Experiencing daylight indoors

Prof. Marilyne Andersen

EPFL professor and Head of LIPID lab

Academic Director of smart living lab

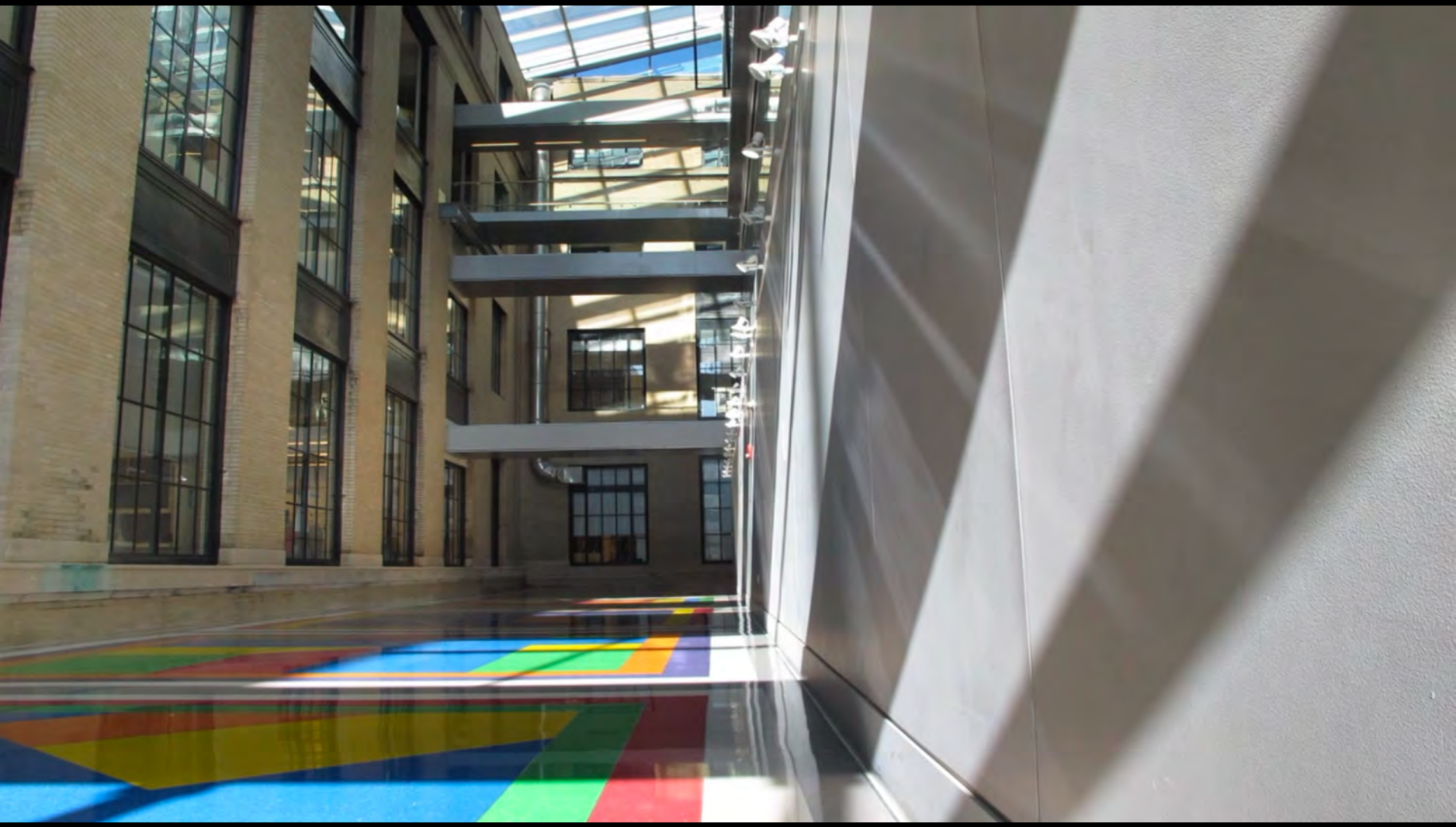
Co-Founder of OCULIGHT dynamics

SinBerBEST symposium – August 5, 2019

LIPID
Laboratory of Integrated Performance in design

OCULIGHT dynamics

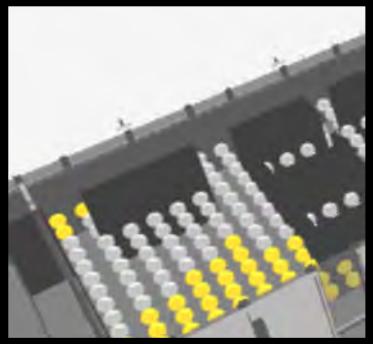
DAYLIGHT IS FAMILIAR, BUT NOT ALWAYS INTUITIVE



BEYOND ILLUMINATION

where and when healthy, stimulating, and comfortable light will to occur ...

GRID-BASED
adequate
task lighting



+

VITALITY
physiology

COMFORT
acceptability

EMOTION
psychology

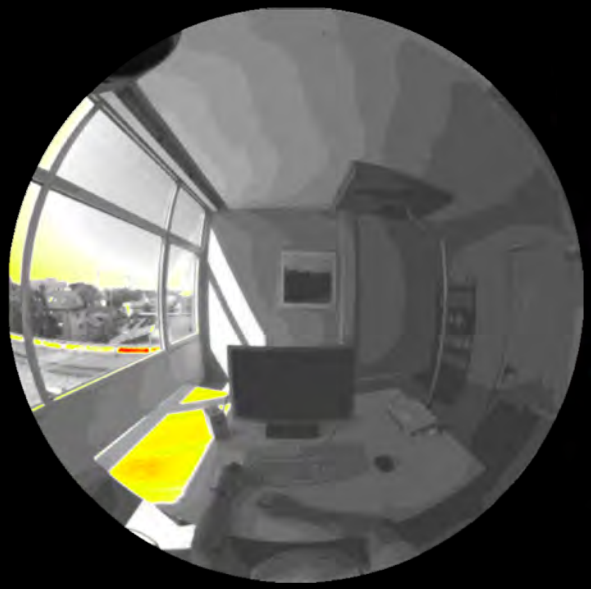
... dynamically over time & space

OCULIGHT dynamics

EPFL

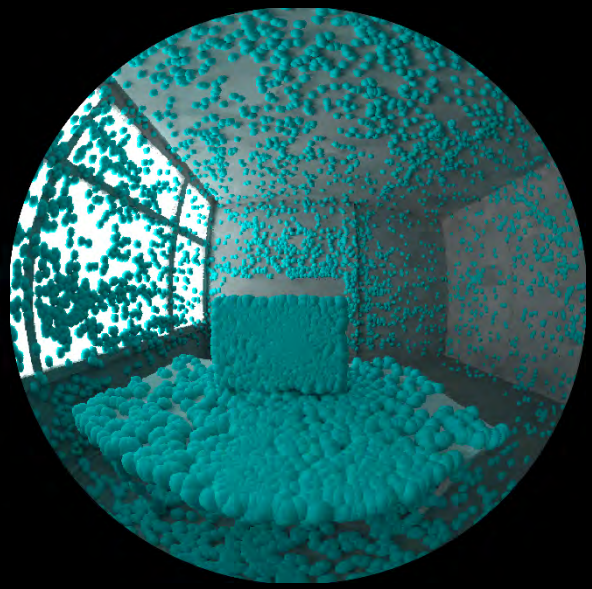
visual comfort dynamics

gaze behavior based on lighting conditions and task

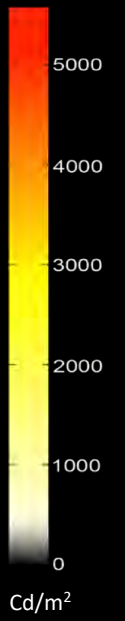


perceived light

field of view



gaze response

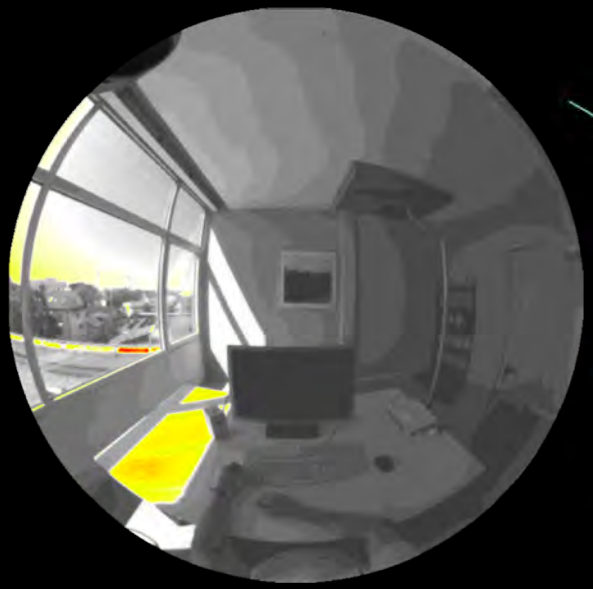


EPFL

visual comfort dynamics

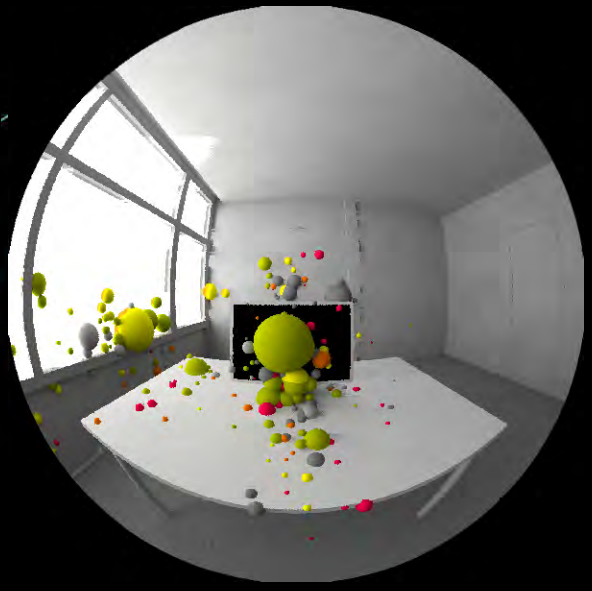
gaze behavior based on lighting conditions and task

ergorama

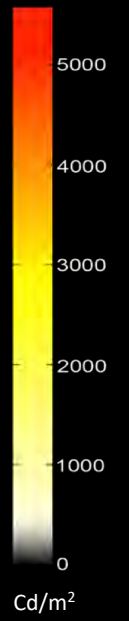


perceived light

field of view



thinking



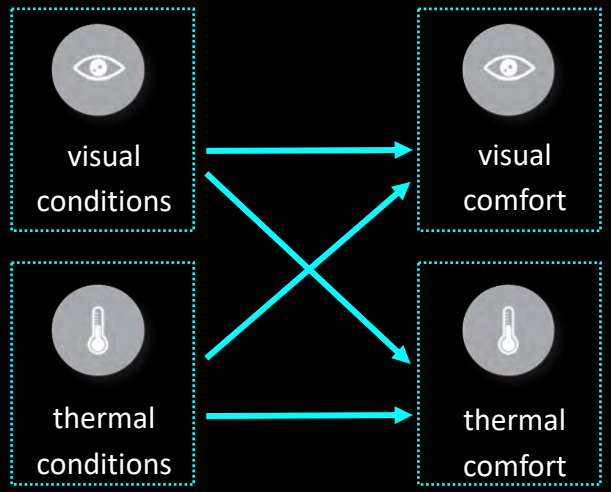
EPFL

visual and thermal comfort

perceived interactions

Giorgia Chinazzo
PhD student

SwissTech Convention Center / Richter Dahl Rocha & Associés



EPFL

visual and thermal comfort

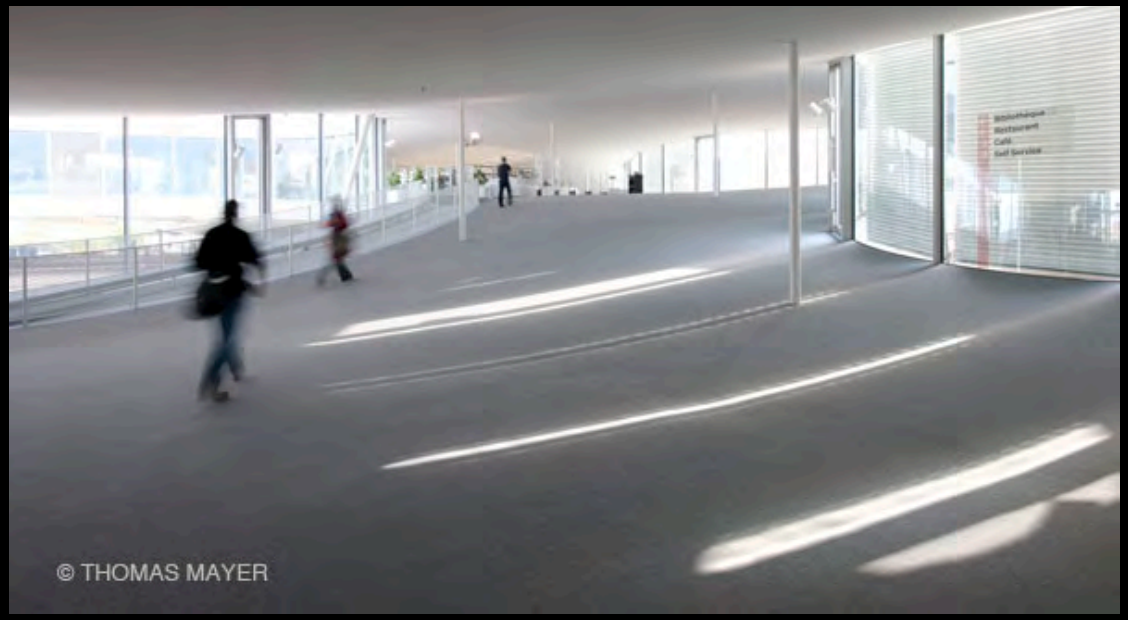
perceived interactions

Your Rainbow Panorama by Studio Olafur Eliasson

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

visual and thermal comfort

perceived interactions



Rolex Learning Center / SANAA

- does thermal perception depend on **color of light**?
- does thermal perception depend on **brightness**?
- does visual perception depend on **temperature**?

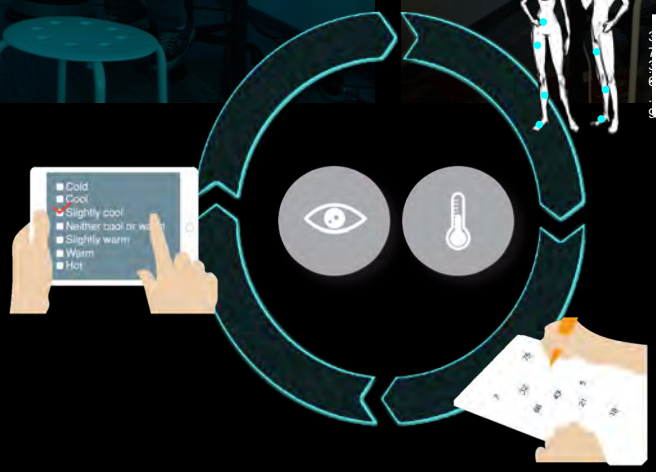
EPFL

visual and thermal comfort

interaction effects

color of light & temperature

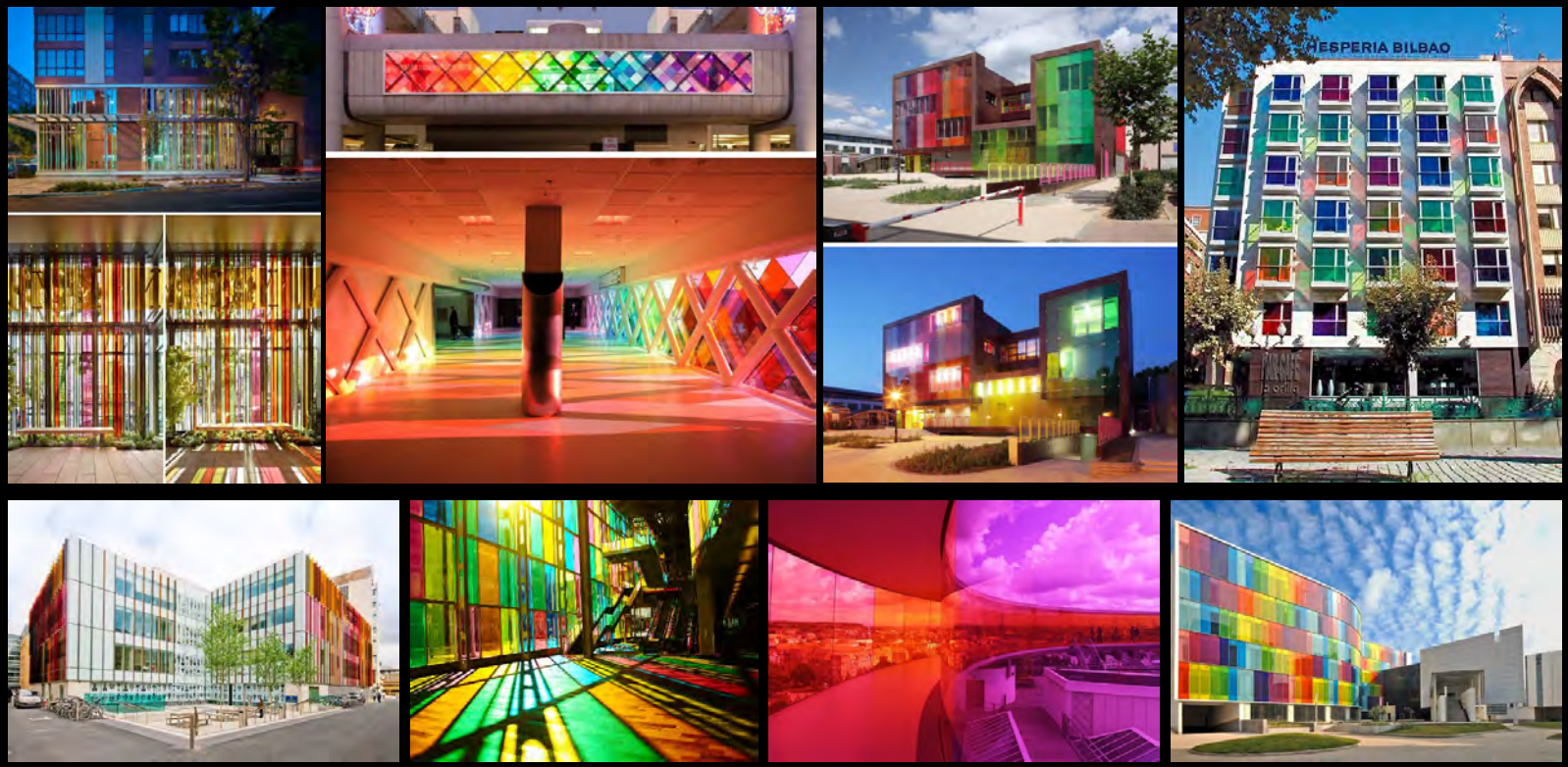
light quantity & temperature



EPFL

visual and thermal comfort

impact on thermal perception of a visual experience



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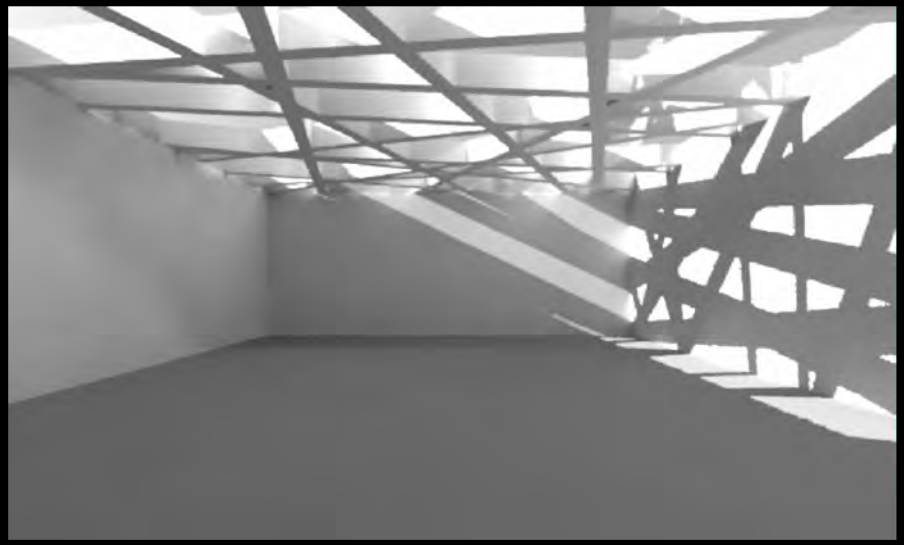
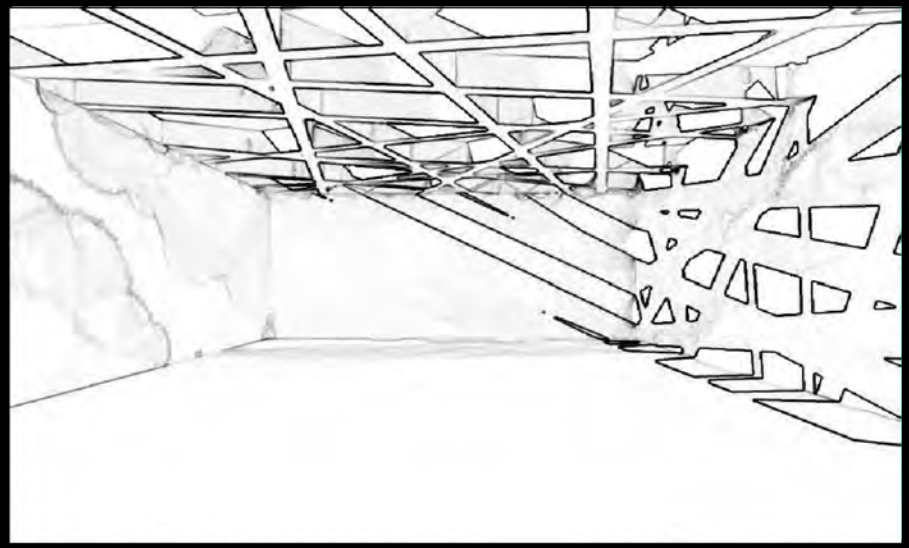
emotion

perceptual effects and visual interest in daylit architecture

Prpf. Siobhan Rockcastle
LIPID PhD+PostDoc alumnus
Co-Founder of OCULIGHT – U of O, USA





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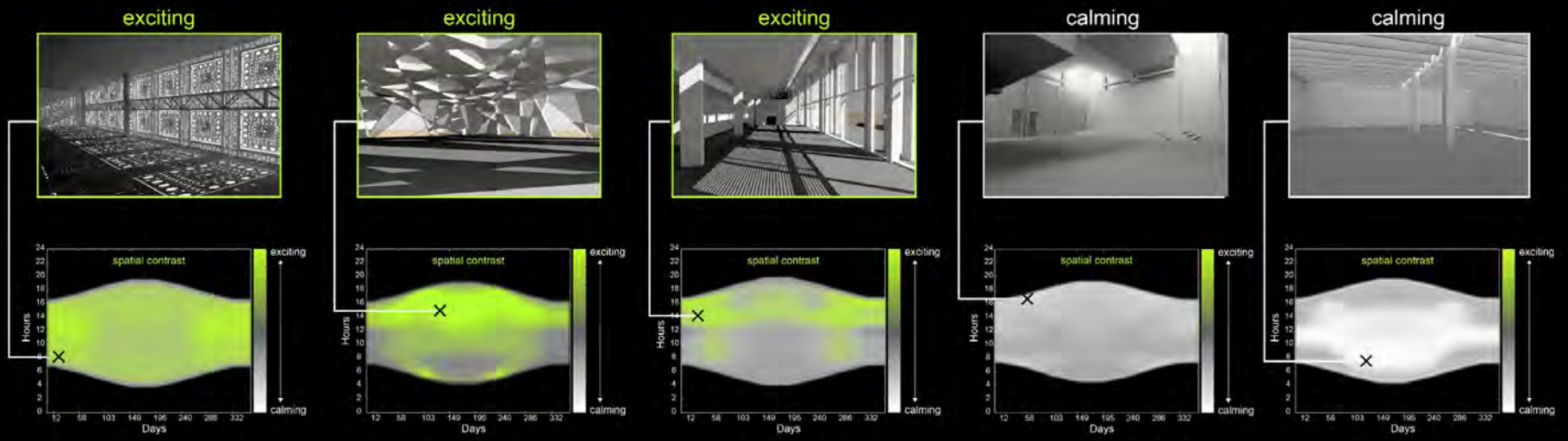
spatial contrast

dynamic spatial and temporal qualities of daylight



perception of daylight patterns

irregularity linked to positive impressions

Kynthia Chamilothori
PhD student

Demonstration of the experimental setup by G. Chinazzo

Dr. Jan Wienold
Co-advisor

EPFL

perception of daylight patterns

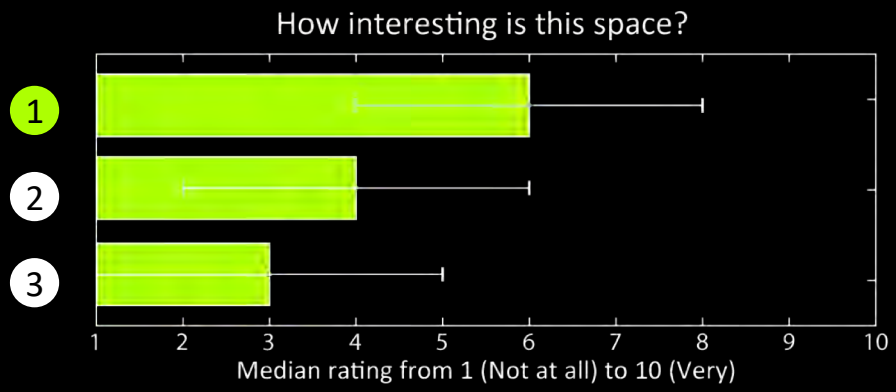
irregularity linked to positive impressions
and measurable calming effect

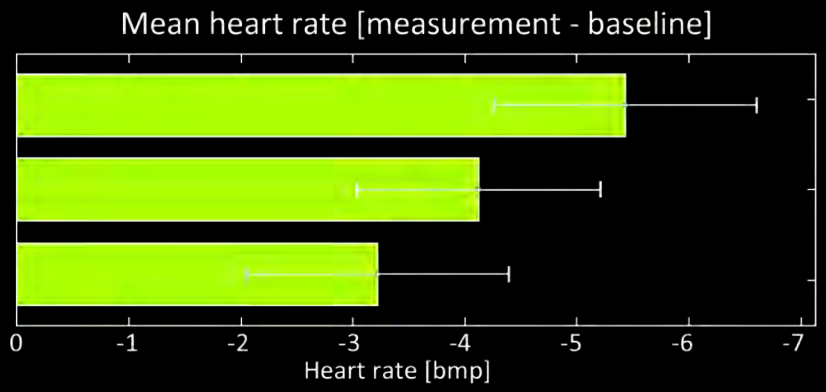
2

1

3

Giorgia Chinazzo
PostDoc researcher





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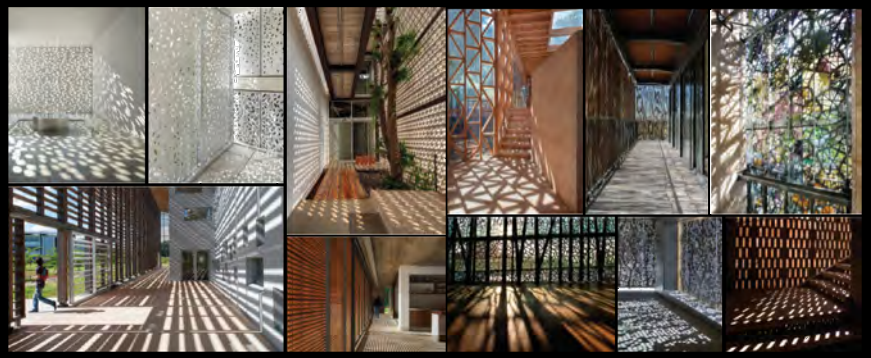
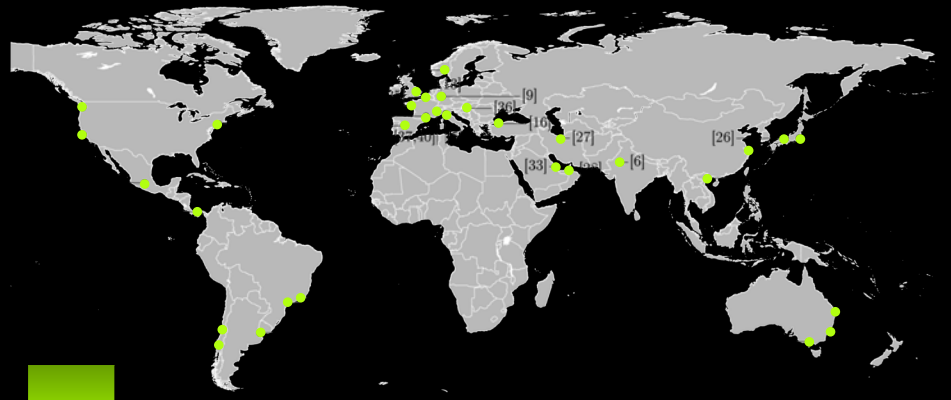
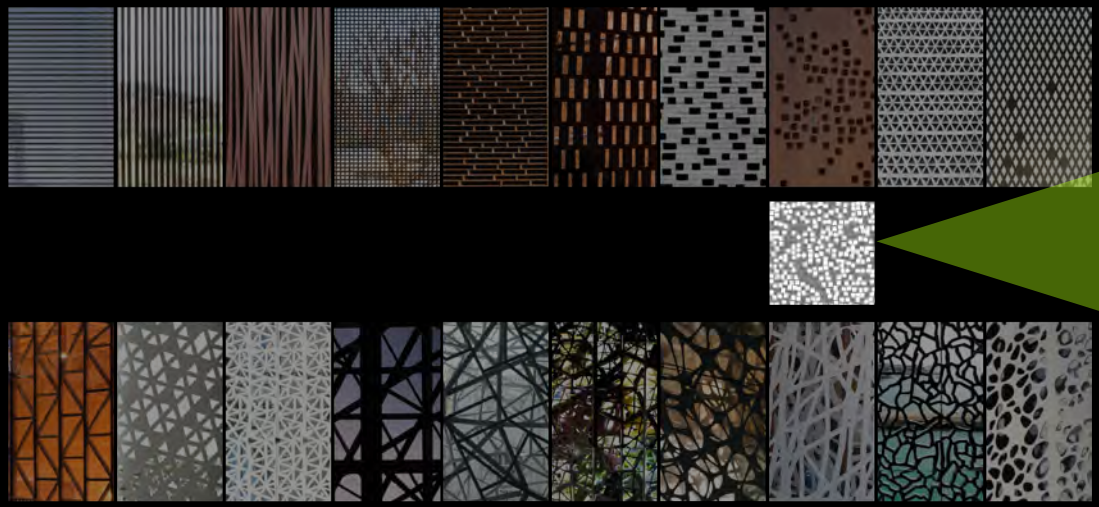
façade patterns

inspiration from worldwide architecture







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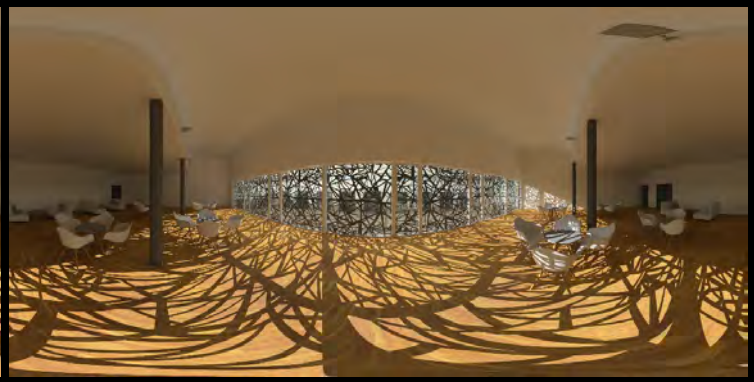
assessing human response to daylight patterns

VR immersion

left eye



right eye

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daylight patterns and environmental context

overcast conditions

EPFL

daylight patterns and complexity

irregular pattern

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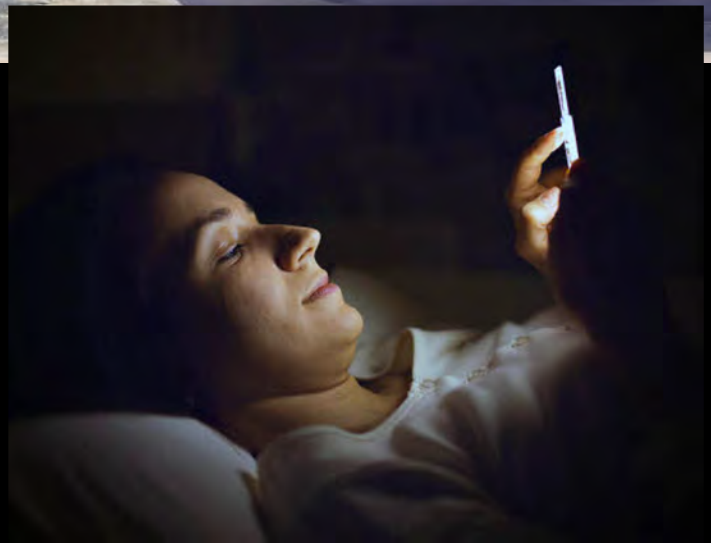
vitality

Image Source: Date and Time

Environmental impact

Image Source: Web Urbanist; Harvard Health



Behavioral/Lifestyle impact

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non-visual system

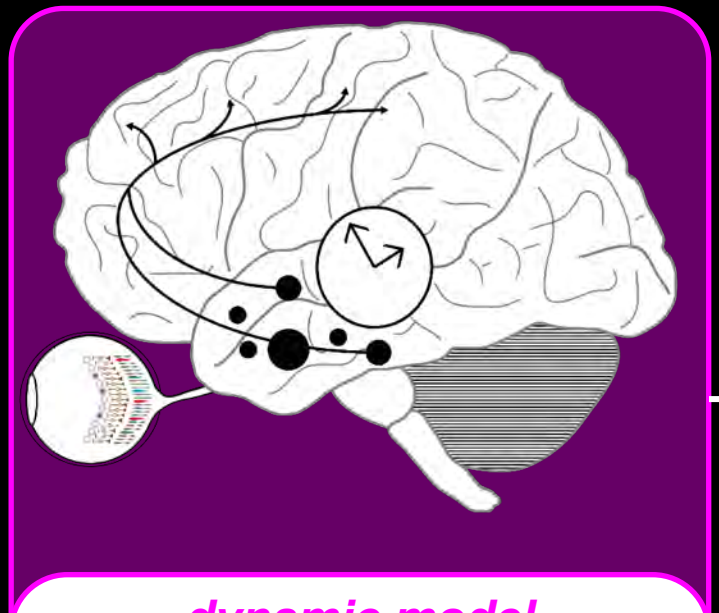
effects of ocular light exposure on human health

Dr. Maria Amundadottir
LIPID PhD alumnus
Co-Founder of OCULIGHT – Entrepreneur,, Iceland

INPUT

vertical illuminance

factors
intensity
wavelength
duration
timing
history



dynamic model
thresholds
spectral sensitivity
integration
circadian rhythms
adaptation

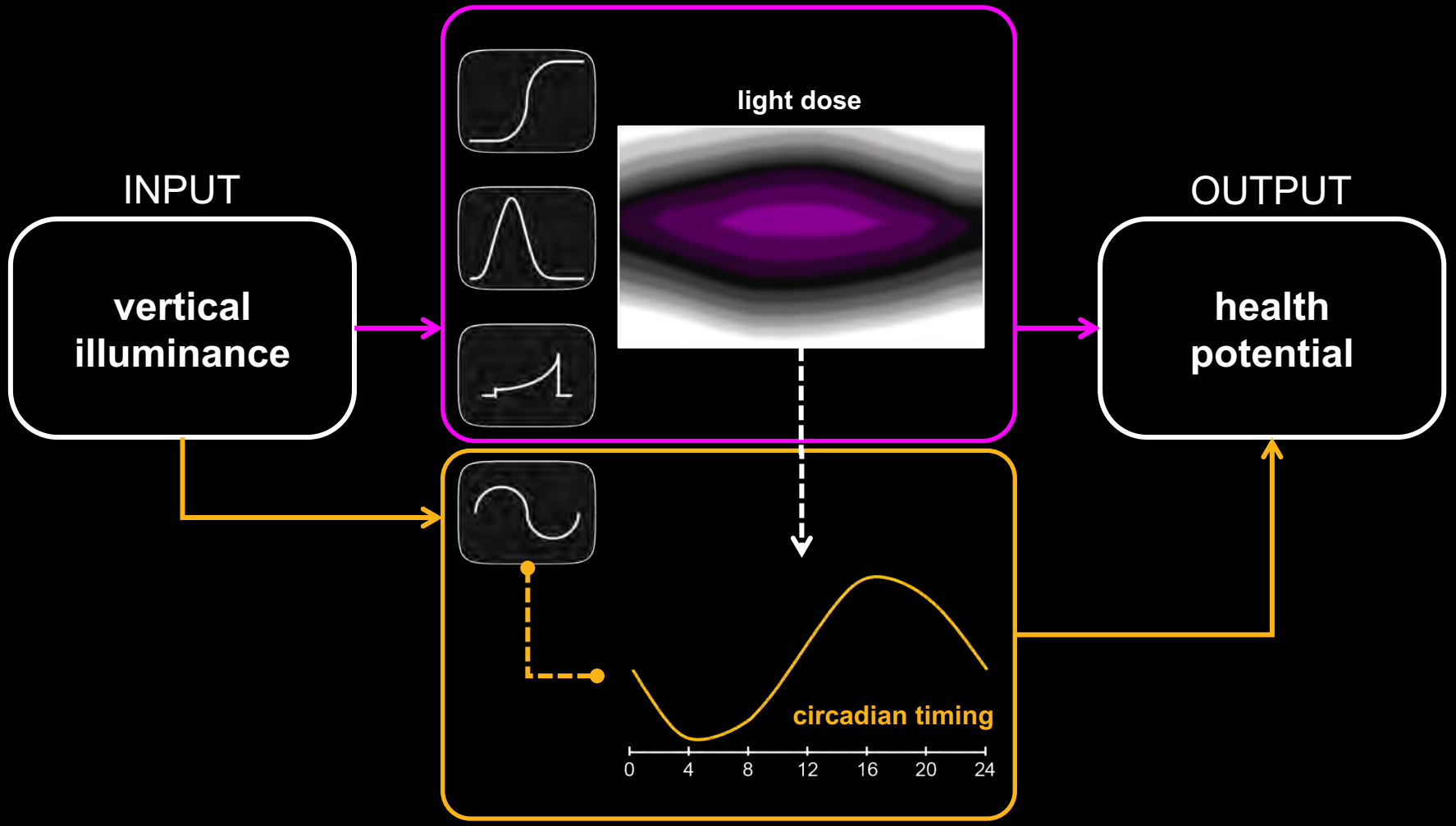
OUTPUT

health potential

health benefits
alertness
performance
wellbeing
sleep quality
mood

dynamic model

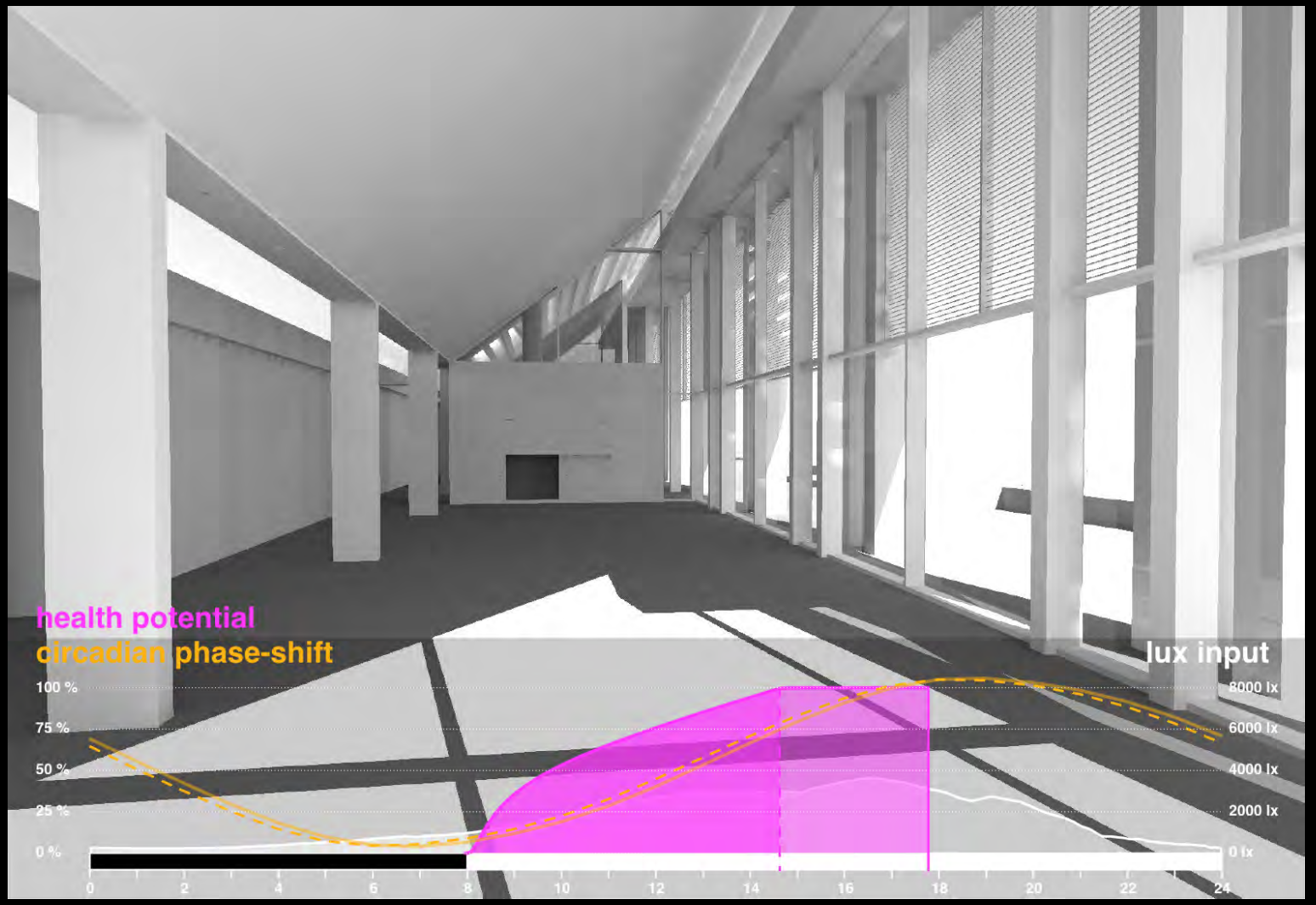
maximize the daily light dose without disturbing circadian timing



dynamic model

cumulative dose and daily cycle

Dr. Maria Amundadottir
LIPID PhD alumnus
Co-Founder of OCULIGHT dynamics, Iceland



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impact of spectrum and brightness on alertness

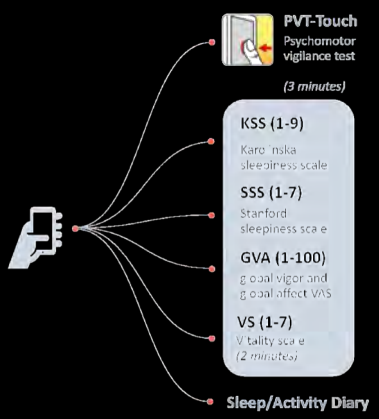
Victoria Soto Magan
PhD student

1 effect of spectrum
'bluer' vs neutral

2 effect of intensity
bright vs dim

3 intensity+spectrum
bright 'blue 1' vs dim 'blue 2'

subjective + cognitive evaluation



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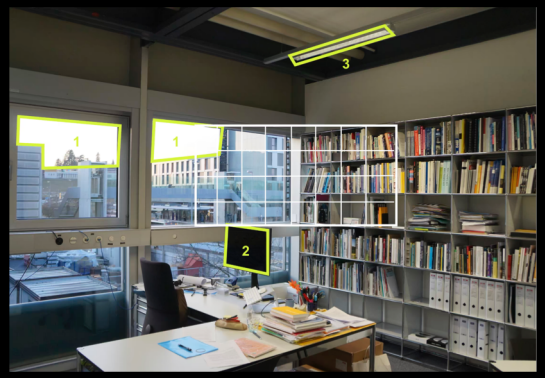
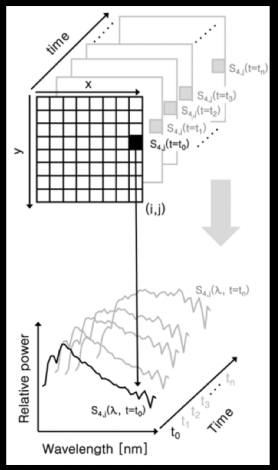
alertness and circadian resetting

phase-shifting impact of spectrum and brightness (physiological effects)

Forrest Webler
PhD student

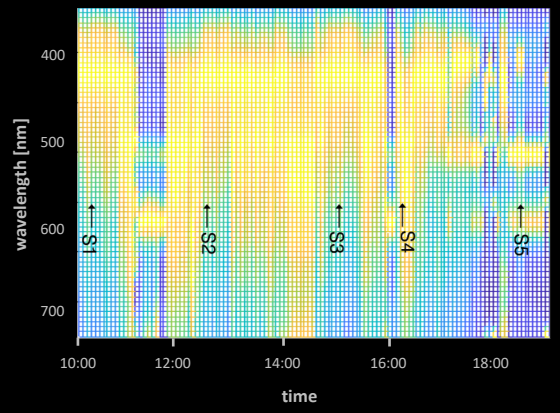


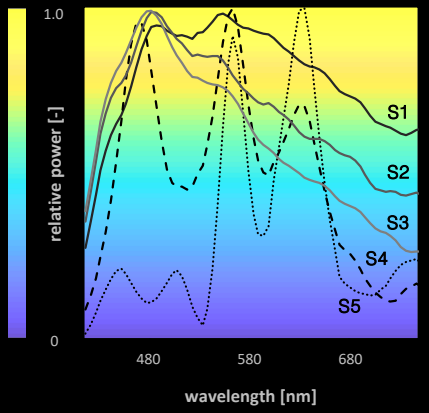
'hyperspectral' scenes



wearable technology

spectral exposure

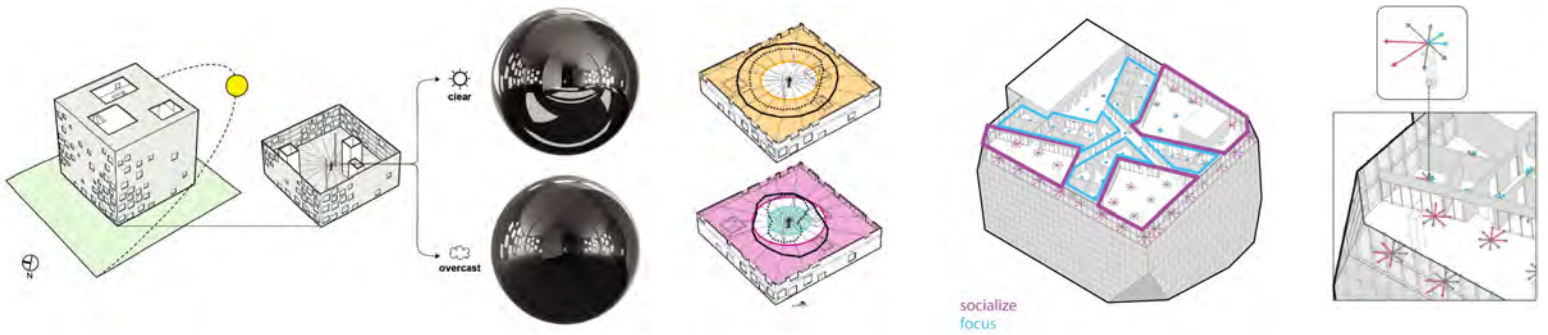


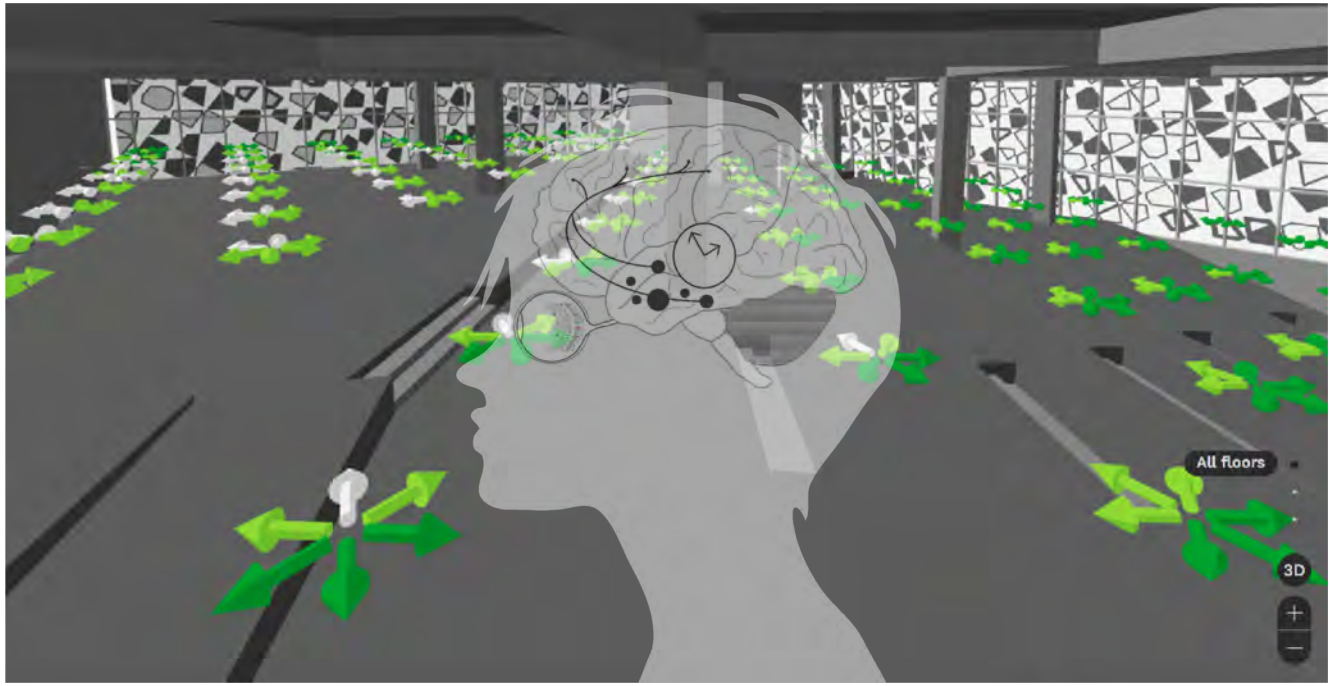


spectral diversity

EPFL

TAKING THE **OCCUPANT'S** PERSPECTIVE IN **DESIGN**

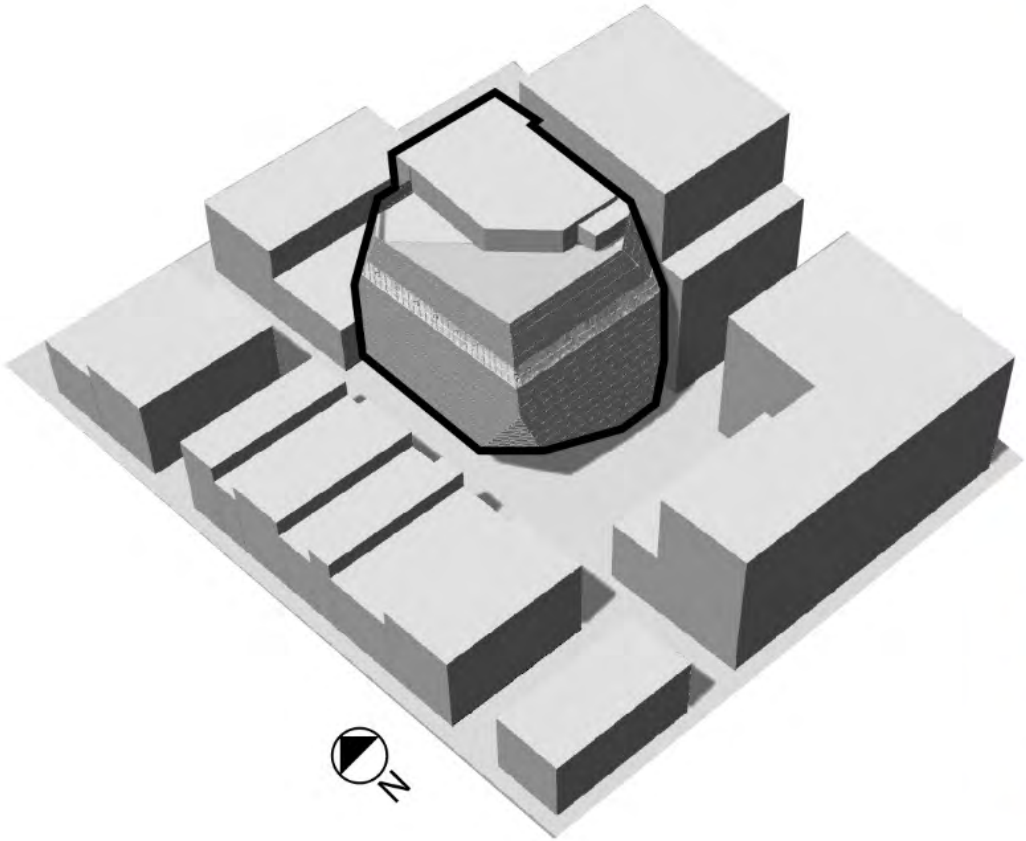


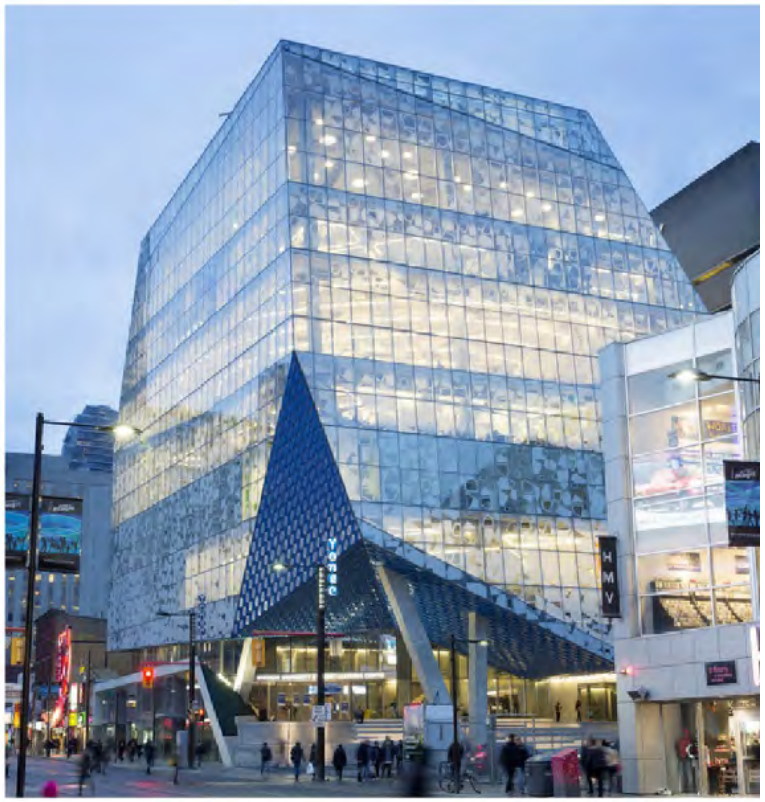


OCULIGHT dynamics

EPFL

EVALUATING A BUILDING'S **MULTIDIMENSIONAL DAYLIGHT QUALITIES**





OCULIGHT dynamics

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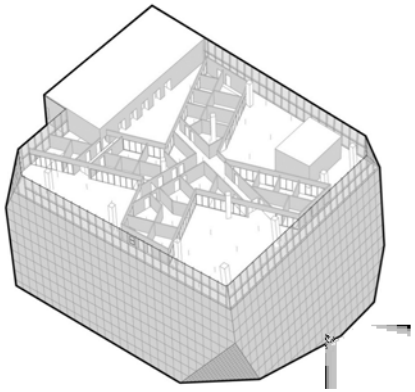
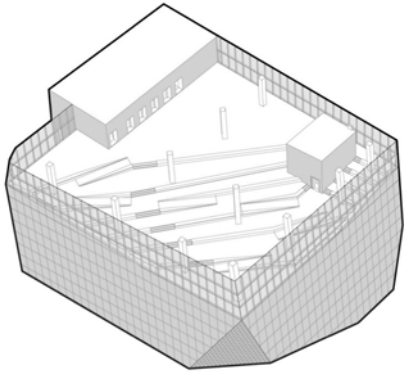
Toronto, CA | Snøhetta & Zeidler Partnership

EACH SPACE ITS OWN **QUALITY**…



the ‘FOREST’



the ‘BEACH’

OCULIGHT dynamics

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THE **OCULIGHT** APPROACH

SKY CLEAR

DATE & TIME

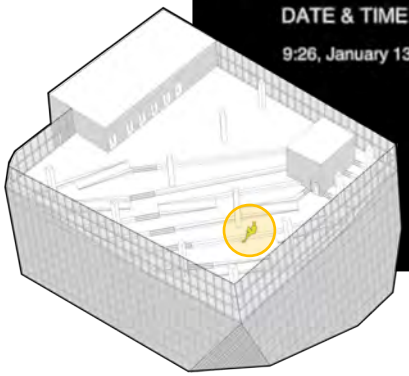
9:26, January 13th

HEALTH POTENTIAL (nvR_D)

DOSE ACHIEVED

VISUAL INTEREST (mSC)

CALMING EXCITING



N

S

SKY OVERCAST

HEALTH POTENTIAL (nvR_D)

DOSE ACHIEVED

VISUAL INTEREST (mSC)

CALMING EXCITING

OCULIGHT dynamics

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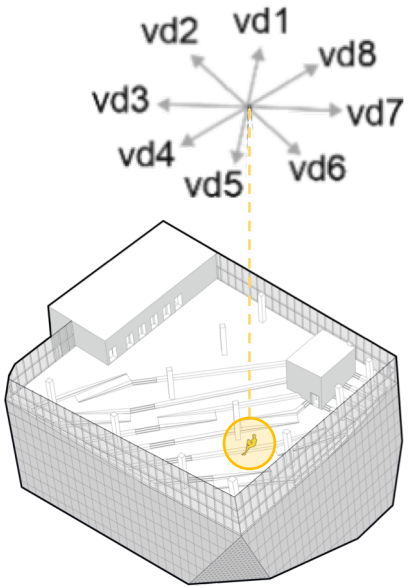
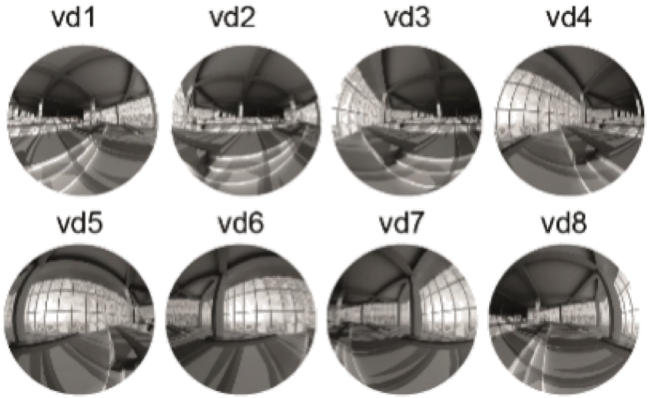
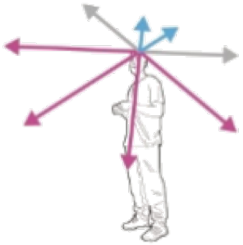
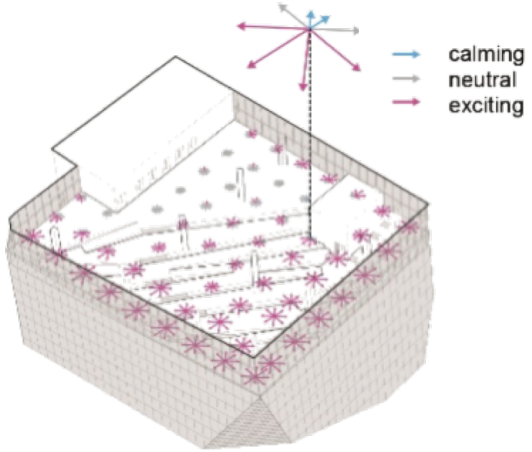
OCCUPANT-CENTERED **WORKFLOW**







calming < 6.96
6.96 ≤ neutral ≤ 11.75
exciting >11.75



OCULIGHT dynamics

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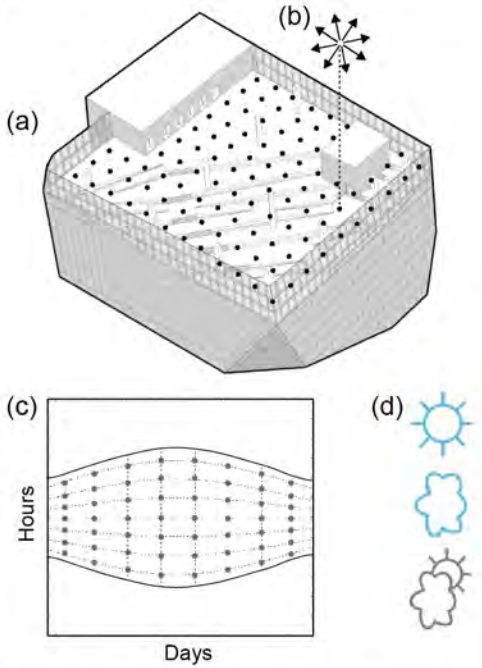
INTEGRATED **SOFTWARE SUITE**

OCUSIM

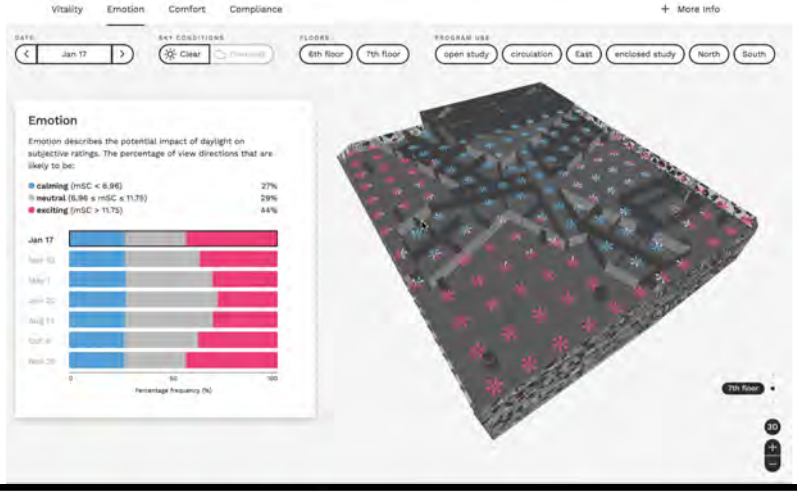


for each (a) view position, (b) view direction,
(c) time series, and (d) sky condition:
-vitality (nvR_D)
-emotion (mSC_5)
-comfort (DGP & Ev)
for each (a) view position:
-compliance (sDA, ASE, DF)

DATA VARIABLES

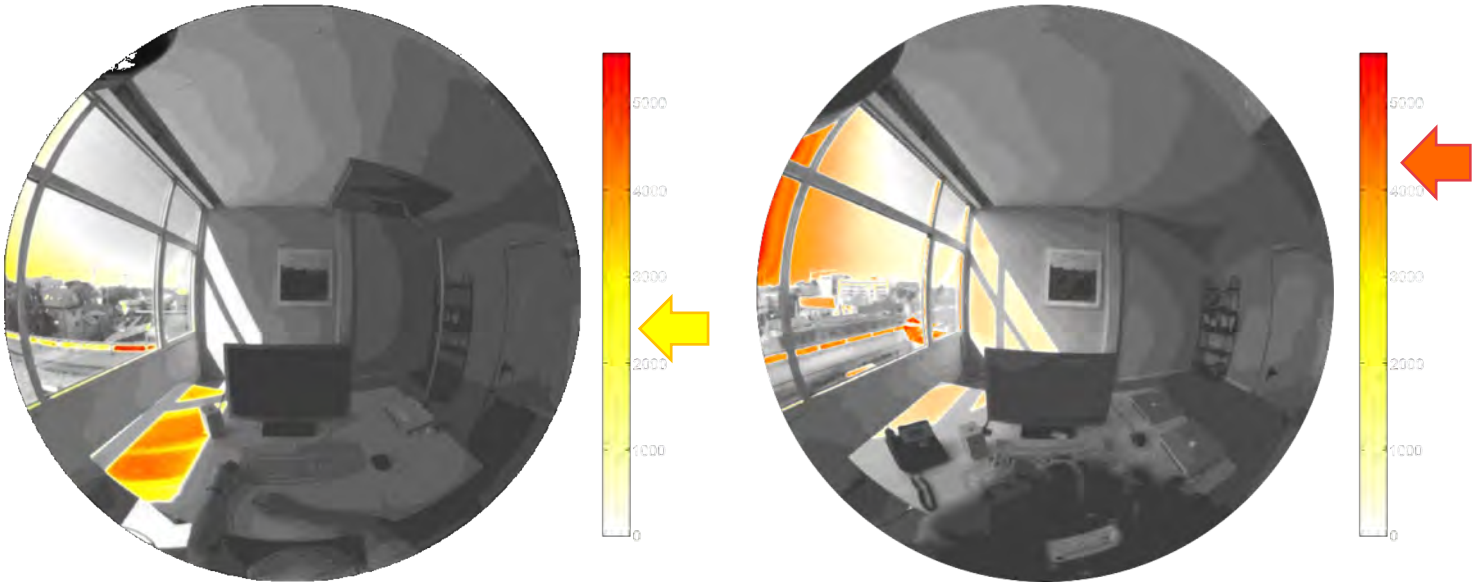
Variable	Attribute	Description
sky	id, type	Describes the sky model used in the simulation.
time	id, month, date, hour	Contains information about the time steps.
group	id, name, tags, position, view direction	Describes the point groups. Each group can be tagged by floor, program and/or occupant, stored under <tags>. The <position> and <view direction> contain nested objects that include x, y, z coordinate info and a reference id.

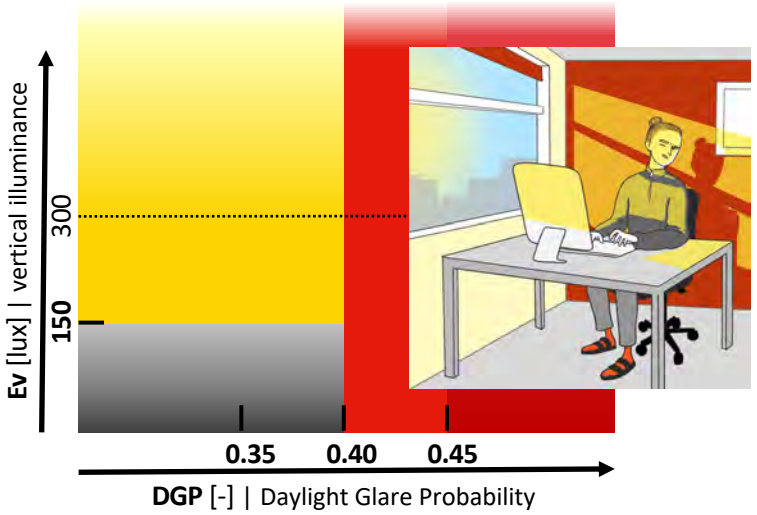
OCUVIS



OCULIGHT dynamics

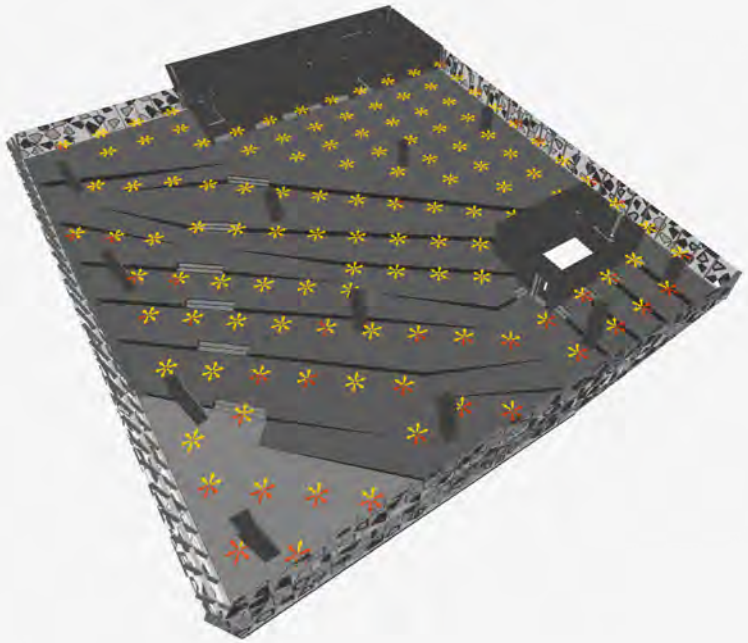
COMFORT



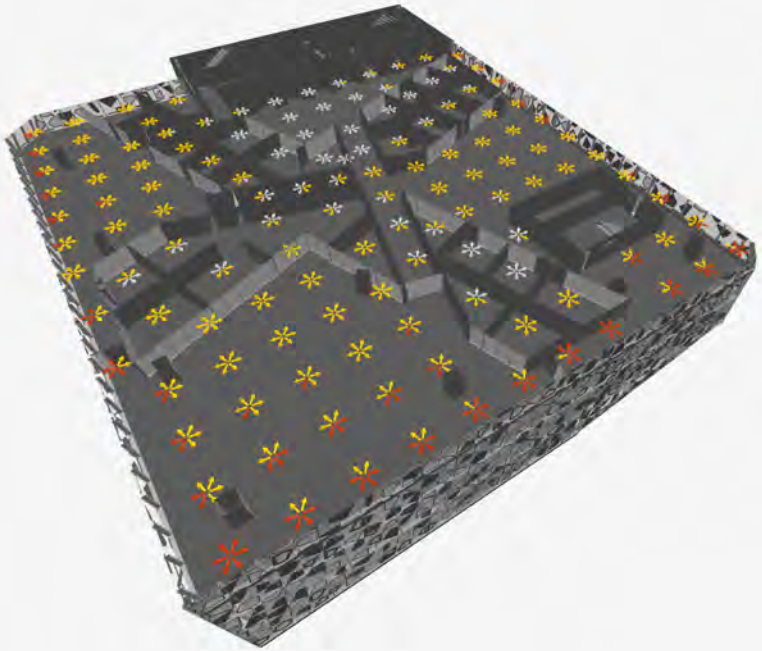


OCULIGHT dynamics

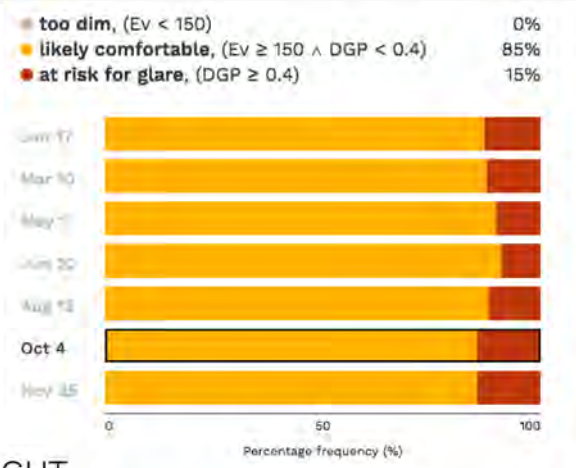
COMFORT

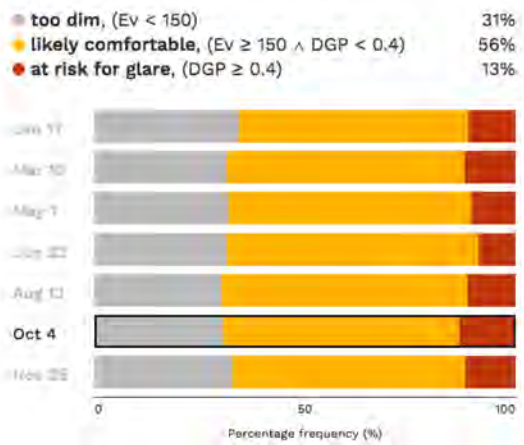


the ‘BEACH’



the ‘Forest’

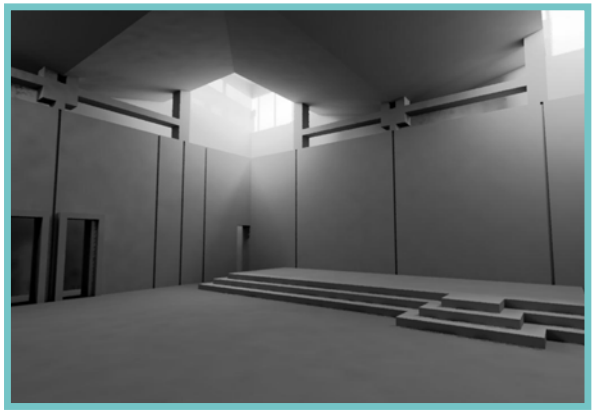




OCULIGHT dynamics

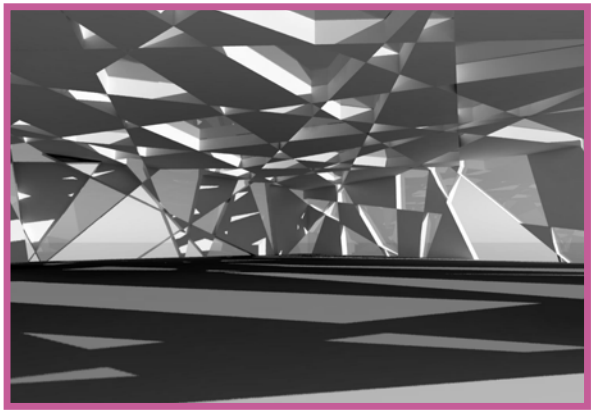
EMOTION

calming?

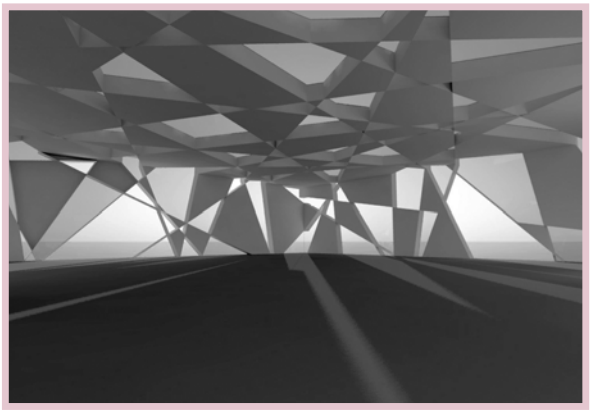


first unitarian church

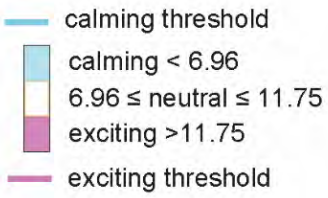
exciting?

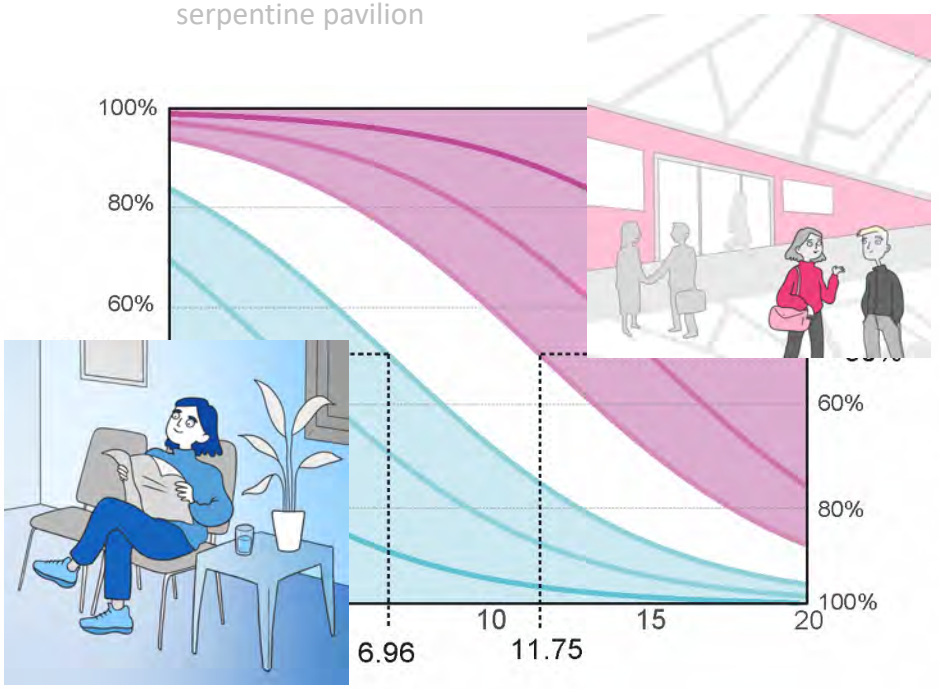


less exciting?



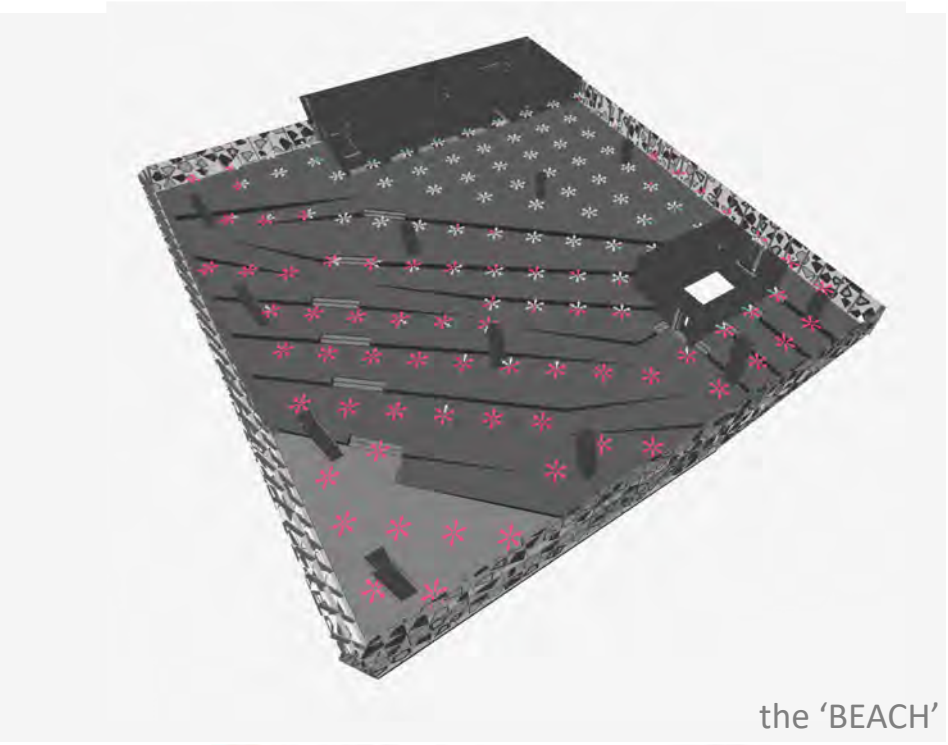
serpentine pavilion



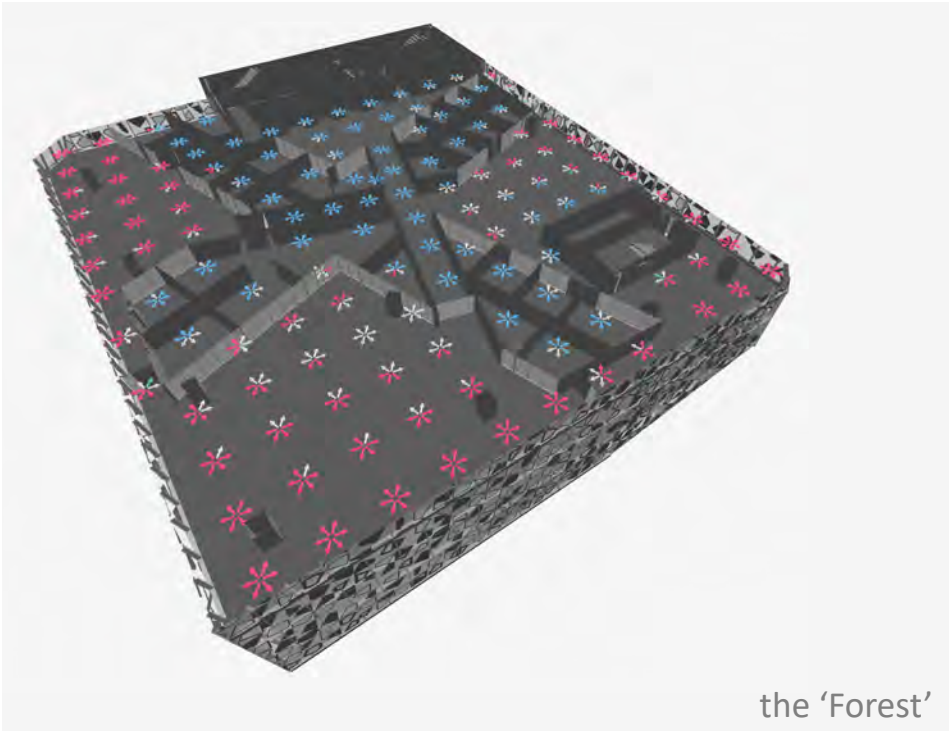


OCULIGHT dynamics

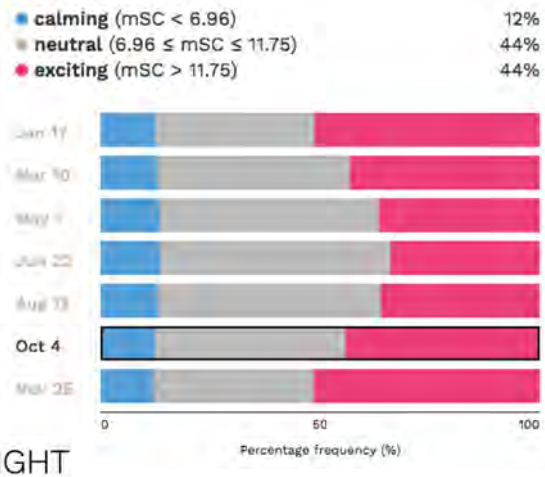
EMOTION

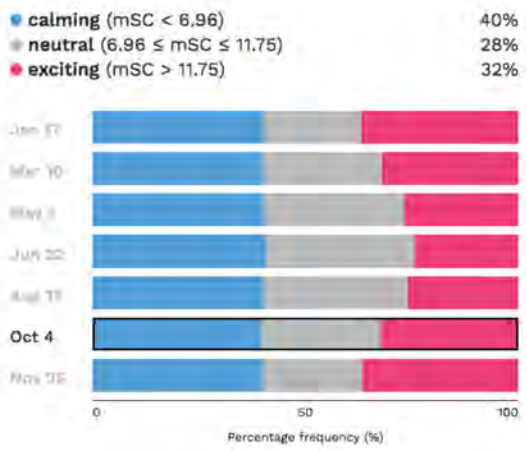


the ‘BEACH’



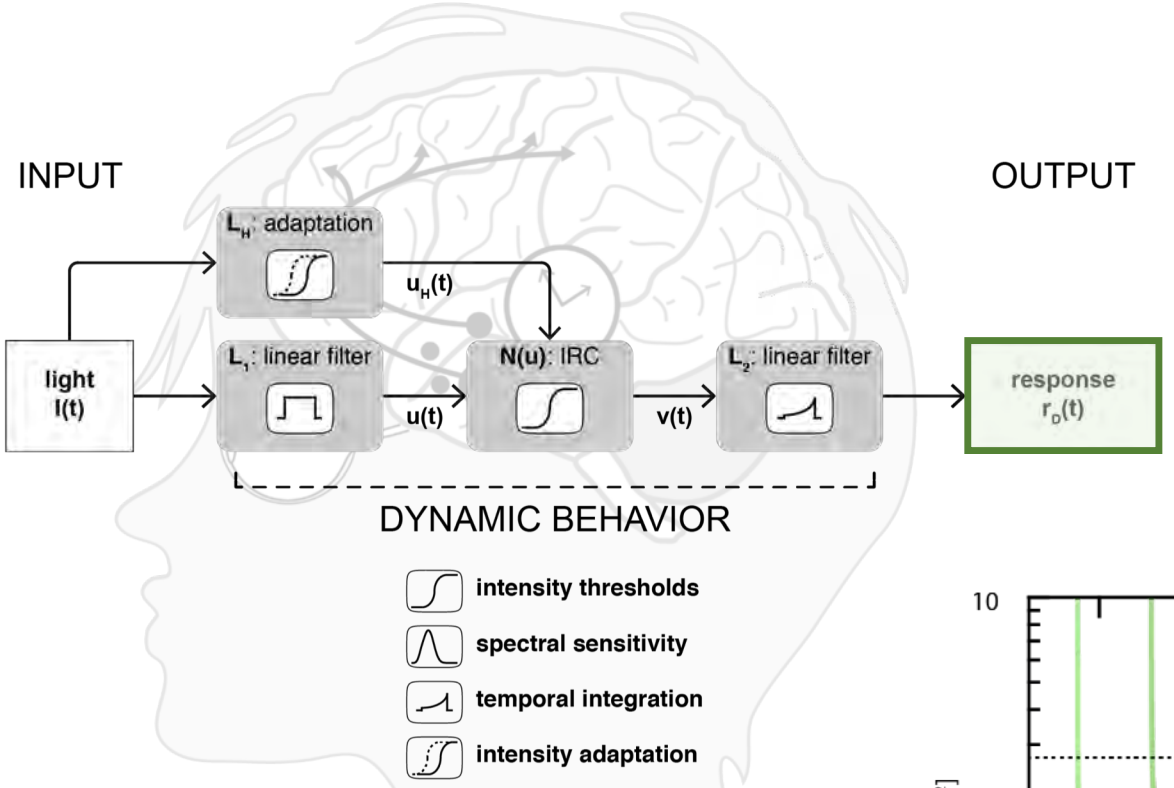
the ‘Forest’





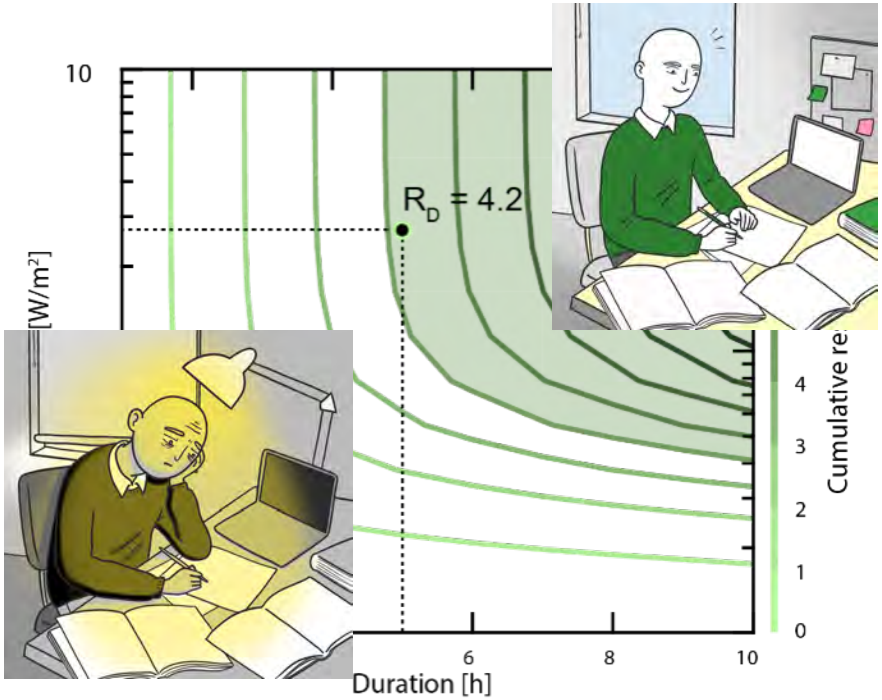
OCULIGHT dynamics

VITALITY



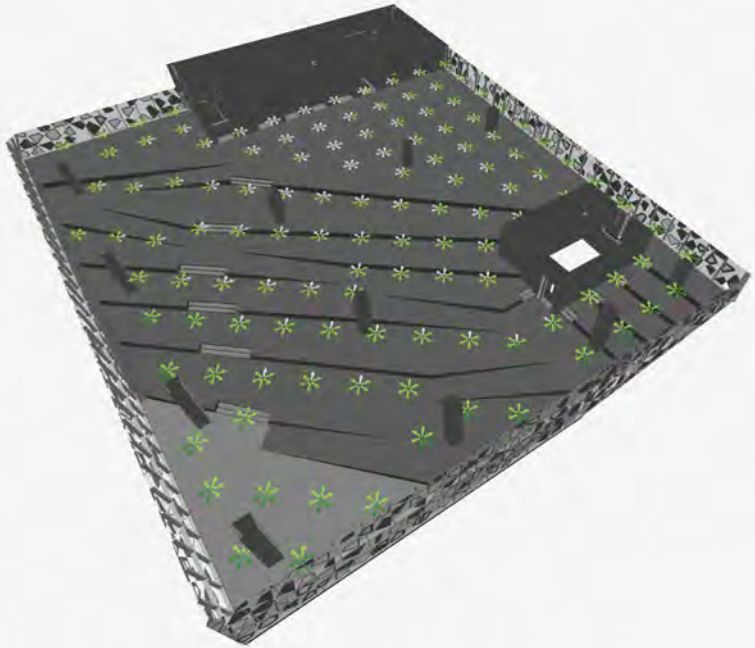
dose achieved < 4.2

Non-visual health potential
$R_D > 4.2$

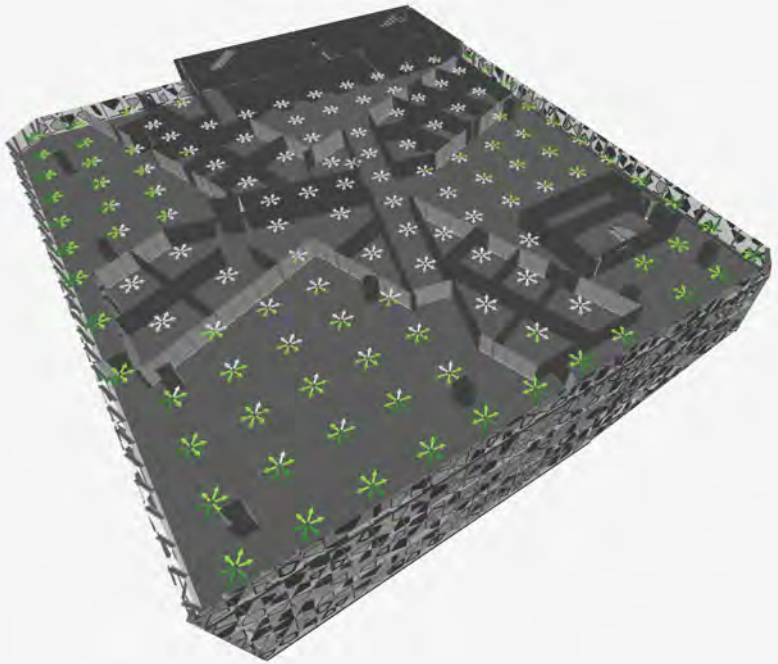


OCULIGHT dynamics

VITALITY



the ‘BEACH’



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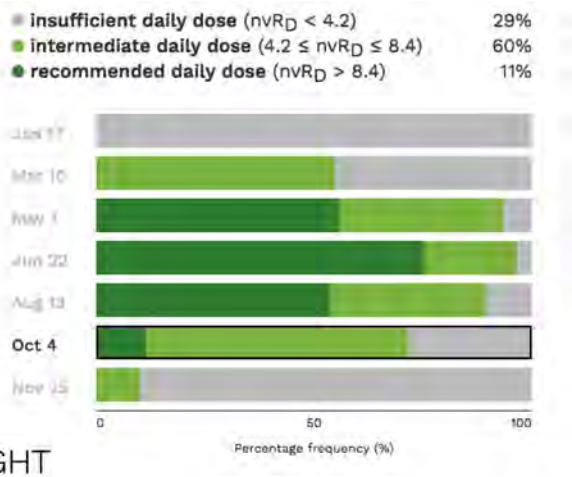
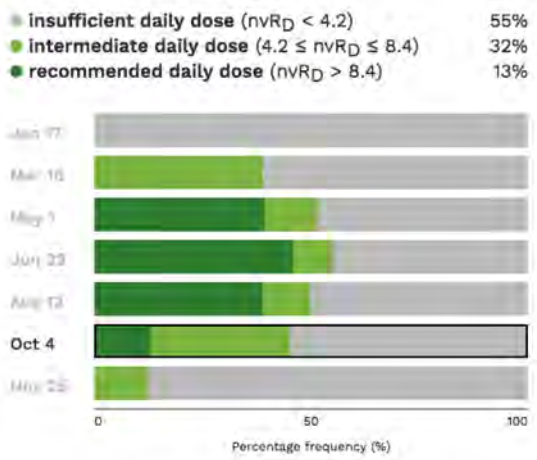


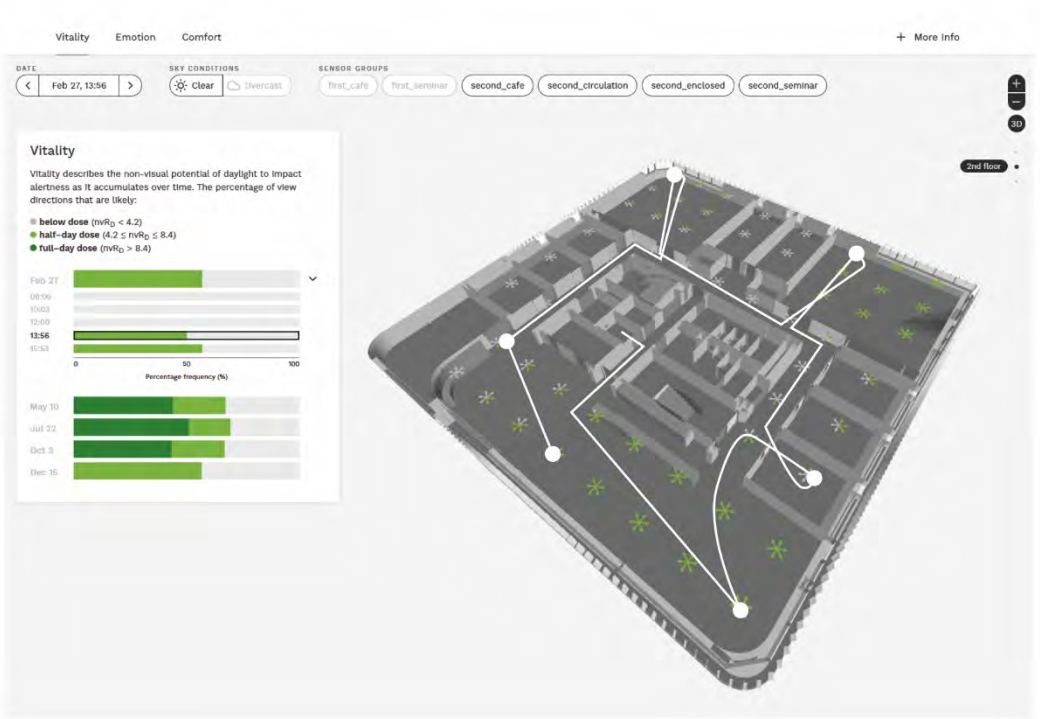


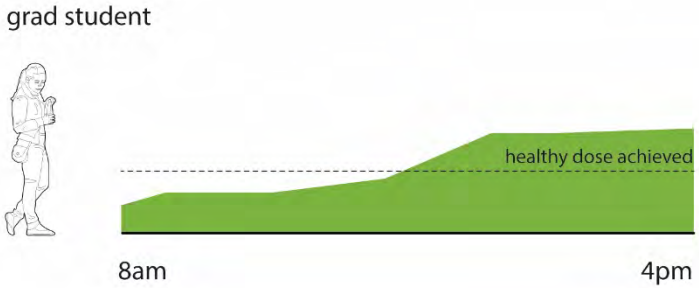
OCULIGHT dynamics

FUTURE DEVELOPMENTS

spatio-temporal population analytics

from building performance to ***occupant performance*** in buildings…





OCULIGHT dynamics

FUTURE DEVELOPMENTS

spatio-temporal population analytics

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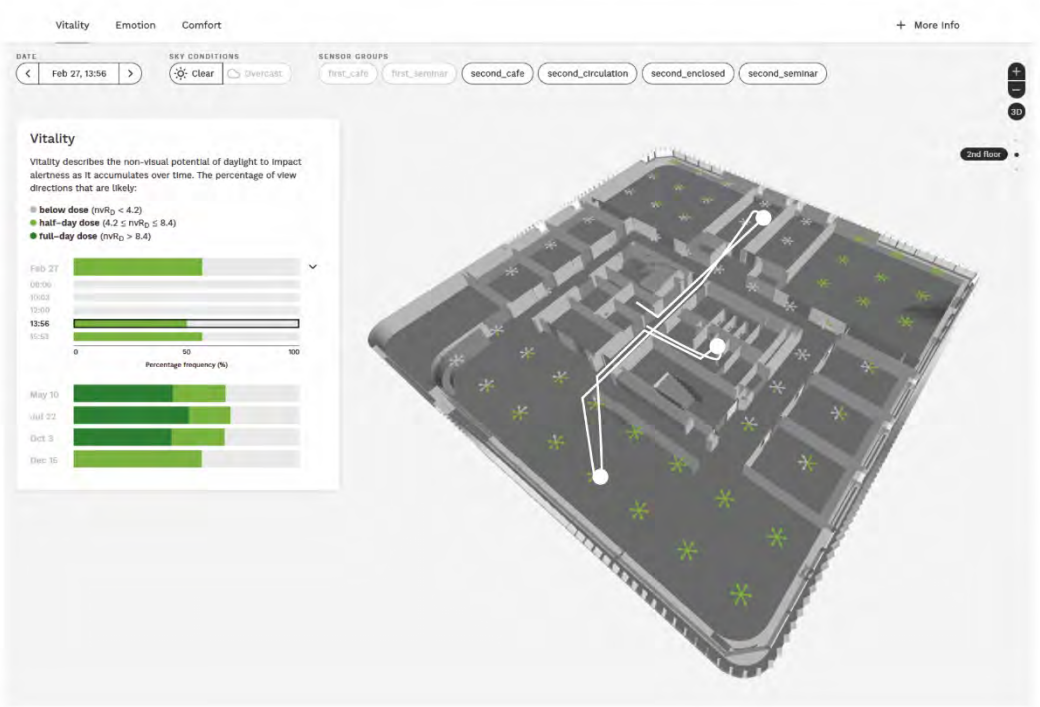
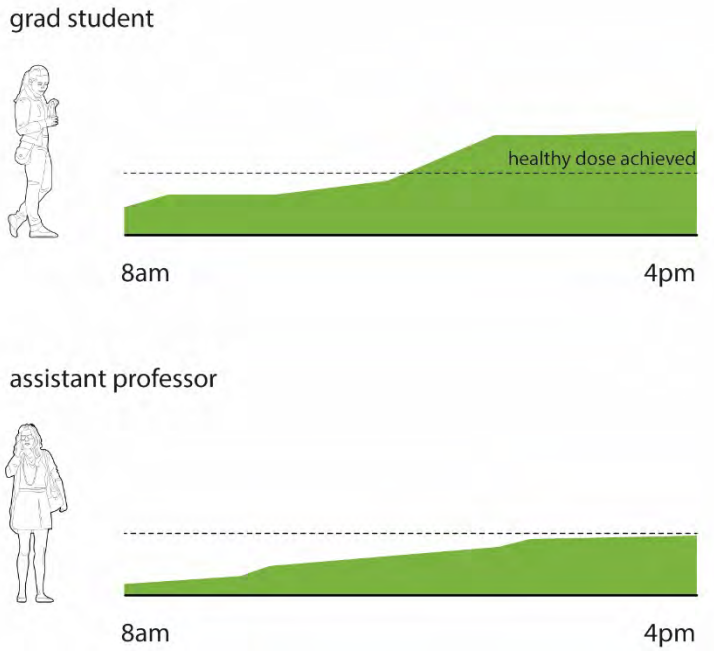




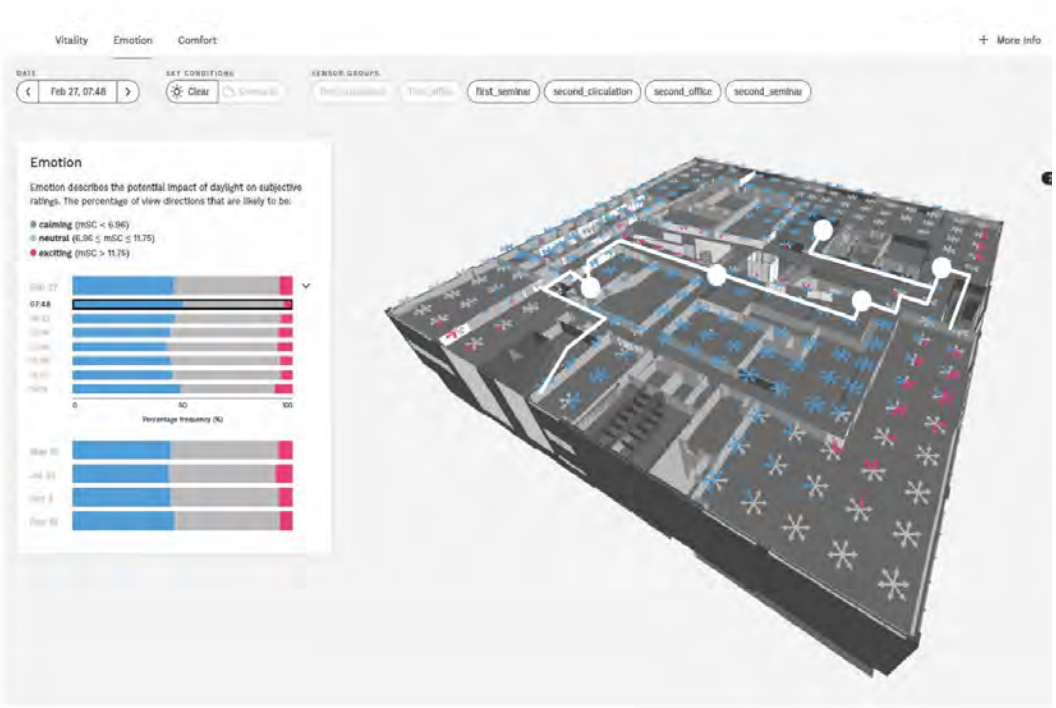
… with in-situ monitoring using **wearable** technology

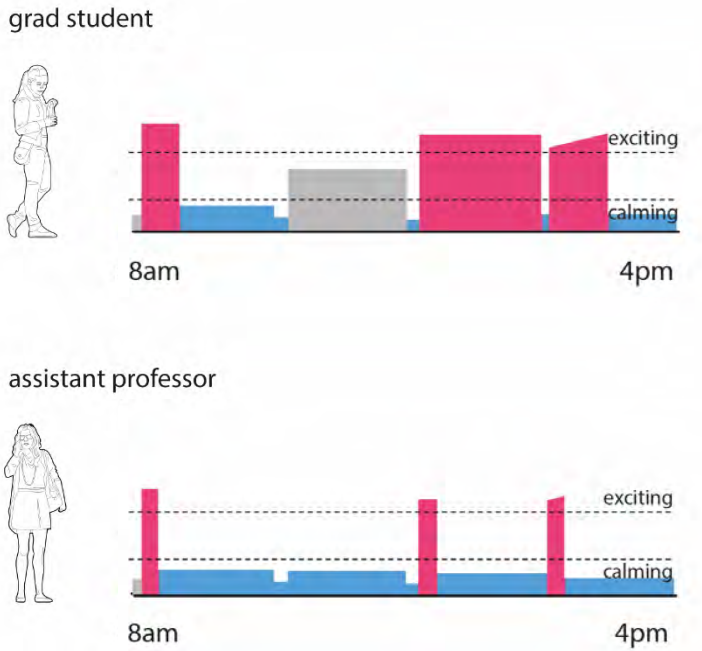
OCULIGHT dynamics

FUTURE DEVELOPMENTS

spatio-temporal population analytics

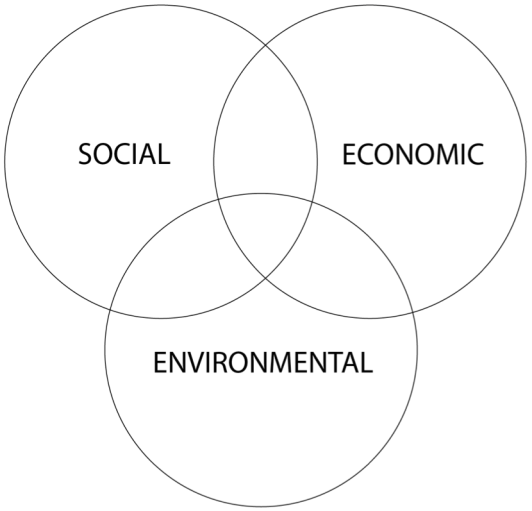
from building performance to ***occupant performance*** in buildings…

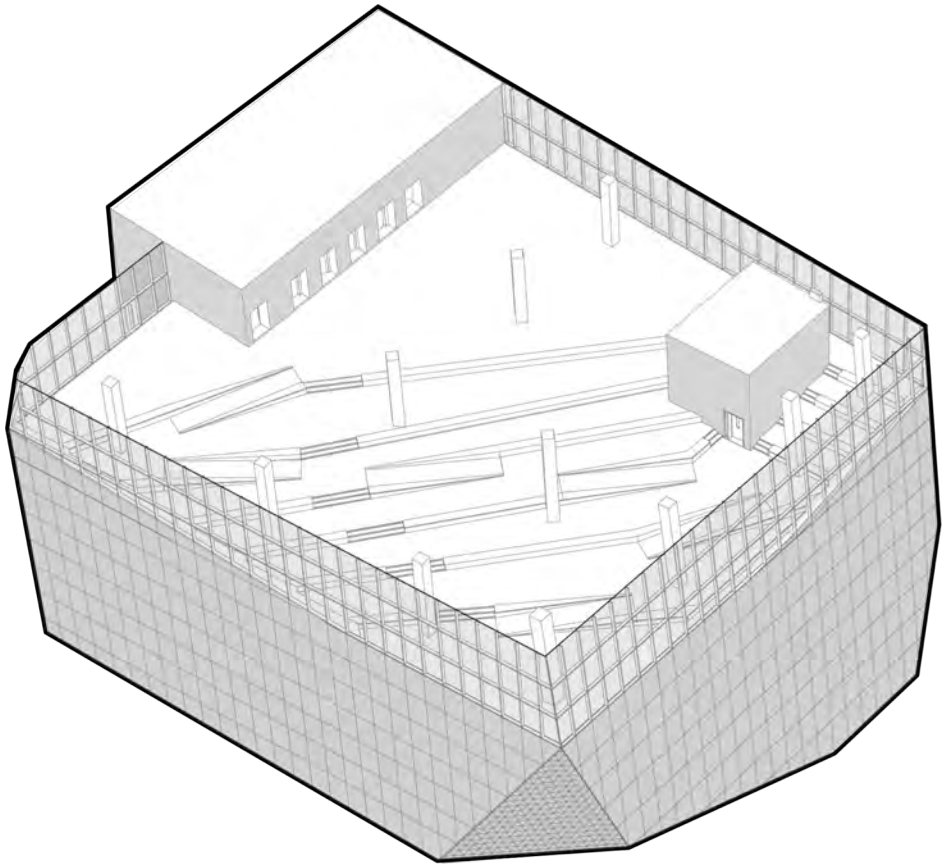




OCULIGHT dynamics

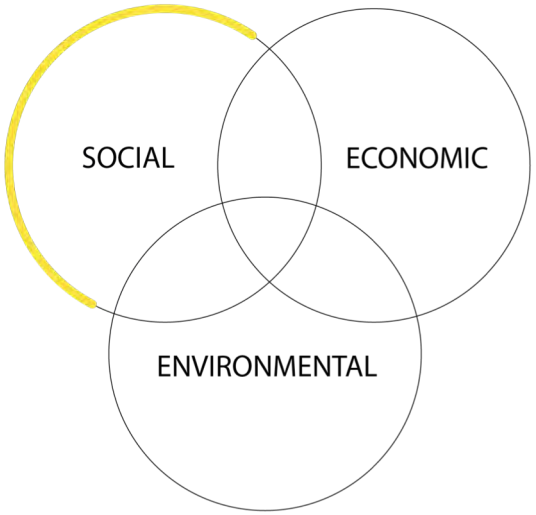
REVISITING **SUSTAINABILITY**…





OCULIGHT dynamics

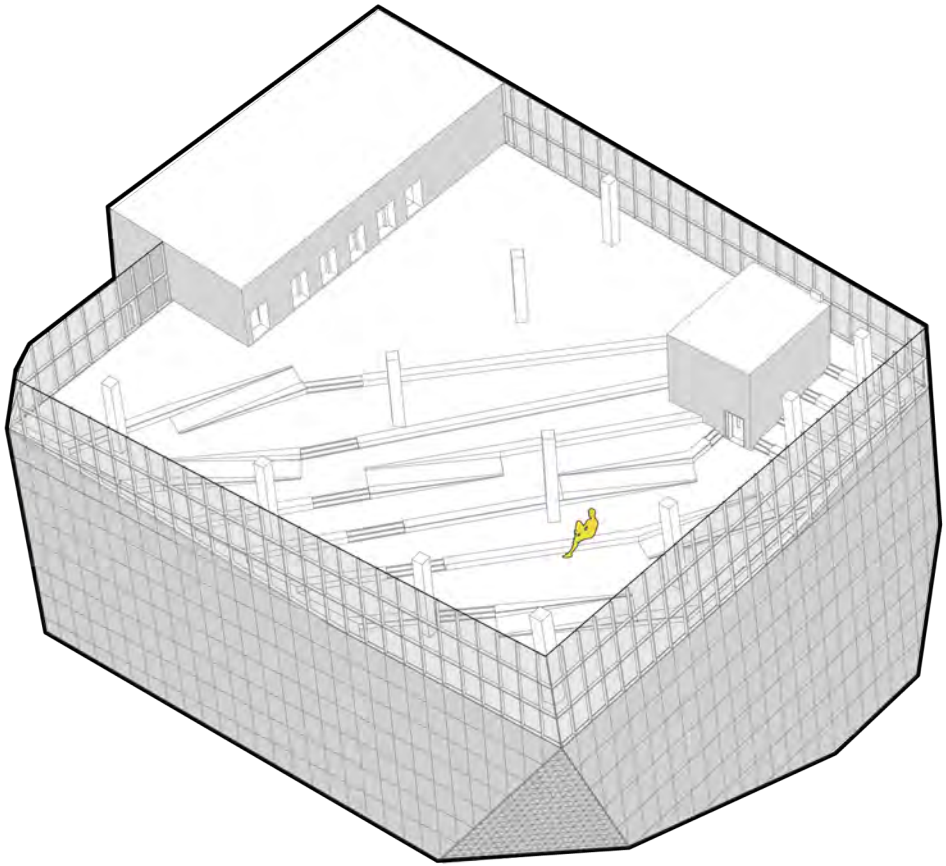
REVISITING **SUSTAINABILITY**…



EMOTION

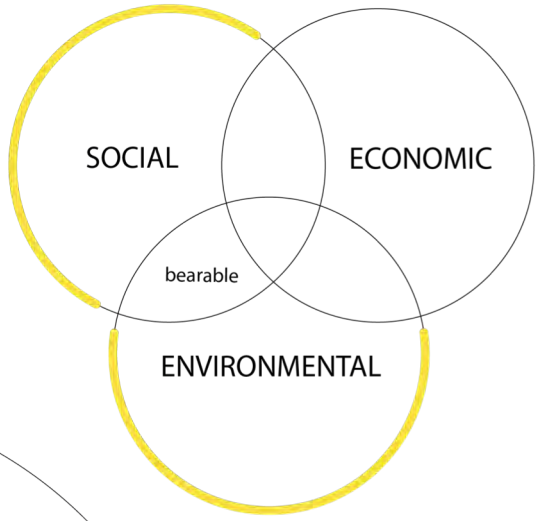
HEALTH

COMFORT



OCULIGHT dynamics

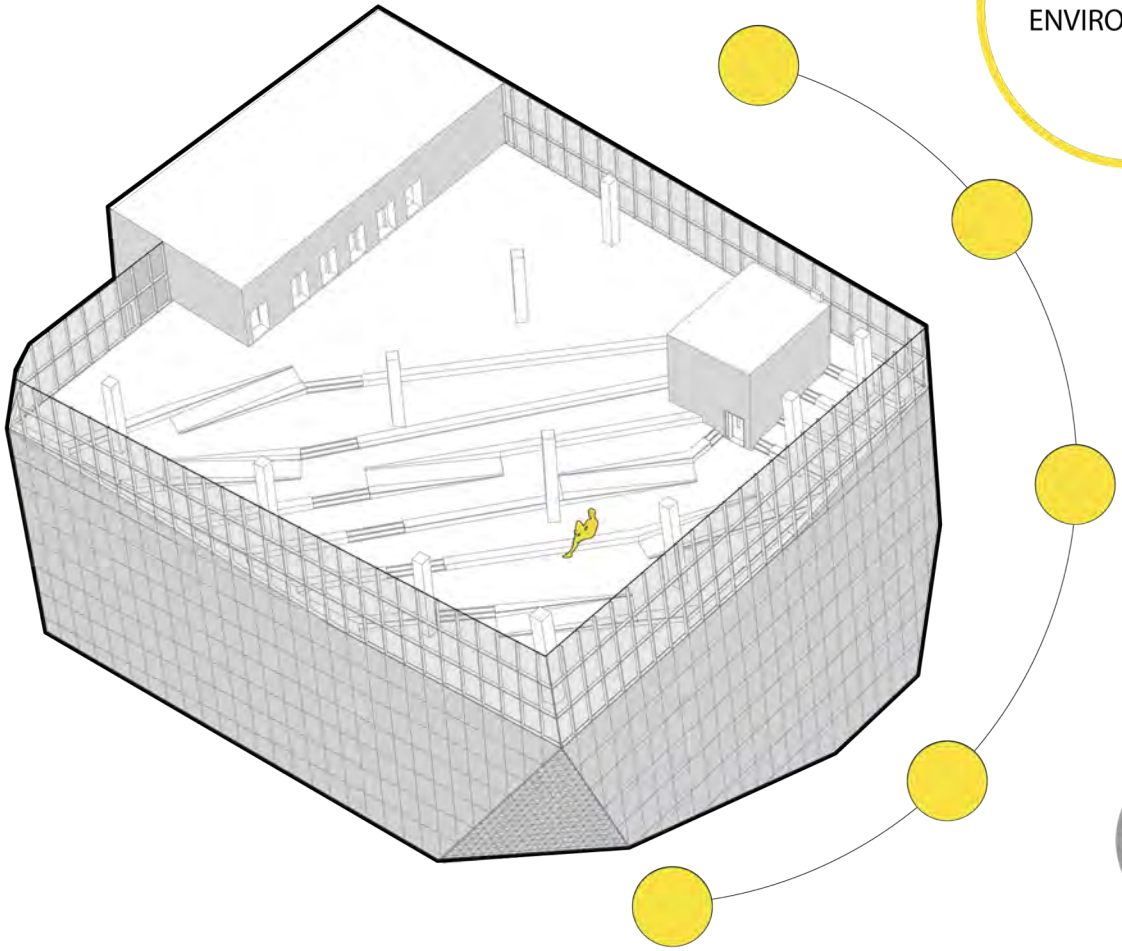
REVISITING **SUSTAINABILITY**…



EMOTION

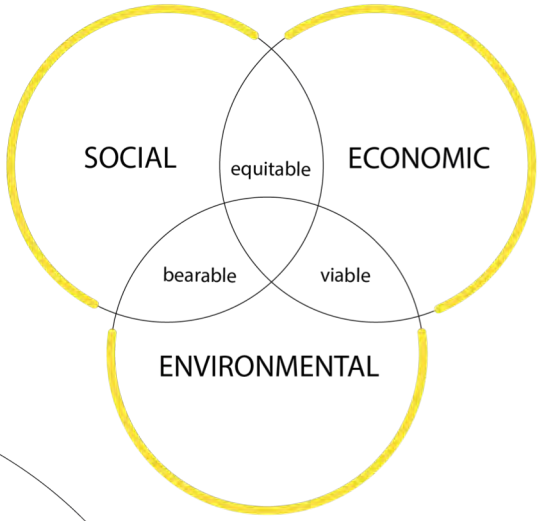
HEALTH

COMFORT



OCULIGHT dynamics

REVISITING **SUSTAINABILITY**…

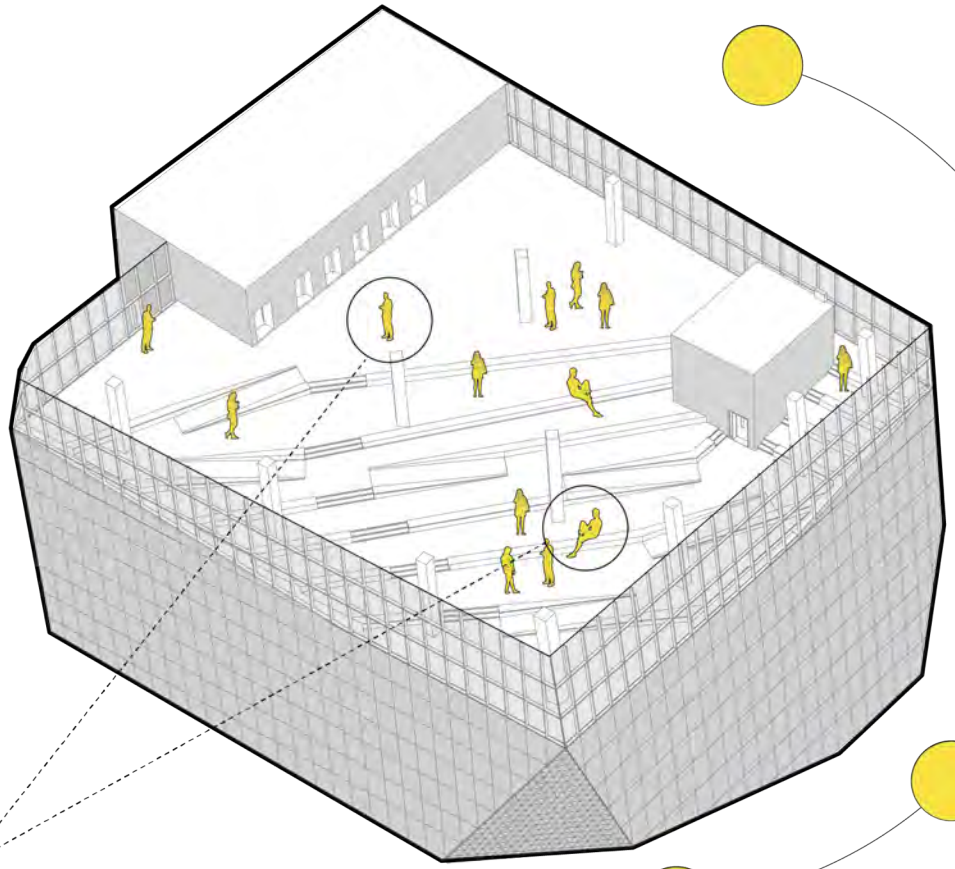


EMOTION

HEALTH

COMFORT

EQUITY



OCULIGHT dynamics

… BY TAKING THE **OCCUPANT'S** PERSPECTIVE

http://lipid.epfl.ch

http://oculightdynamics.com

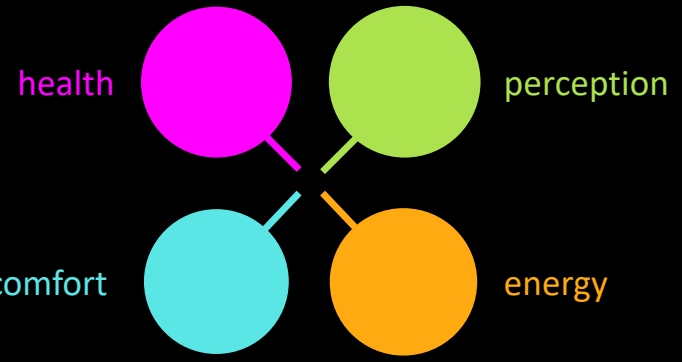
OCULIGHT dynamics

EPFL

EPFL - LIPID | Laboratory of Integrated Performance in Design

Prof. Marilyne Andersen
Head of LIPID

Dr. Jan Wienold
Scientist



LIPID Alumni

LIPID PhDs and PostDocs

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OCULIGHT dynamics

FNSNF Swiss National Science Foundation

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