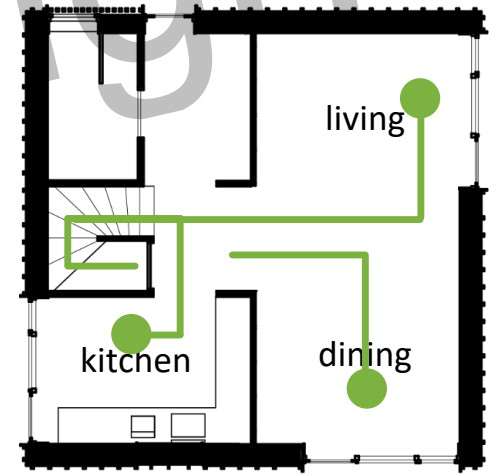
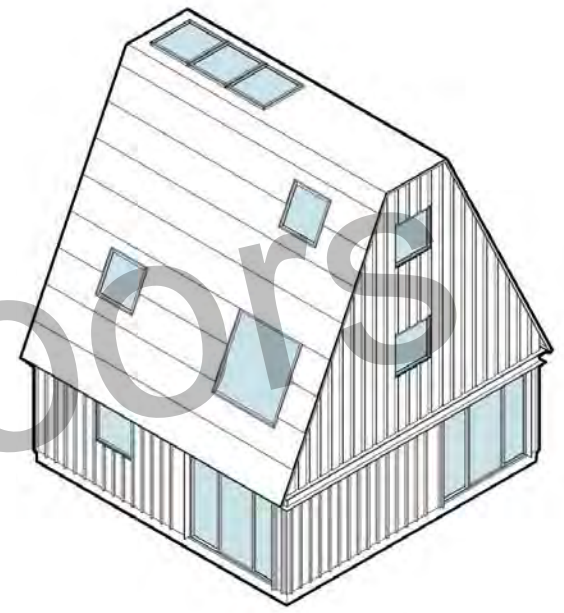
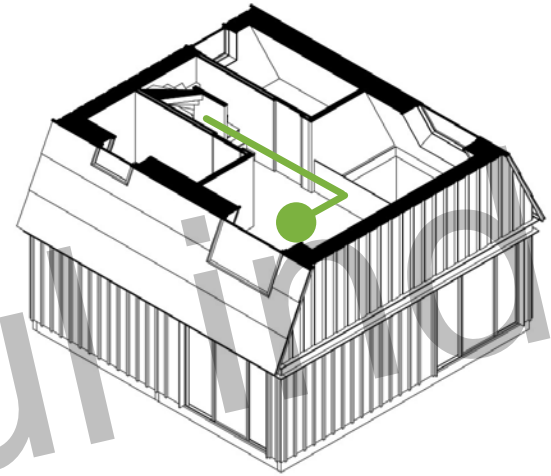
Build for Life house prototype, Denmark  
Effekt Arkitekter

# exposure to (day)light... in time and space

1st

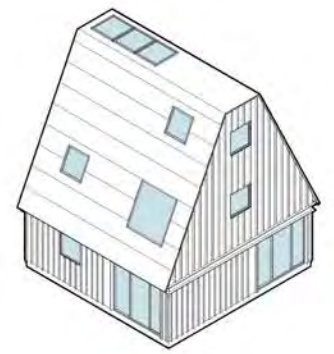
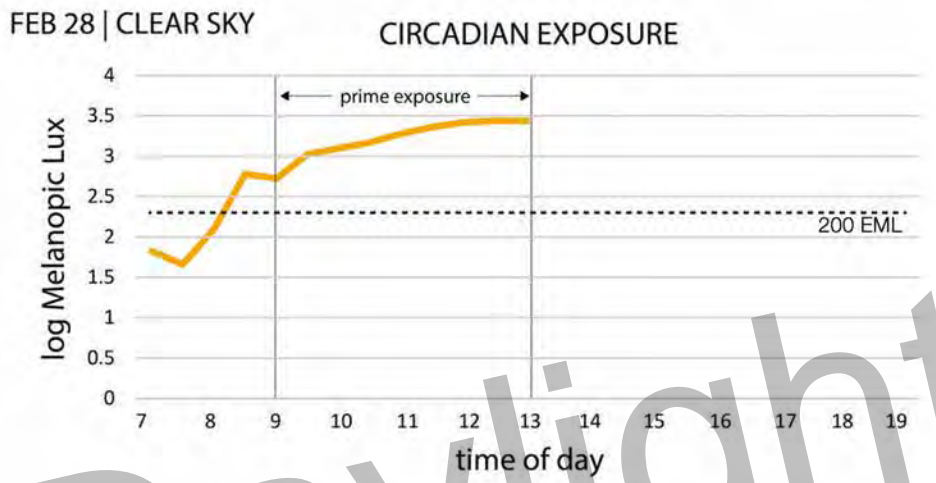


2nd



Build for Life house prototype, Denmark  
Effekt Arkitekter

# exposure to (day)light... in time and space



Build for Life house prototype, Denmark  
Effekt Arkitekter

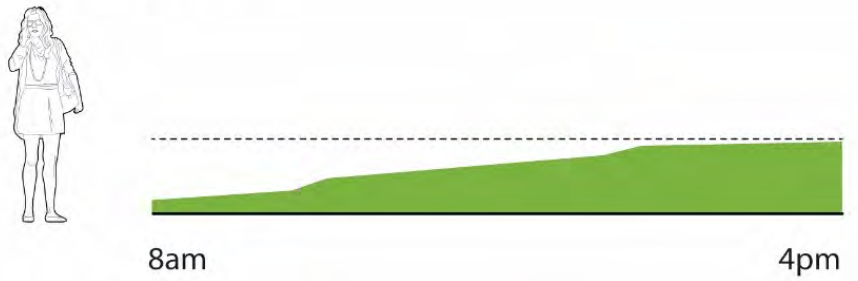
# exposure to (day)light... in time and space



grad student



assistant professor





DATE

SKY CONDITIONS

FLOORS

PROGRAM USE

< May 6 >

☀️ Clear ☁️ Overcast

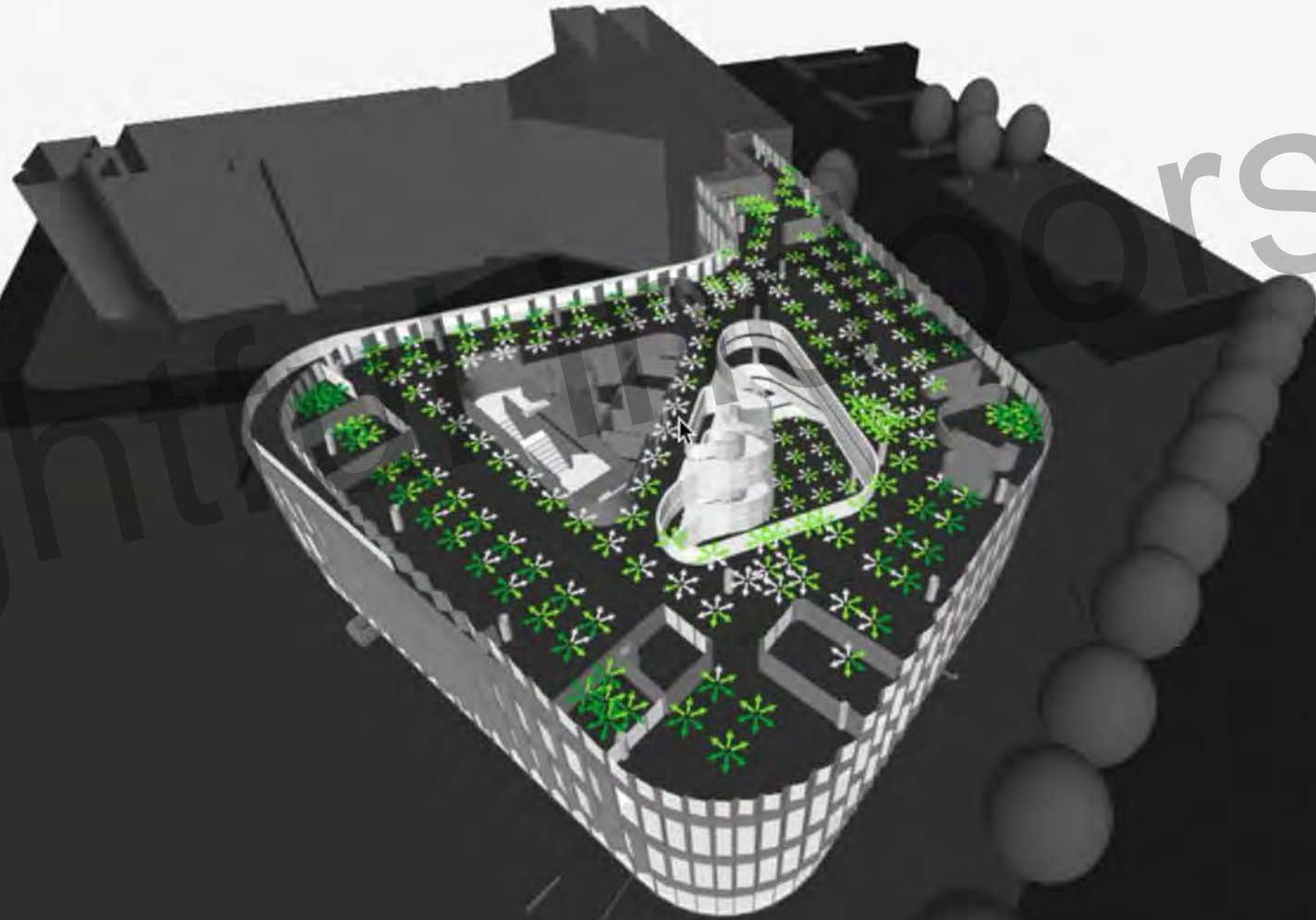
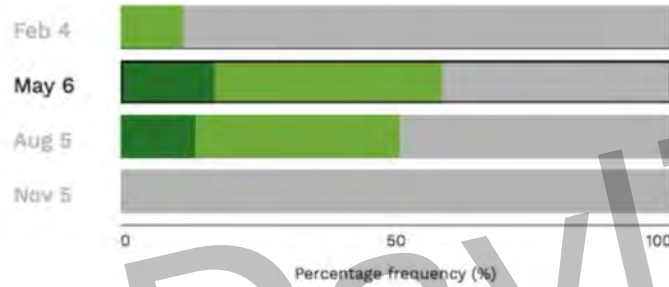
1st floor 4th floor

circulation maximum\_focus medium\_focus minimum\_focus minimum focus medium focus maximum

### Vitality

Vitality describes the non-visual potential of daylight to impact alertness as it accumulates over time. [Read more](#)

- insufficient daily dose ( $nvR_D < 4.2$ ) 42%
- intermediate daily dose ( $4.2 \leq nvR_D \leq 8.4$ ) 41%
- recommended daily dose ( $nvR_D > 8.4$ ) 17%



4th floor

3XN | DENMARK

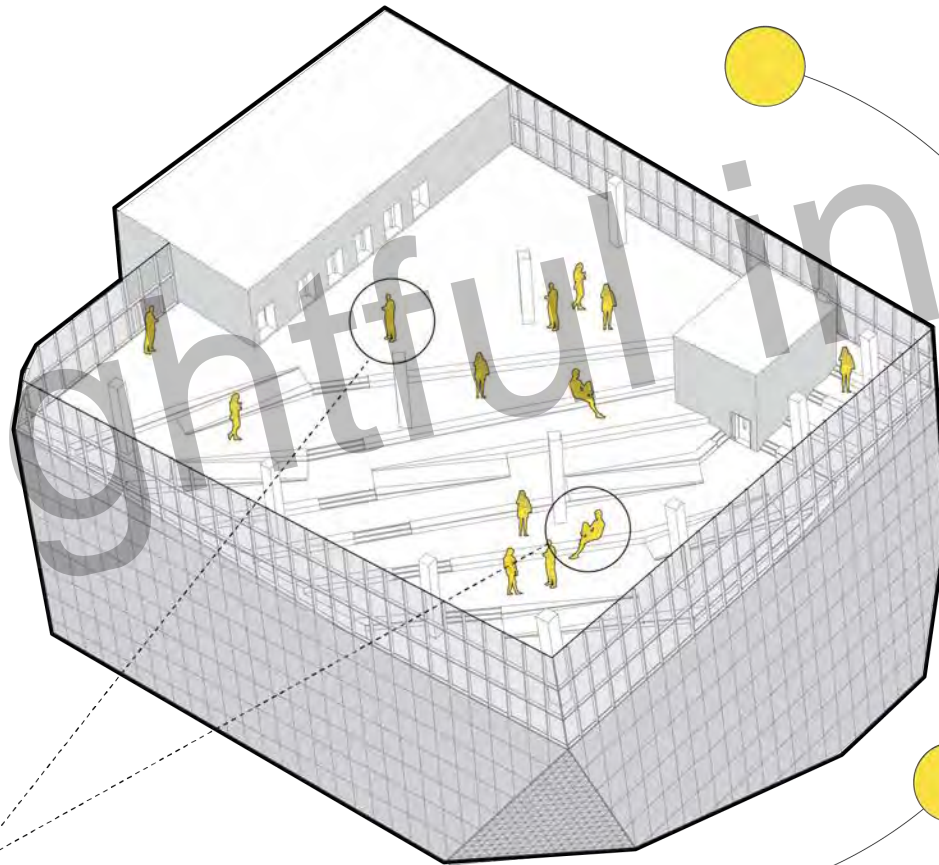
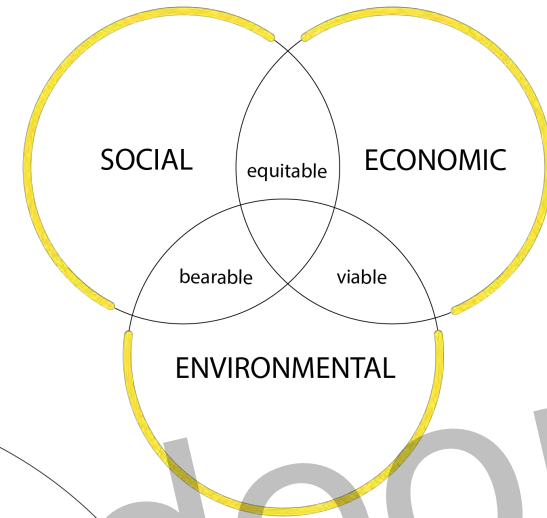
Schuco Headquarters

3D

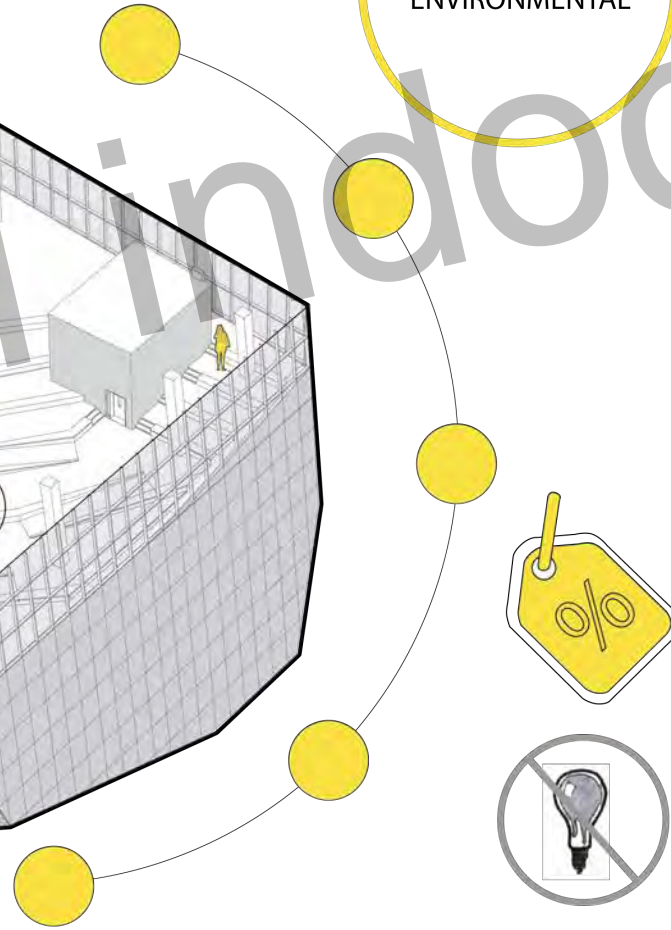
+

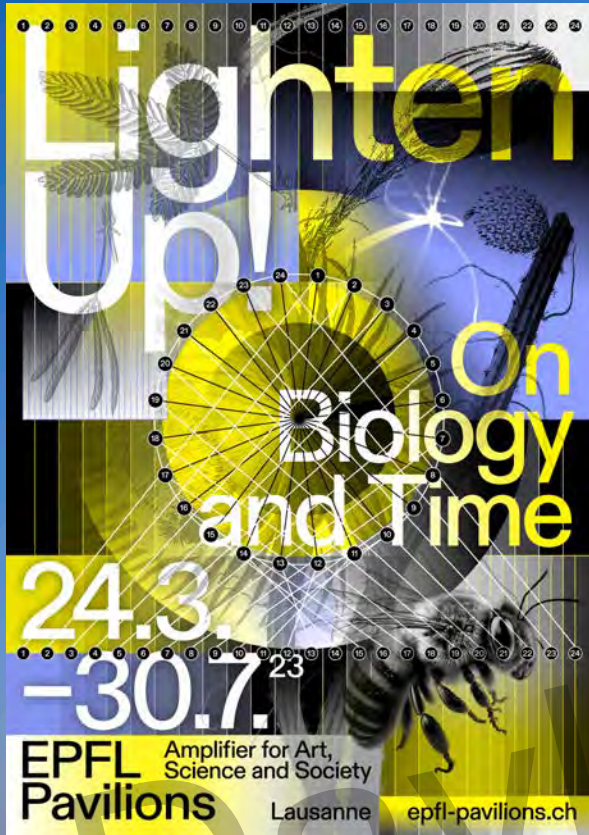
-

# REVISITING SUSTAINABILITY ...



Davlightful indoors





**Lighten  
Up!**

**On  
Biology  
and Time**

**24.3.  
-30.7.<sup>23</sup>**

**EPFL** Amplifier for Art,  
Science and Society  
**Pavilions** Lausanne [epfl-pavilions.ch](http://epfl-pavilions.ch)



# CIRCA DIEM

Marilyne Andersen *et al.*  
2021-2023









Daylightful indoors



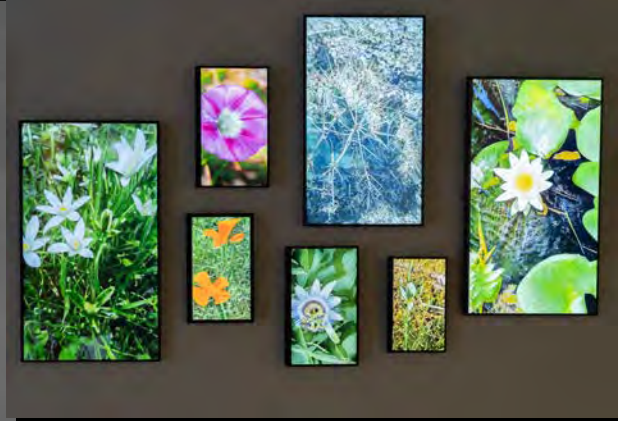
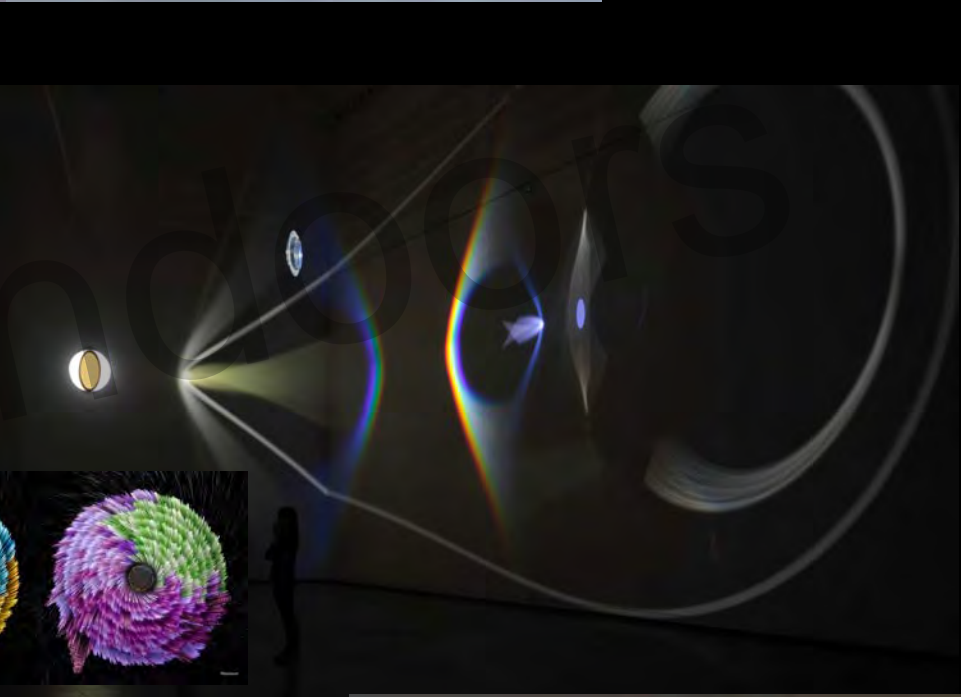
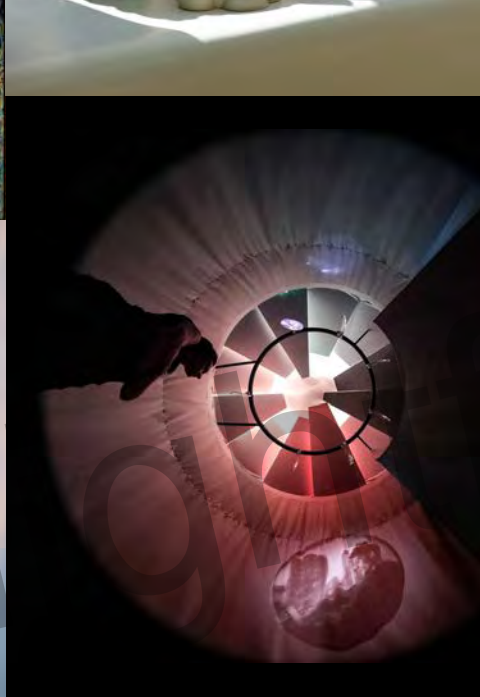
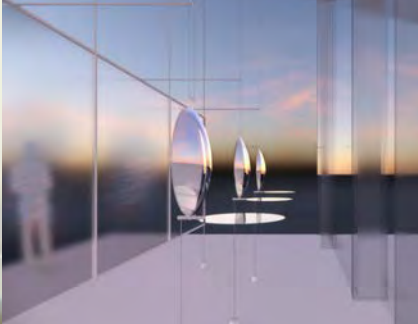
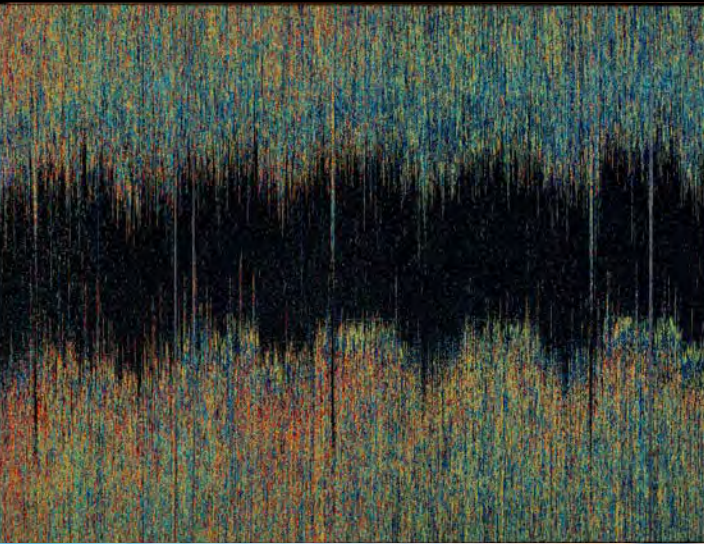




 **RAYFORM**  
Reshaping light

Courtesy of Prof. Mark Pauly, GCM lab, EPFL







# Sunlightful indoors

WAKING UP IN THE MORNING IS  
A CHALLENGING TASK  
GENERATING  
MENTAL BODY TIME

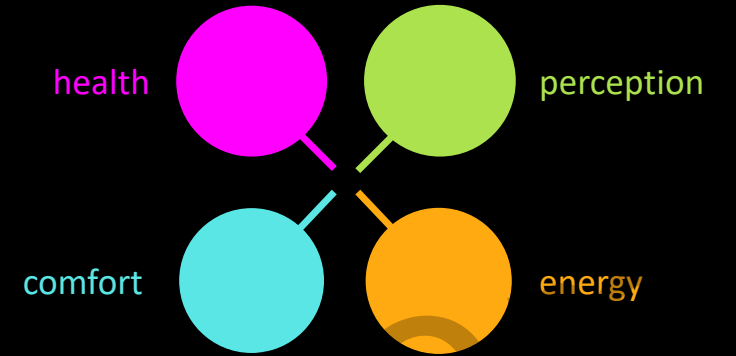
# LIPID | Laboratory of Integrated Performance in Design



**Prof. Marilyne Andersen**  
Head of LIPID



**Dr. Jan Wienold**  
Senior Scientist



LIPID Alumni

LIPID PhDs and PostDocs

LIPID Alumni



main support for this research from:



SWISS NATIONAL SCIENCE FOUNDATION

VELUX STIFTUNG



Horizon 2020  
Marie Skłodowska-Curie grant



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra  
Swiss Confederation

Innosuisse – Swiss Innovation Agency

