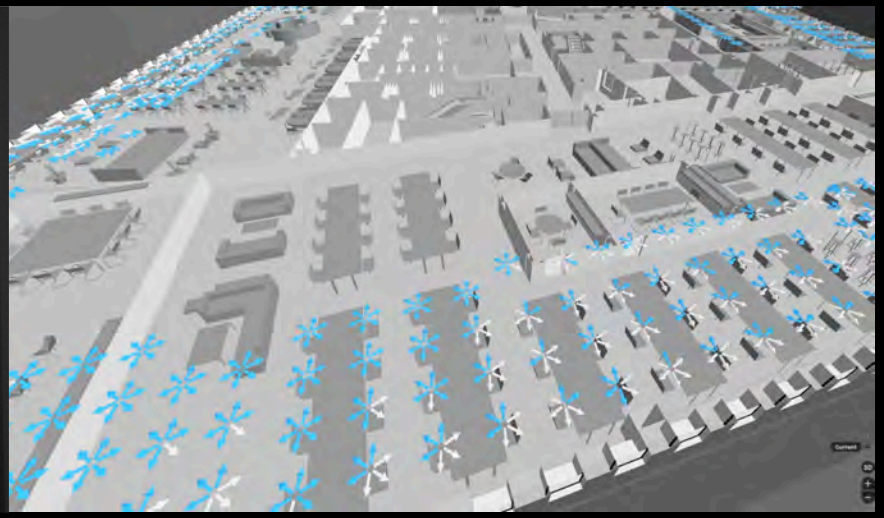
Daylight is more than ‘free’ lighting with high glare risks:
we should appraise it beyond strict illumination and look for…

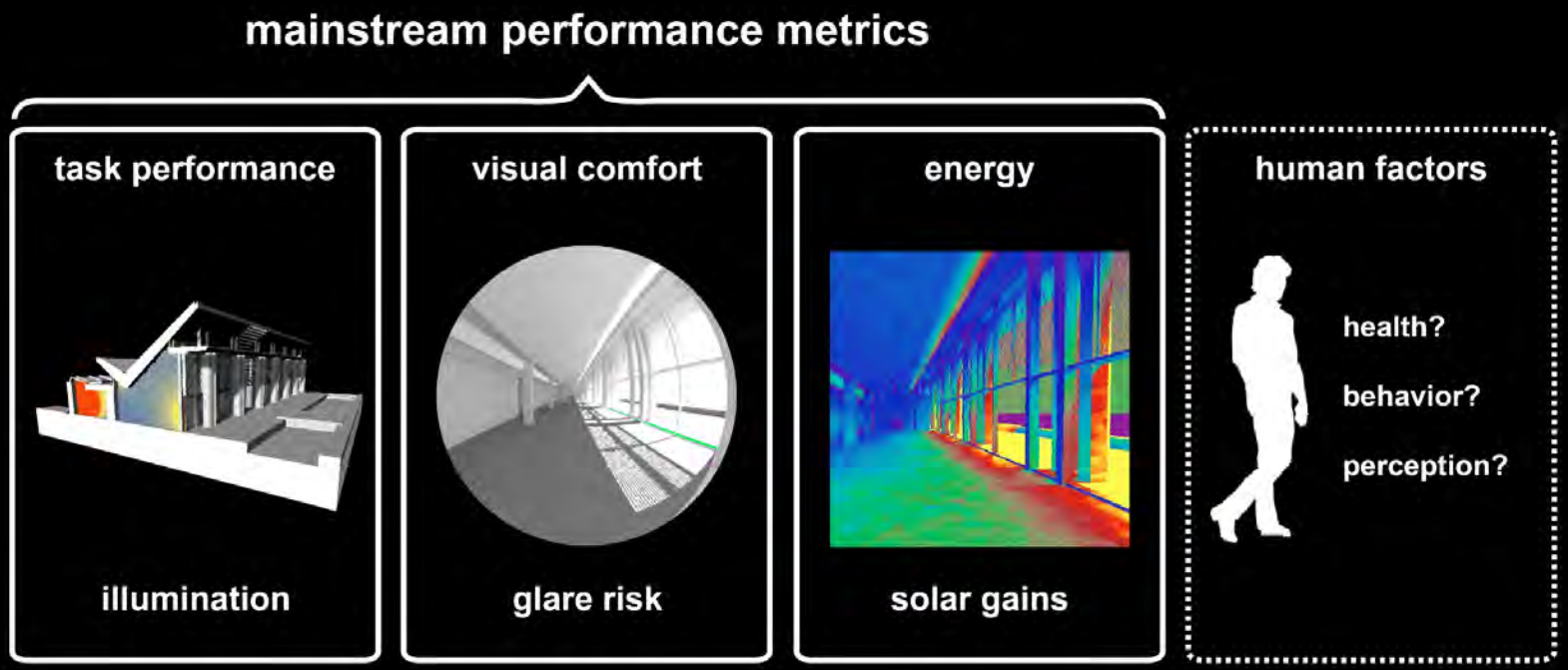


new metrics
human-centered
dynamic

new visualizations
interactive
immersive

daylight dynamics and well-being

- human comfort and well-being back at the centre
- beyond mainstream metrics and performance evaluation

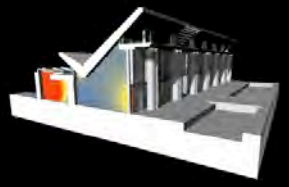


daylight dynamics and well-being

performance over time

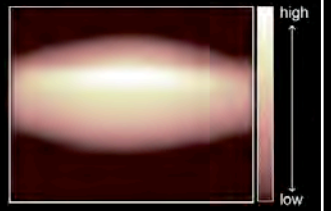
MAINSTREAM

task performance

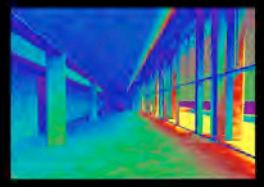


sensor plan

illuminance (lux)

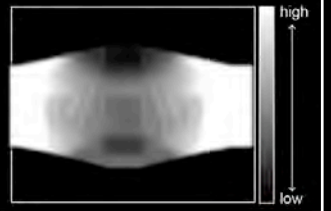


energy



envelope & occupancy info

balance point calc

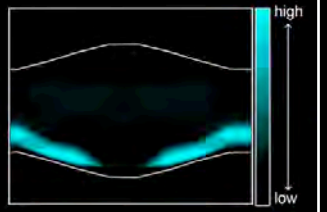


HUMAN-CENTERED

visual responsive comfort

view positison/ view direction

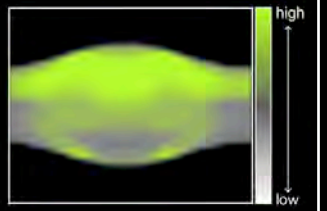
vertical illuminance (lux)
luminance map (cd/m2)



visual delight

view position/ view direction

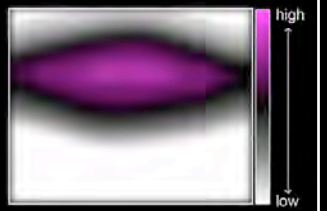
luminance map (cd/m2)



health potential

occular light exposure

vertical illuminance (lux)
sleep/wake time

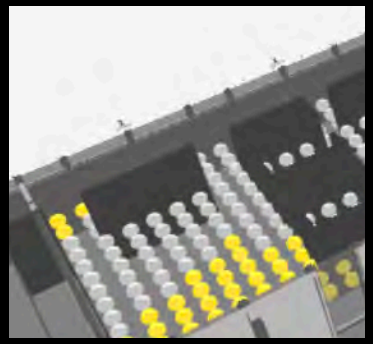


EPFL

BEYOND ILLUMINATION

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

ILLUMINATION
adequate
task lighting



+

VITALITY
physiology

COMFORT
acceptability

EMOTION
psychology

*... **dynamically** over time & space*

OCULIGHT dynamics

EPFL

comfort

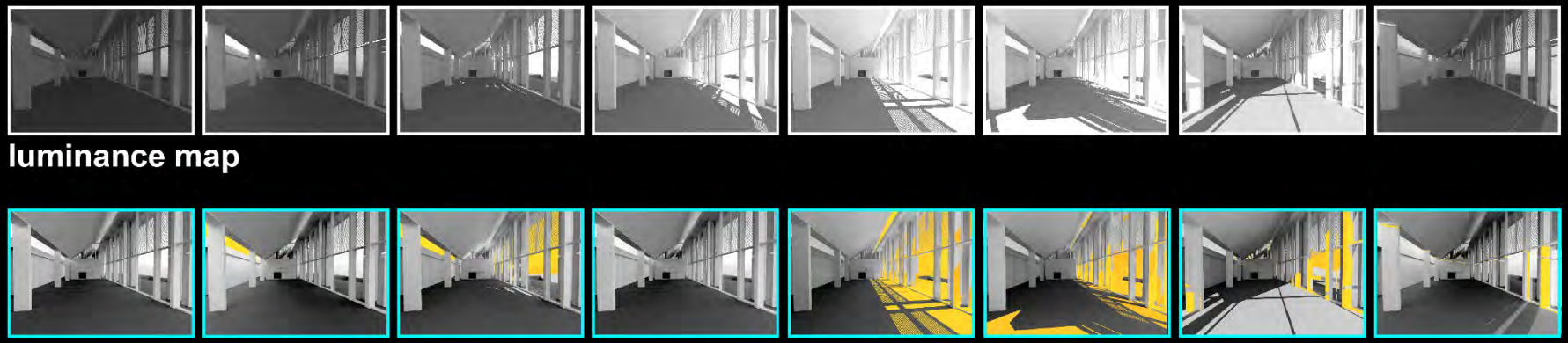
builds on minimal and maximal requirements

SG Foyer, EPFL (rendering by K. Chamilothori)

visual comfort dynamics

glare and gaze

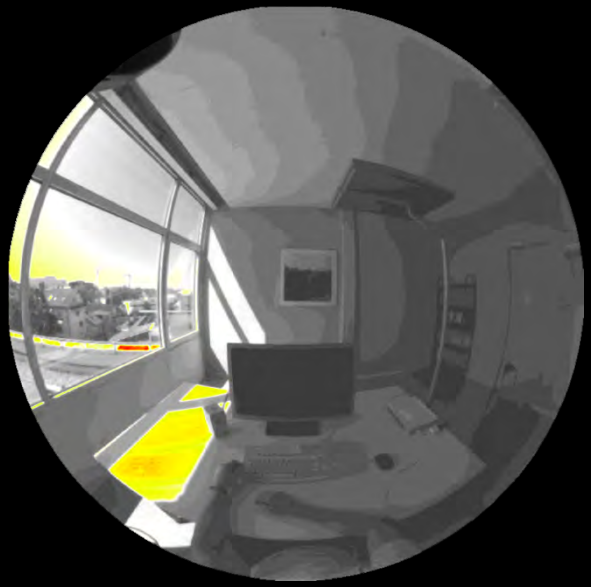
Prof. Mandana Sarey Khanie
LIPID PhD+PostDoc alumnus
Asst. Prof. at DTU, Denmark



EPFL

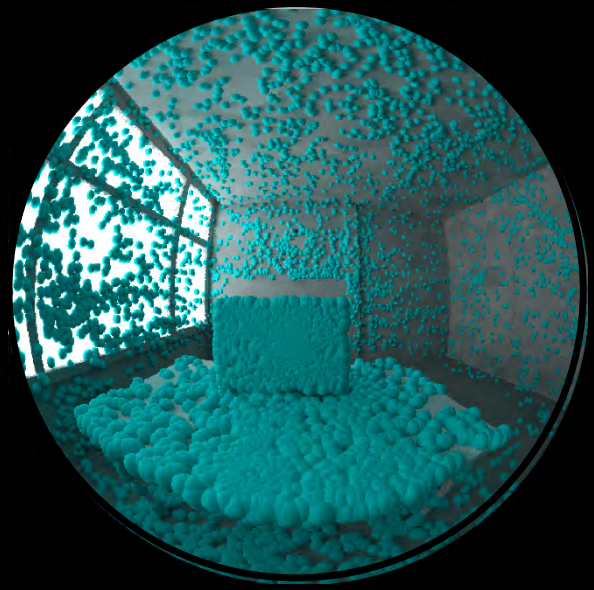
visual comfort dynamics

gaze behavior based on lighting conditions and task

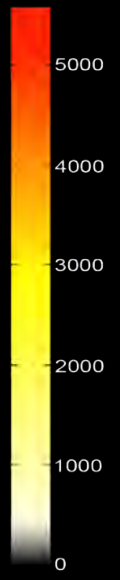


perceived light

field of view



talking [illegible] one



Dr. Jan Wienold
Co-advisor

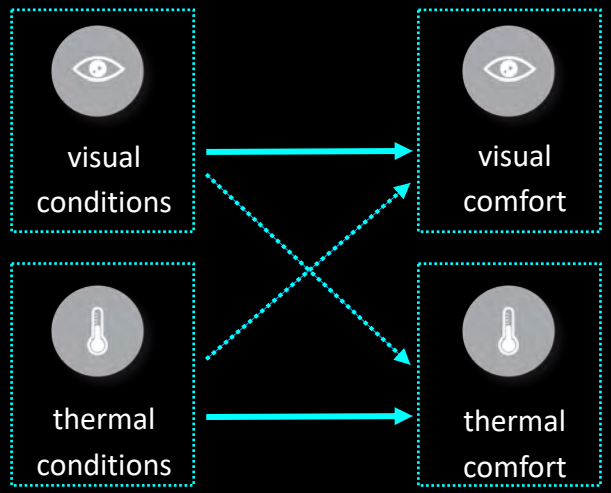
EPFL

visual and thermal comfort

perceived interactions

Dr. Giorgia Chinazzo
LIPID PhD+PostDoc alumnus
PostDoc at Northwestern University, USA

SwissTech Convention Center / Richter Dahl Rocha & Associés



EPFL

visual and thermal comfort

perceived interactions

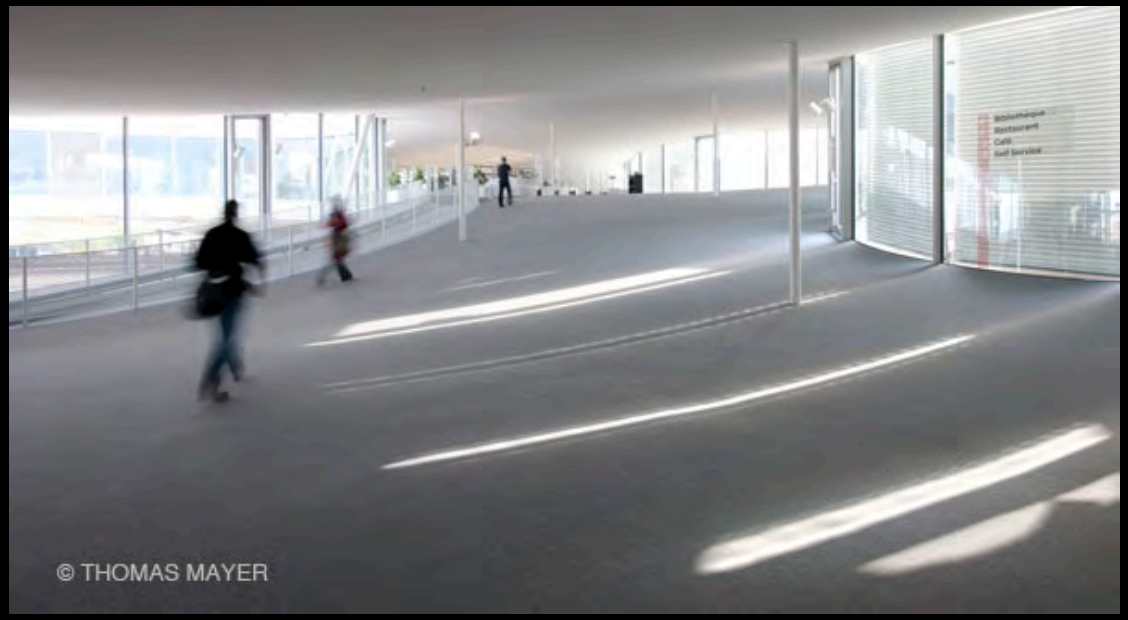
Your Rainbow Panorama by Studio Olafur Eliasson

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

EPFL

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**?

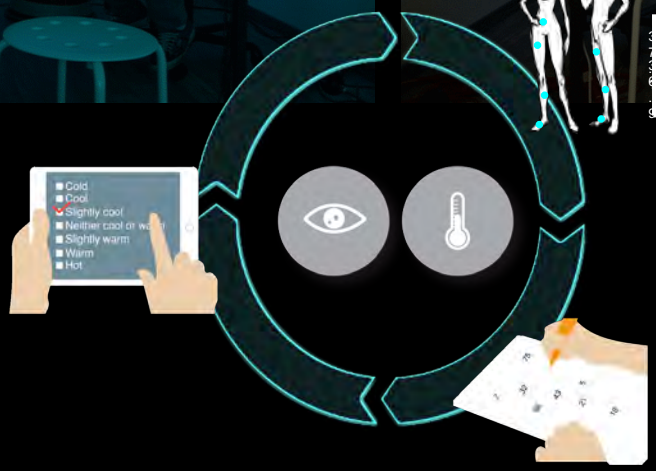
EPFL

visual and thermal comfort

interaction effects

color of light & temperature

light quantity & temperature

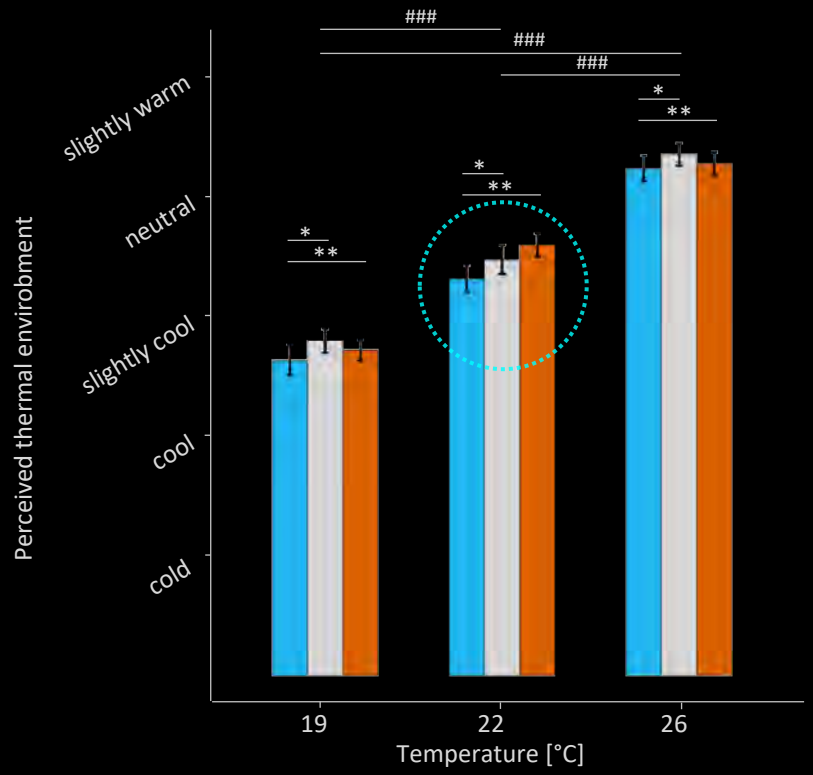


EPFL

visual and thermal comfort

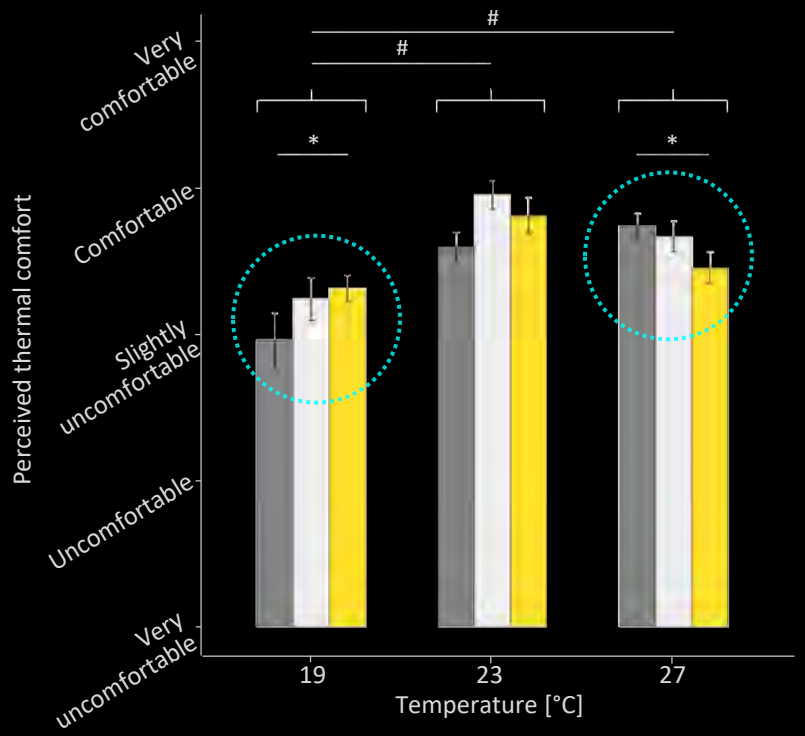
impact of visual environment on thermal perception

color of light & temperature



impact of brightness on thermal comfort

light quantity & temperature



EPFL

emotion

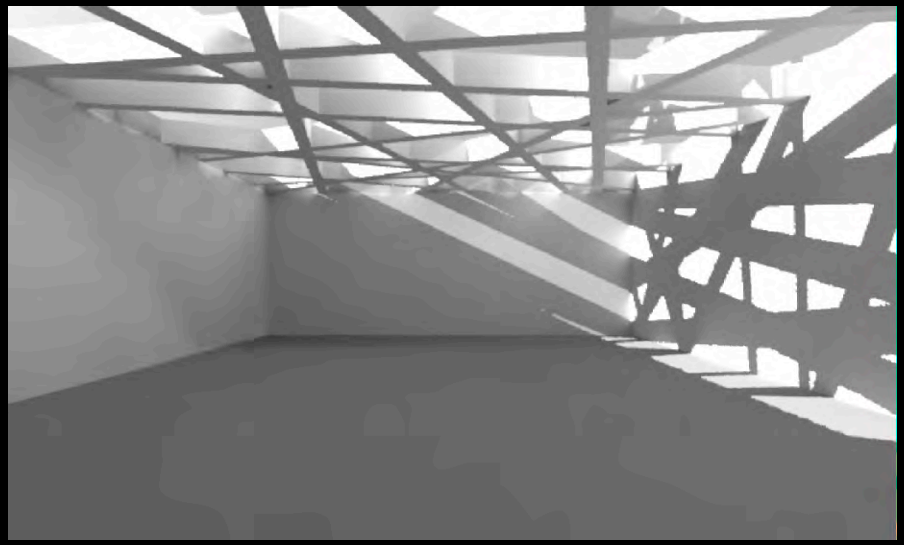
most tangibly connected with architectural experience

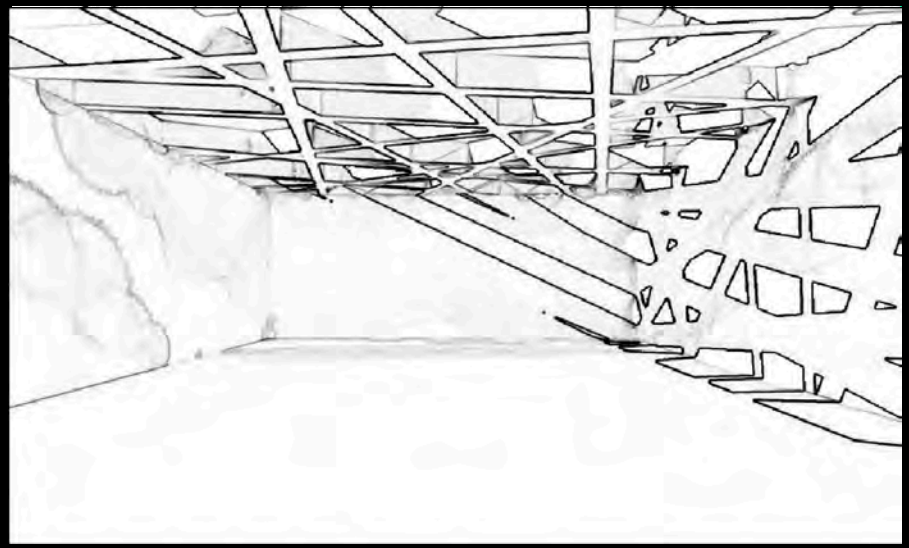
Dominus Winery by Herzog & De Meuron, California

emotion

perceptual effects and visual interest in daylit architecture

Prpf. Siobhan Rockcastle
LIPID PhD+PostDoc alumnus
Co-Founder of OCULIGHT
Asst. Prof. at University of Oregon, USA



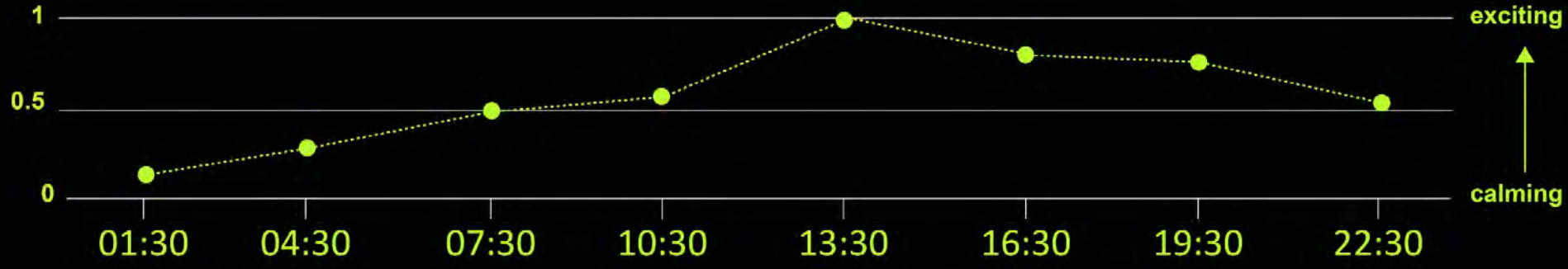


visual delight

dynamic contrast composition

luminance map

spatial contrast



EPFL

spatial contrast

dynamic spatial and temporal qualities of daylight

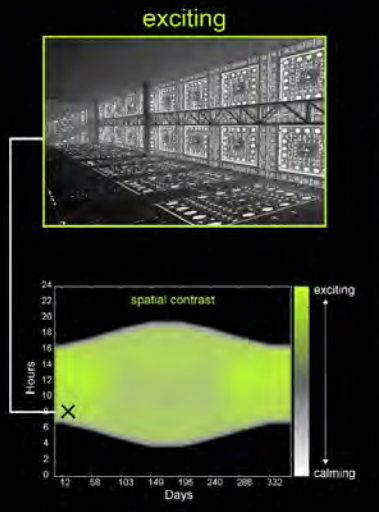
Institut du Monde Arabe
Jean Nouvel

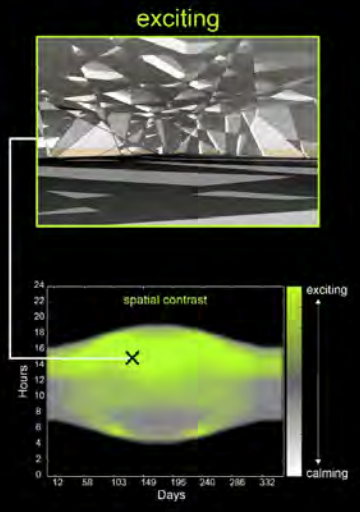
Serpentine Pavilion
Toyo Ito

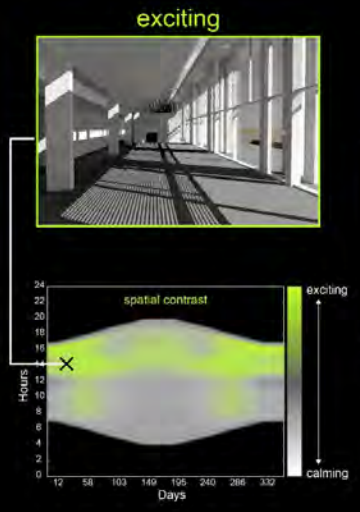
Neugebauer house
Richard Meier & Partners

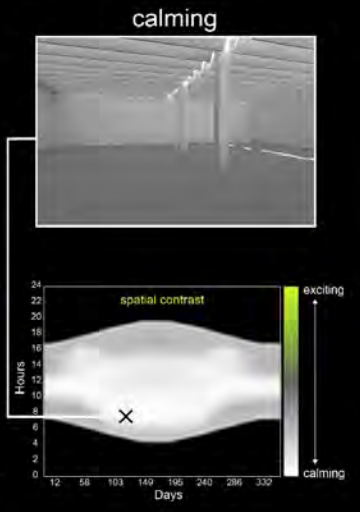
First Unitarian church
Louis Kahn

Menil gallery
Renzo Piano



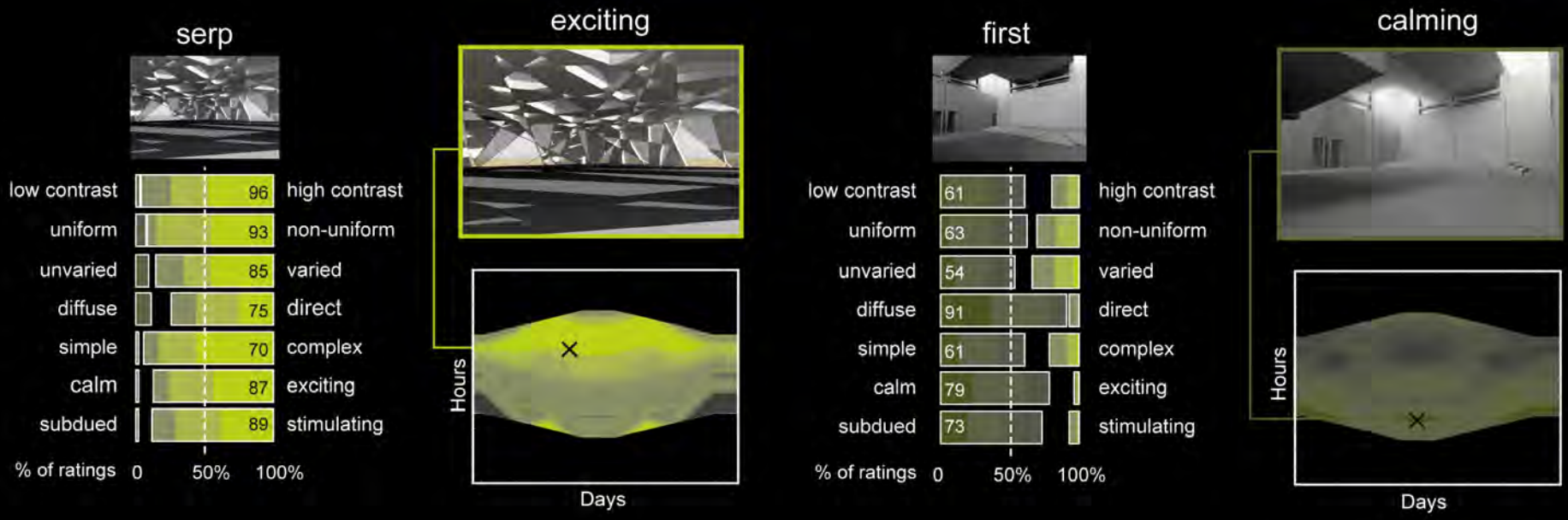






spatial contrast

subjective rating of rendered architectural spaces (online survey)



+ effect of sky (weather)

EPFL

perception of daylight patterns

irregularity linked to positive impressions

Prof. Kynthia Chamilothori
LIPID PhD+PostDoc alumnus
Asst. Prof. at TU Eindhoven, The Netherlands

Demonstration of the experimental setup by G. Chinazzo

EPFL

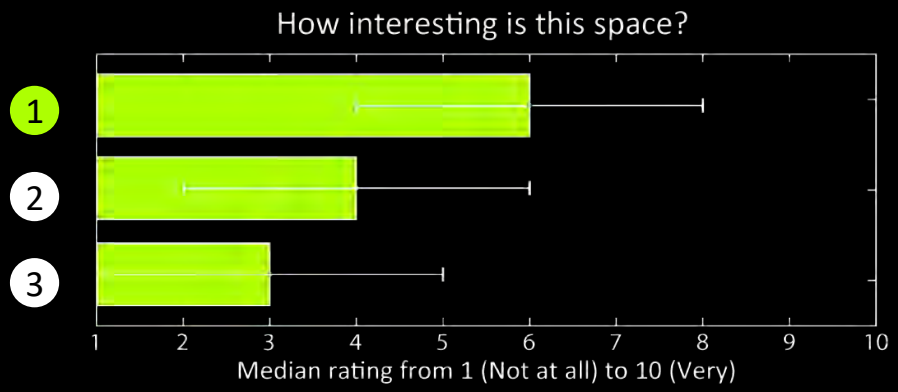
perception of daylight patterns

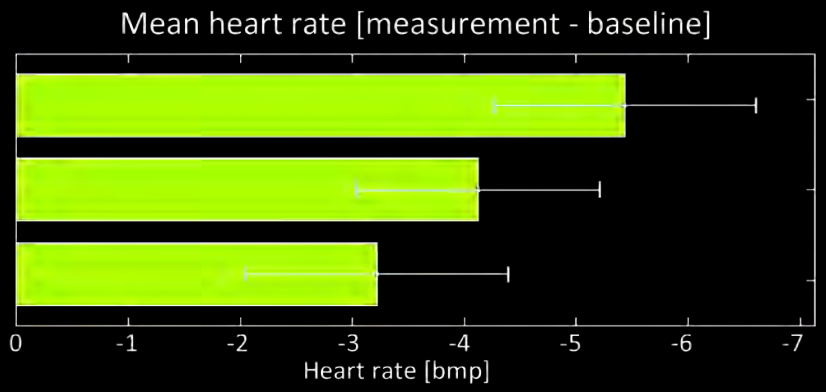
irregularity linked to positive impressions
and measurable calming effect

2

1

3

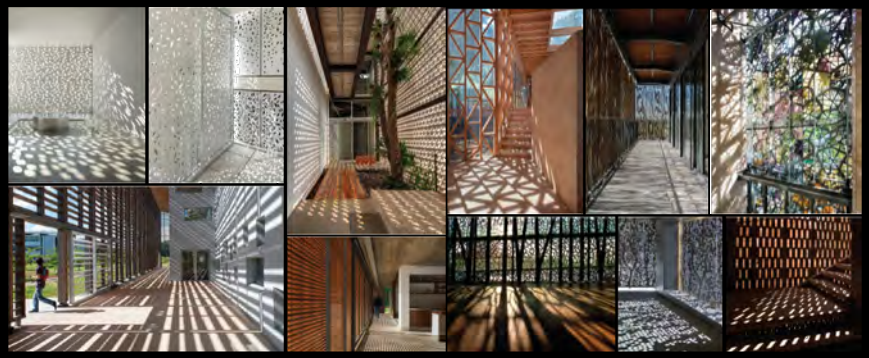


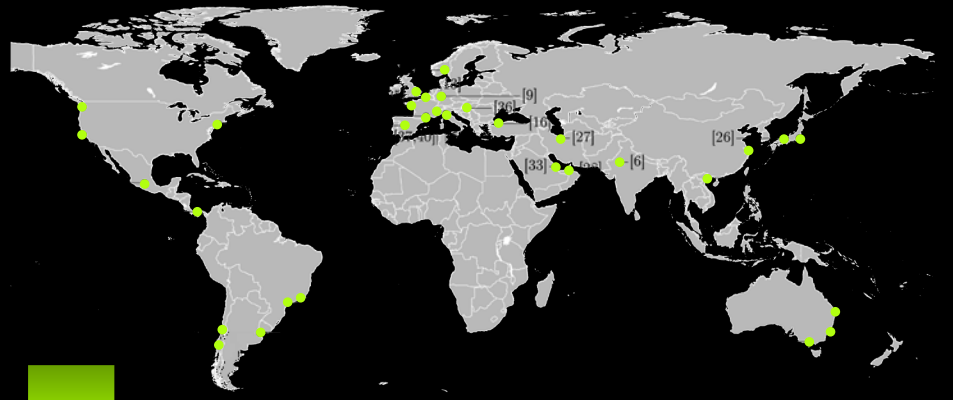


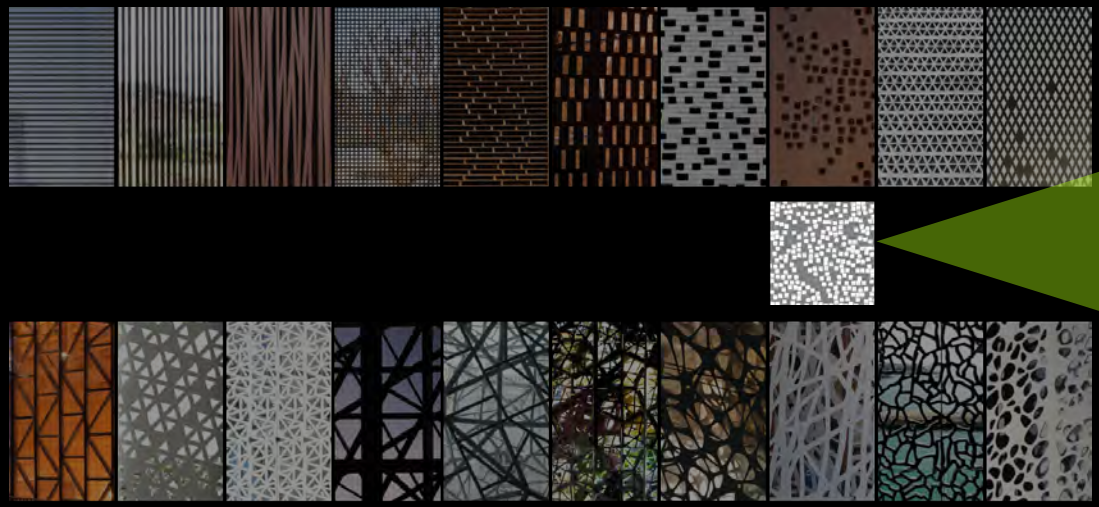
EPFL

façade patterns

inspiration from worldwide architecture



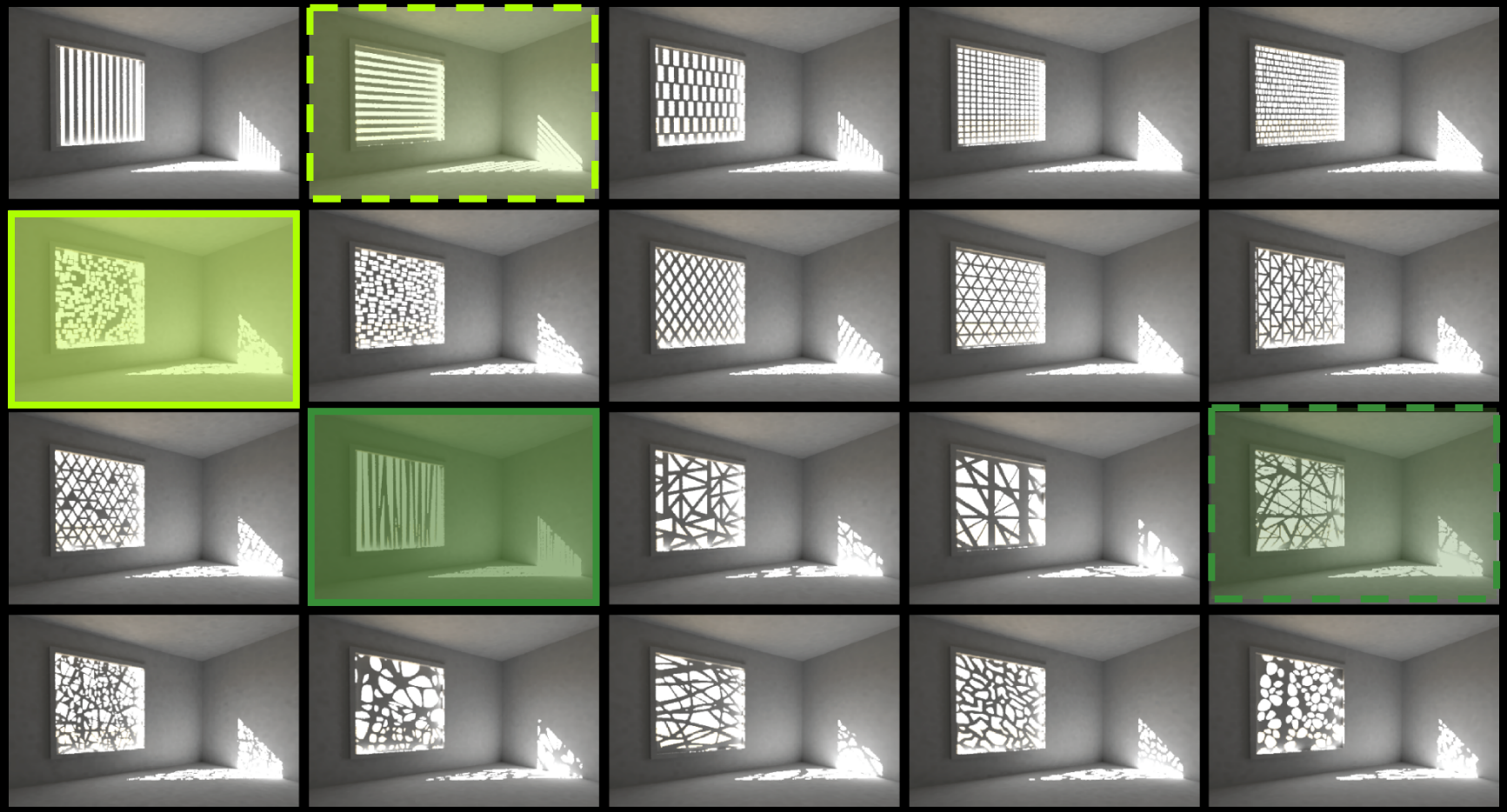




EPFL

façade patterns and daylight composition

consensus on pattern attributes (from designers)



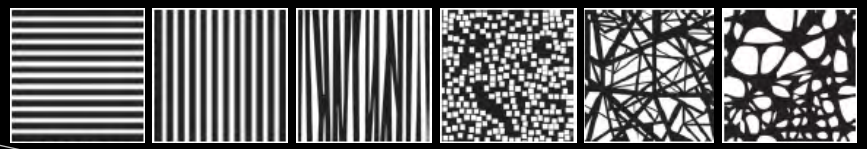
POSITIVE — most exciting — most calming

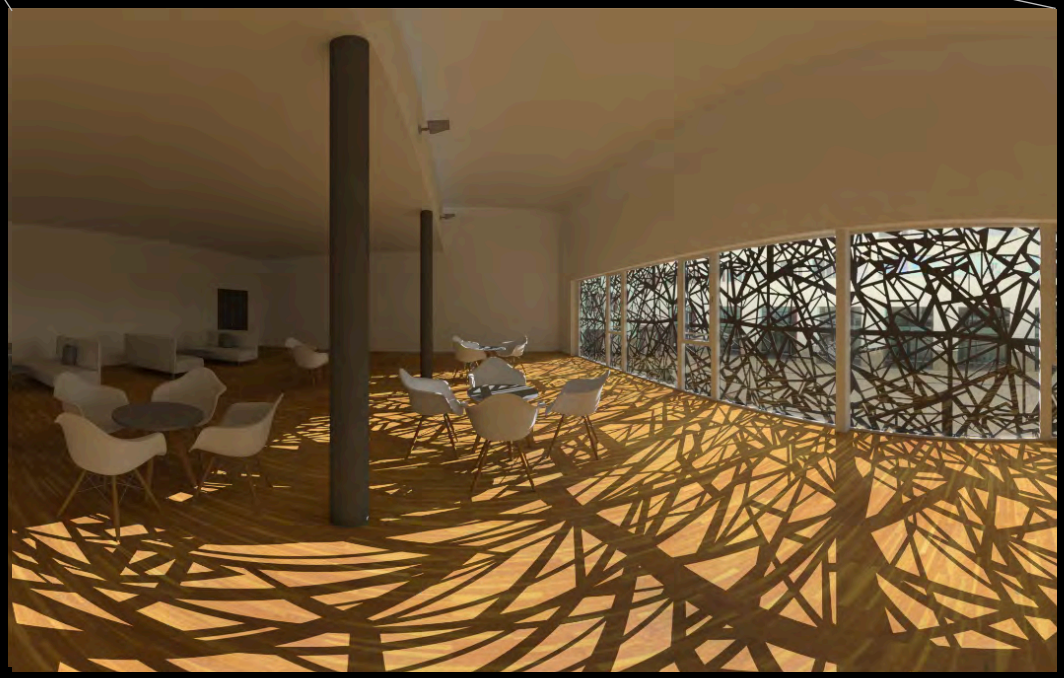
NEGATIVE — least exciting — least calming

EPFL

assessing human response to daylight patterns

VR immersion

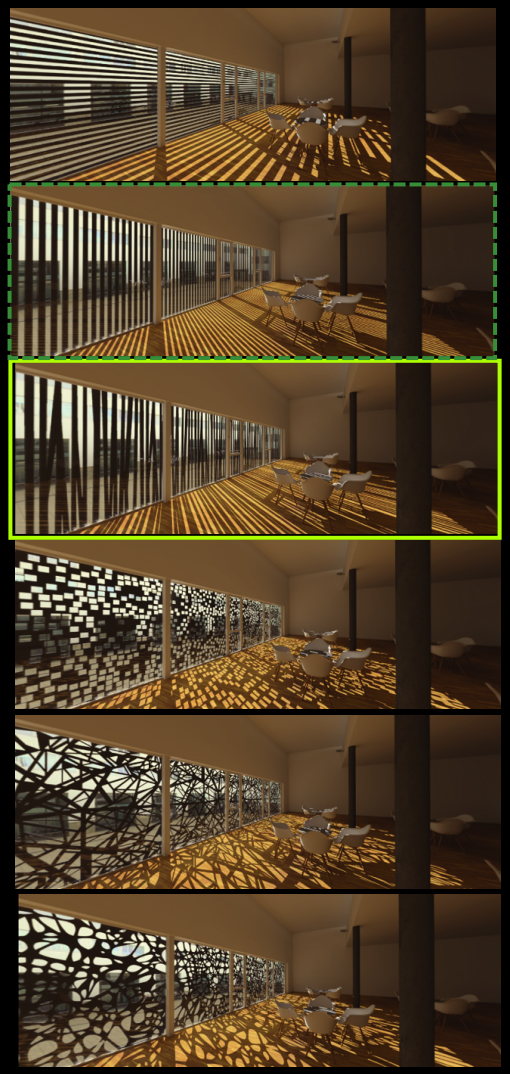


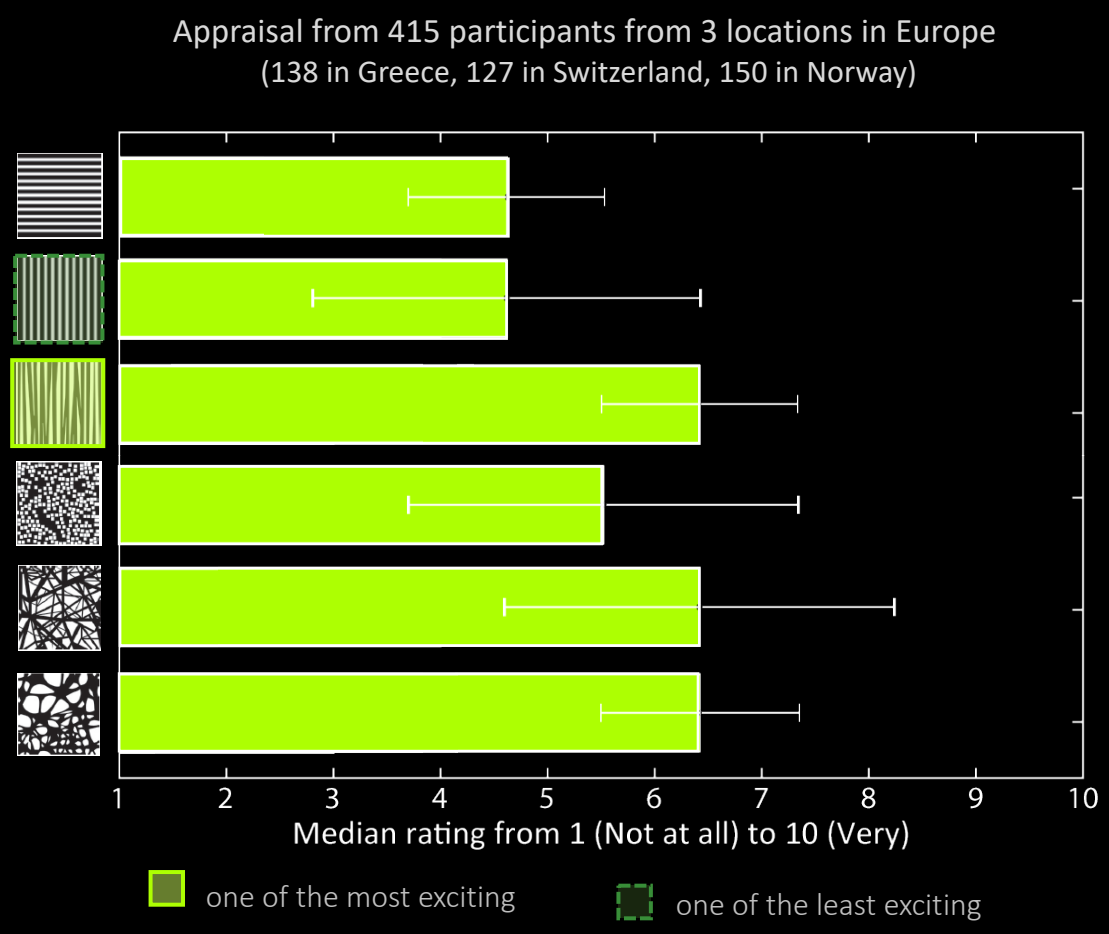


EPFL

daylight patterns and psycho-physiological human response

how exciting is this space?





significant effect of pattern **independently**
of sky/sun, context, size or location!

EPFL

vitality

physiological human needs

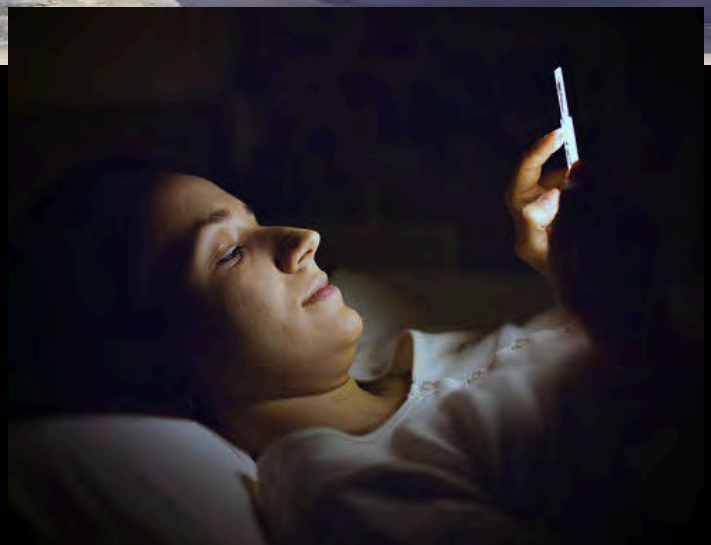
Drawing by M.L. Amundadottir

vitality

Image Source: Date and Time

Environmental impact

Image Source: Web Urbanist; Harvard Health



Behavioral/Lifestyle impact

EPFL

Health implications of disrupted circadian rhythms and the potential for daylight as therapy

Jason Brainard, M.D.,[1] Merit Gobel, B.S.,[1] Benjamin Scott, M.D.,[1] Michael Koeppen, M.D.,[2] and Tobias Eckle, M.D., Ph.D.[1]

Image Source: Snøhetta

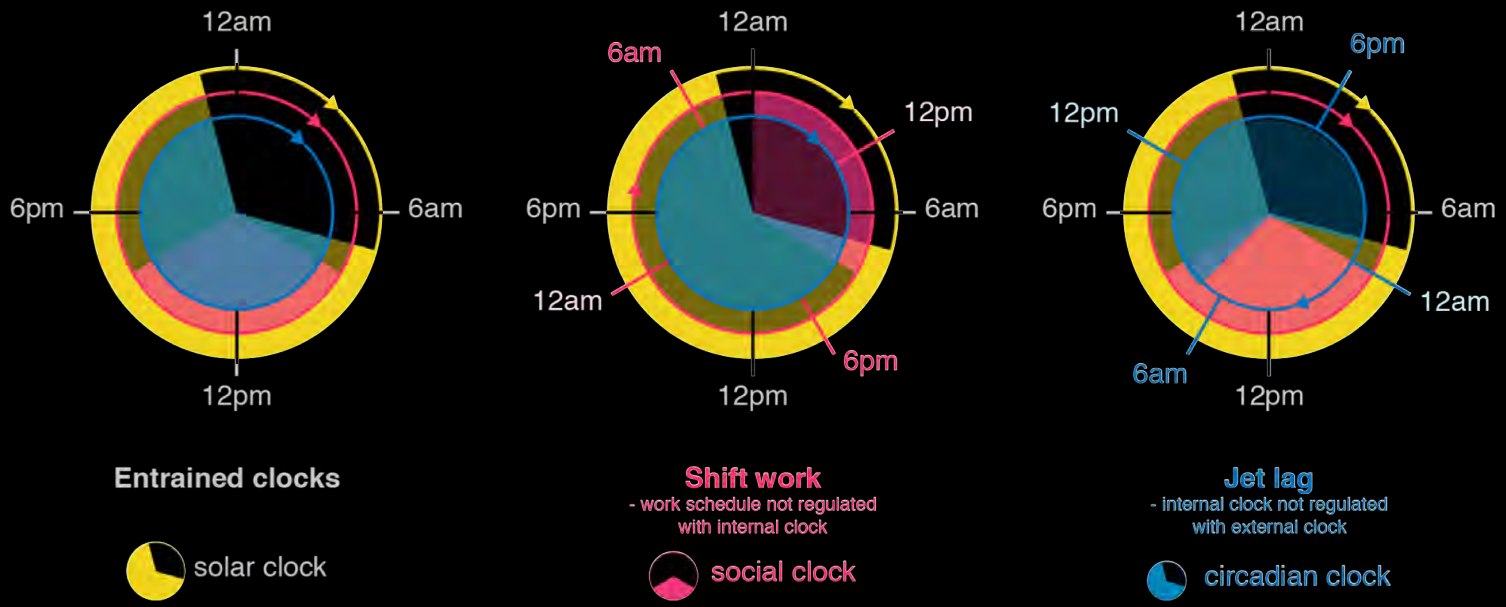


Image Source: Ámundadóttir, 2016

EPFL

non-visual system

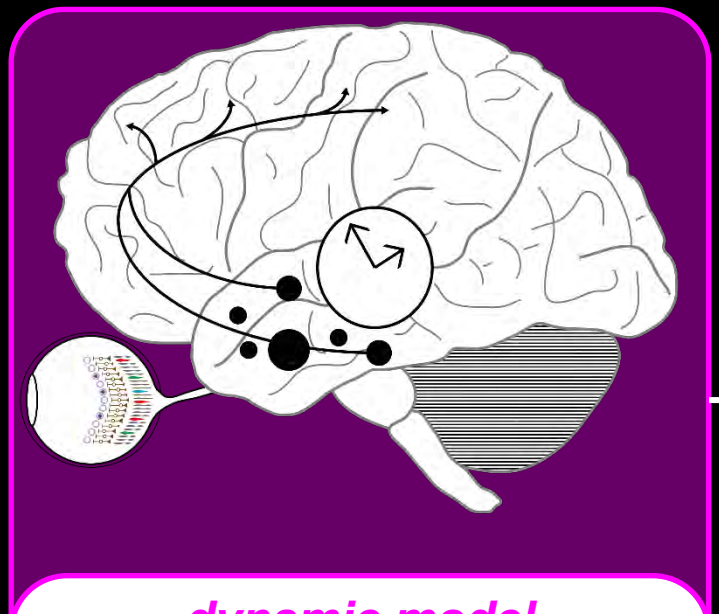
effects of ocular light exposure on human health

Dr. Maria Amundadottir
LIPID PhD alumnus
Co-Founder of OCULIGHT
Data Scientist and Entrepreneur, Iceland

INPUT

vertical illuminance

factors
intensity
wavelength
duration
timing
history



dynamic model
thresholds
spectral sensitivity
integration
circadian rhythms
adaptation

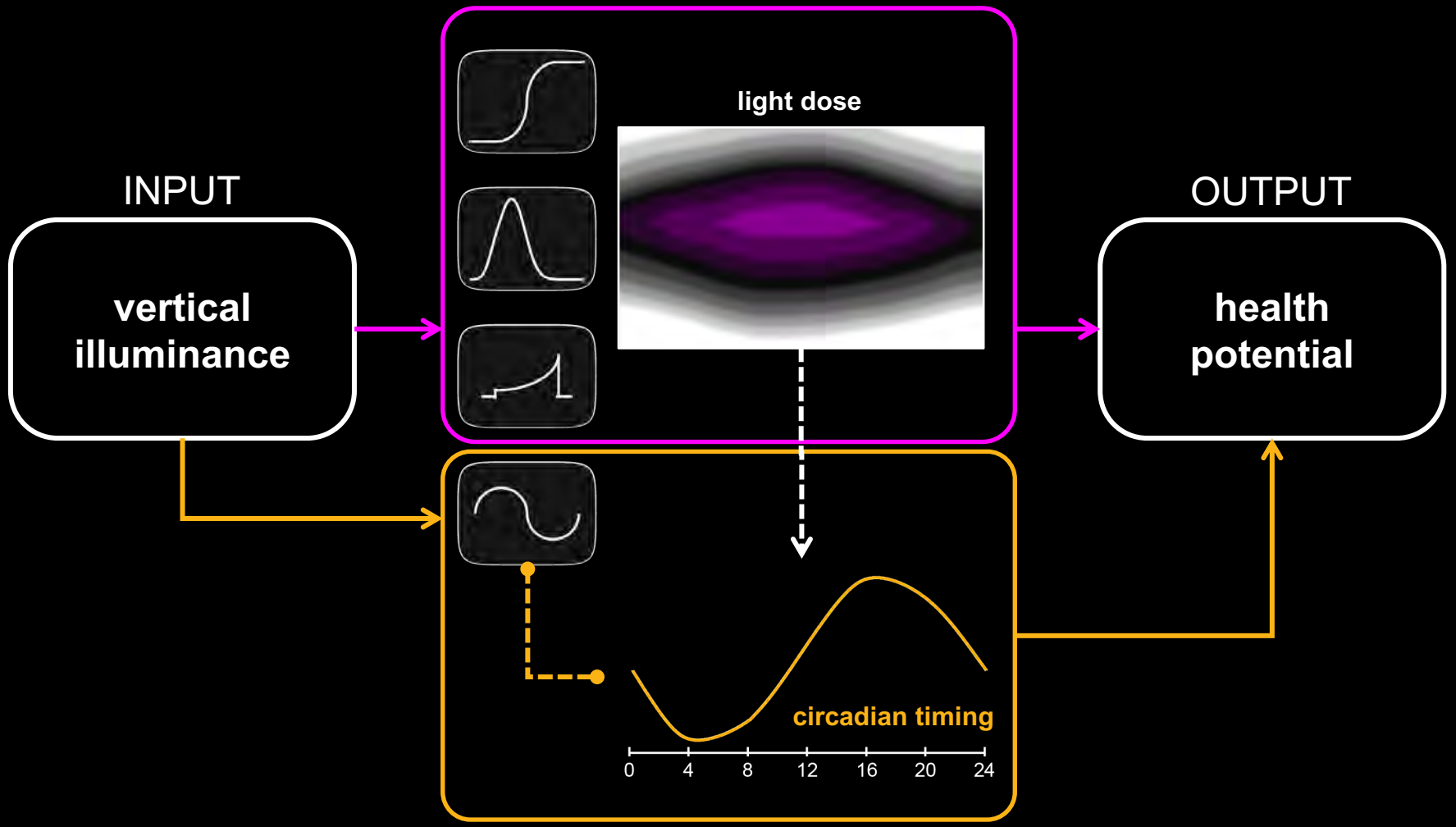
OUTPUT

health potential

health benefits
alertness
performance
wellbeing
sleep quality
mood

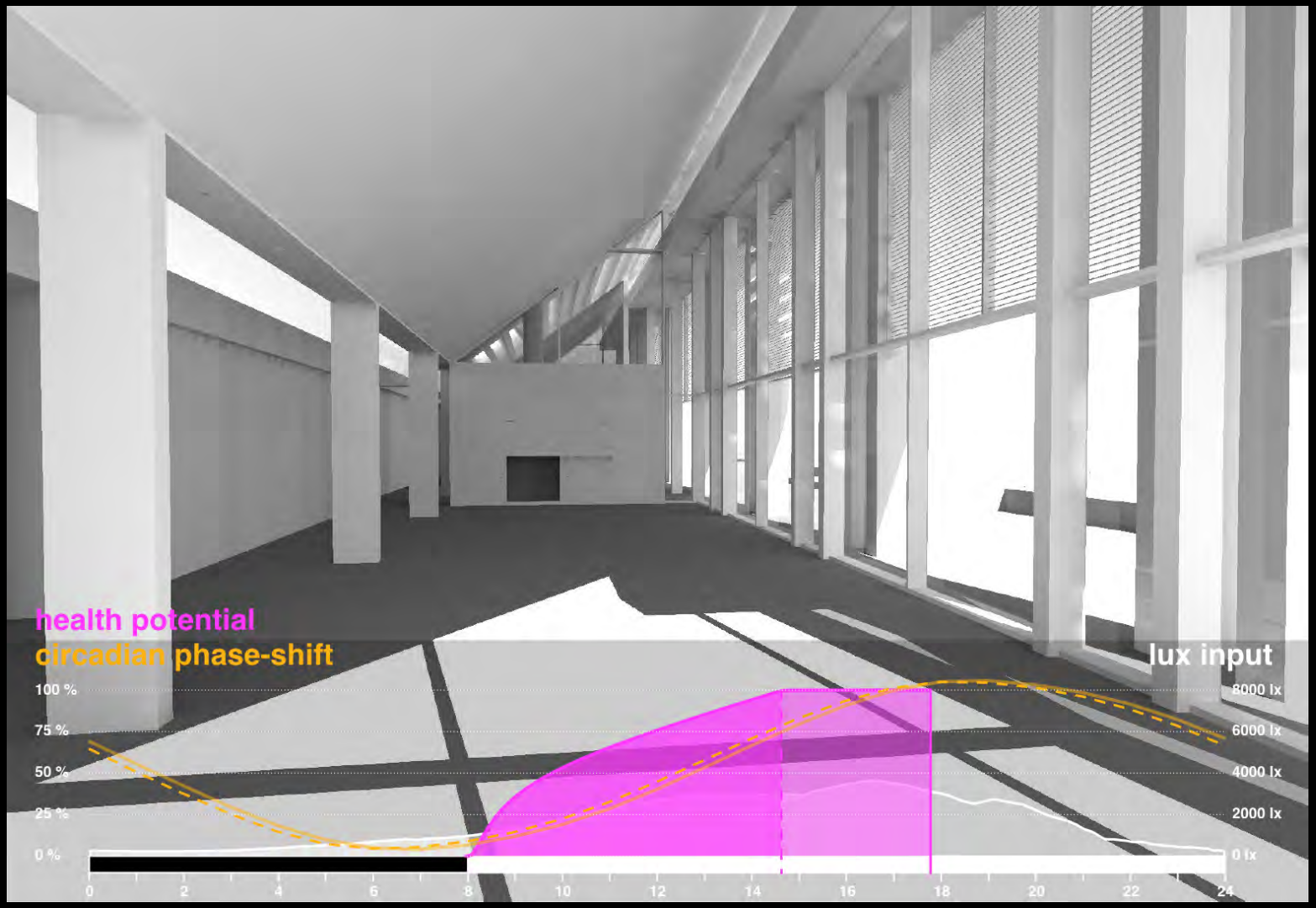
dynamic model

maximize the daily light dose without disturbing circadian timing



dynamic model

cumulative dose and daily cycle



impact of spectrum and brightness on alertness

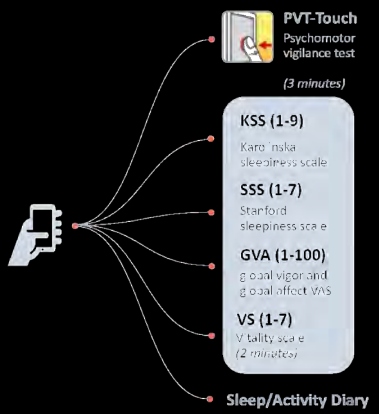
Victoria Soto Magan
PhD student

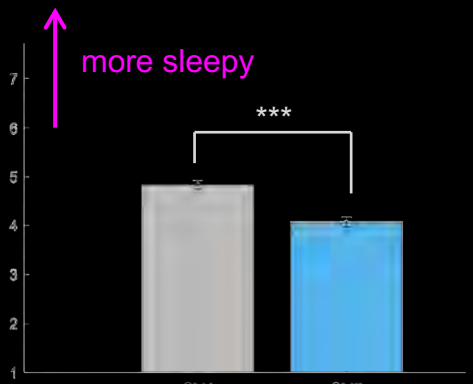
1 effect of spectrum
'bluer' vs neutral

2 effect of intensity
bright vs dim

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

subjective + cognitive evaluation





EPFL

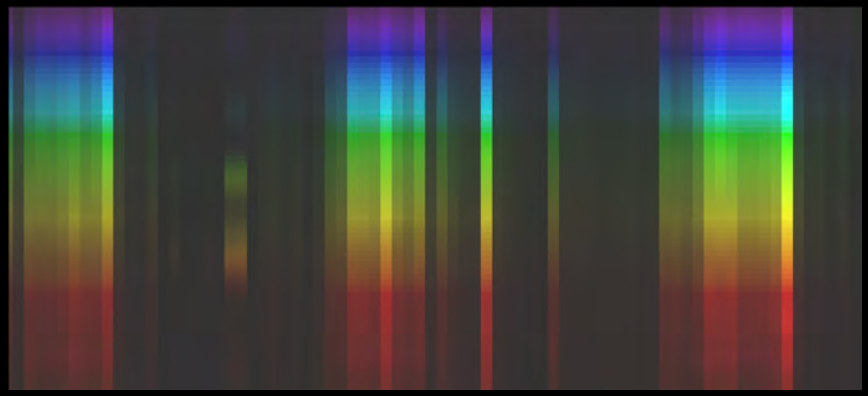
alertness and circadian resetting

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

Forrest Webler
PhD student

'hyperspectral' scenes

spectral monitoring



wearable technology

SPECTRACE prototype