Non-visual pathway

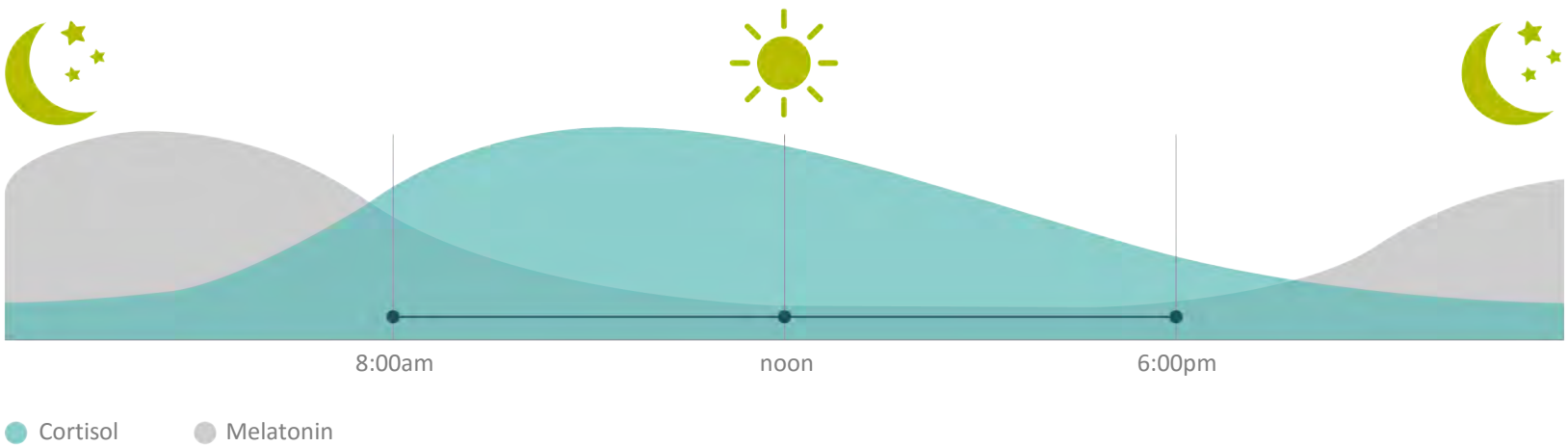
Light regulates our biological clock

Affecting for instance:

- State-of-mind
- Sleep Concentration
- Alertness
- Development/growth

And more indirectly also affecting:

- Immune system
- Recovery
- Wound healing
- Memory
- Behavior



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Five aspects of artificial light
that matter

Light intensity

Color temperature

Light distribution

Personal control

Lighting design

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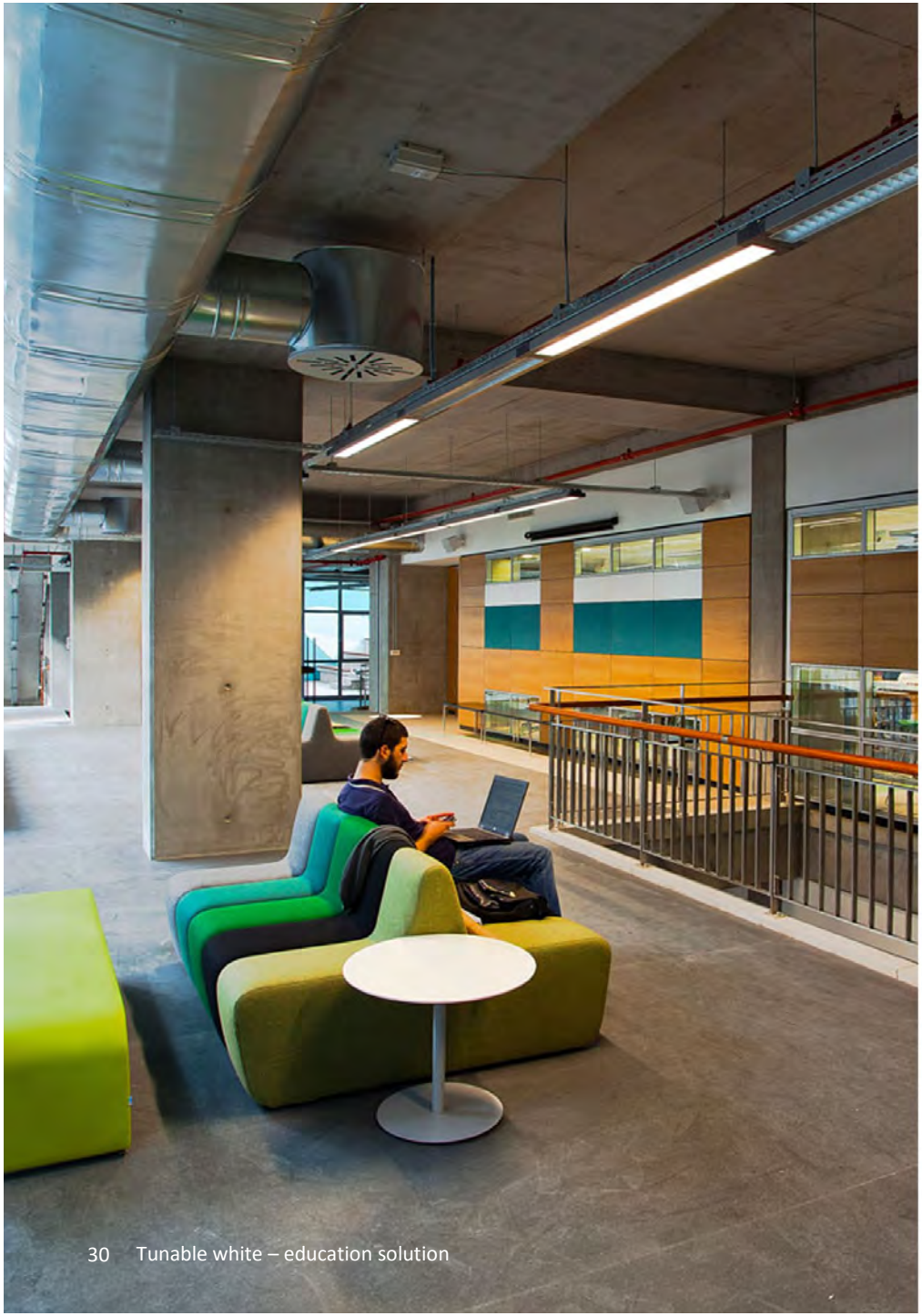

Strength

matters

- The visual acuity depends on the intensity of light: about 40% increase when going from 50lux to 500lux[1]
- Enhances concentration and alertness[2]
- Enhanced cooperative behavior[3] and creativity[4] at dimmed light conditions
- Faster reading speed[5]

Source:
[1]Adrian, 1993
[2]Steidle, 2010; Hoffmann 2008; Ruger 2005
[3]Galetzka, 2010
[4]Steidle, 2010
[5]Mott, 2012; Barkmann 2010; Fuchs 2001

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2. Color temperature

Change color,

boost concentration

- Eye becomes tired less quickly at 6000K than 2700K[1]
- Alertness and concentration is improved[2]
- Reduces sleepiness and increases self-reported performance[3]
- Enhanced cooperative behavior at warm light conditions[4]

Source:
[1]Dou, 2011
[2]Mills, 2007; Rautkylä et al. 2010; Viola, 2008
[3]Viola, 2008
[4]Baron 1992

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Create

the right ambience

- Visual comfort is related to the illumination of the space
- Wall brightness enhances the room appearance
- Goven (2010, 2011) found a trend in children's mood when changing the brightness of the walls and ceilings

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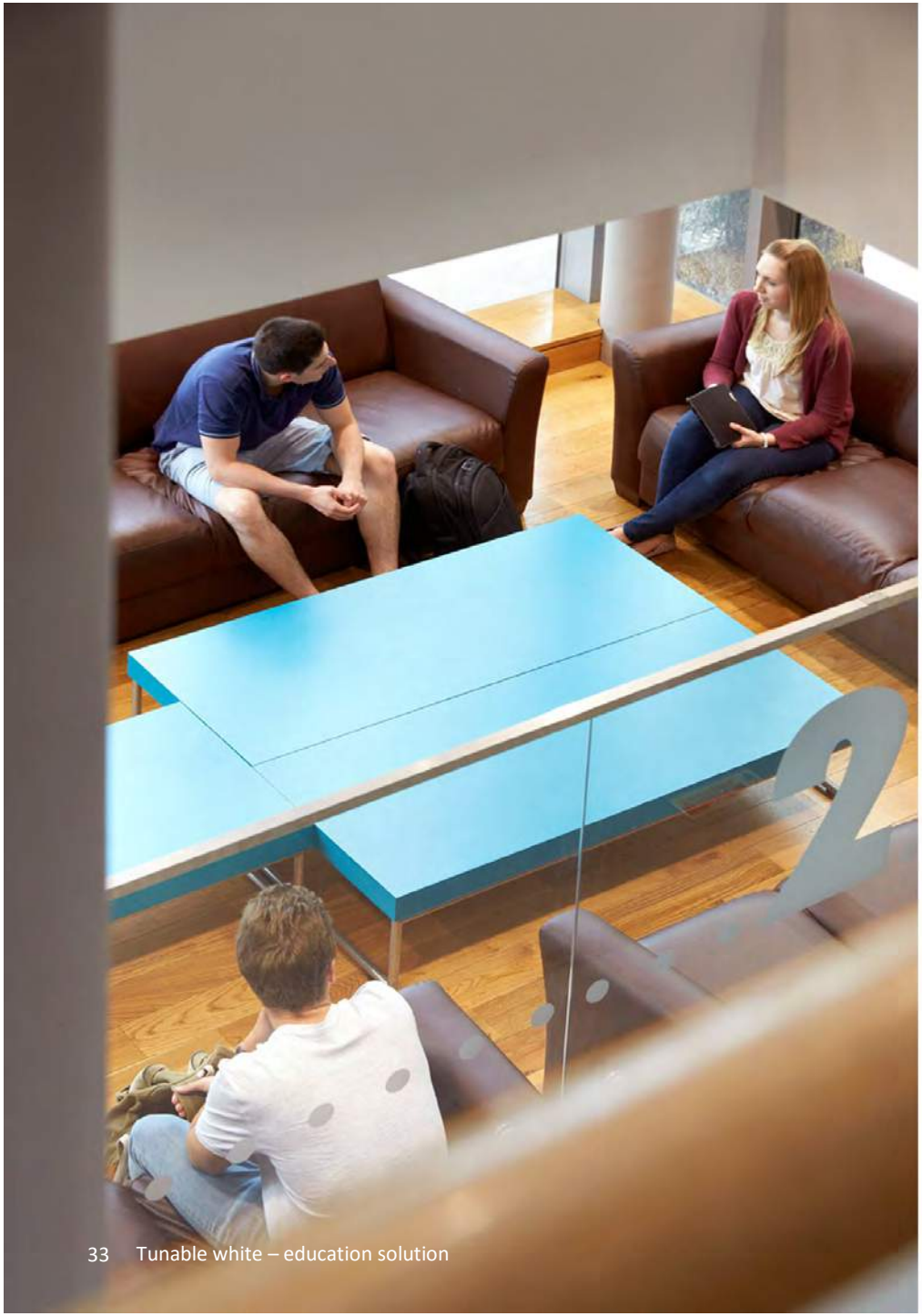

4. Personal control

Light that

puts you in control

- Qualitative research confirms that personalized light tones and intensities leads to optimal visual comfort[1]
- Personal control leads to higher job satisfaction[2], improved mood and comfort[3]; higher perceived productivity[4]

Source:

[1]internal Philips research

[2]Lee and Brand 2005; HermanMiller 2007

[3]Newsham, 2003

[4]Bordass, 1993

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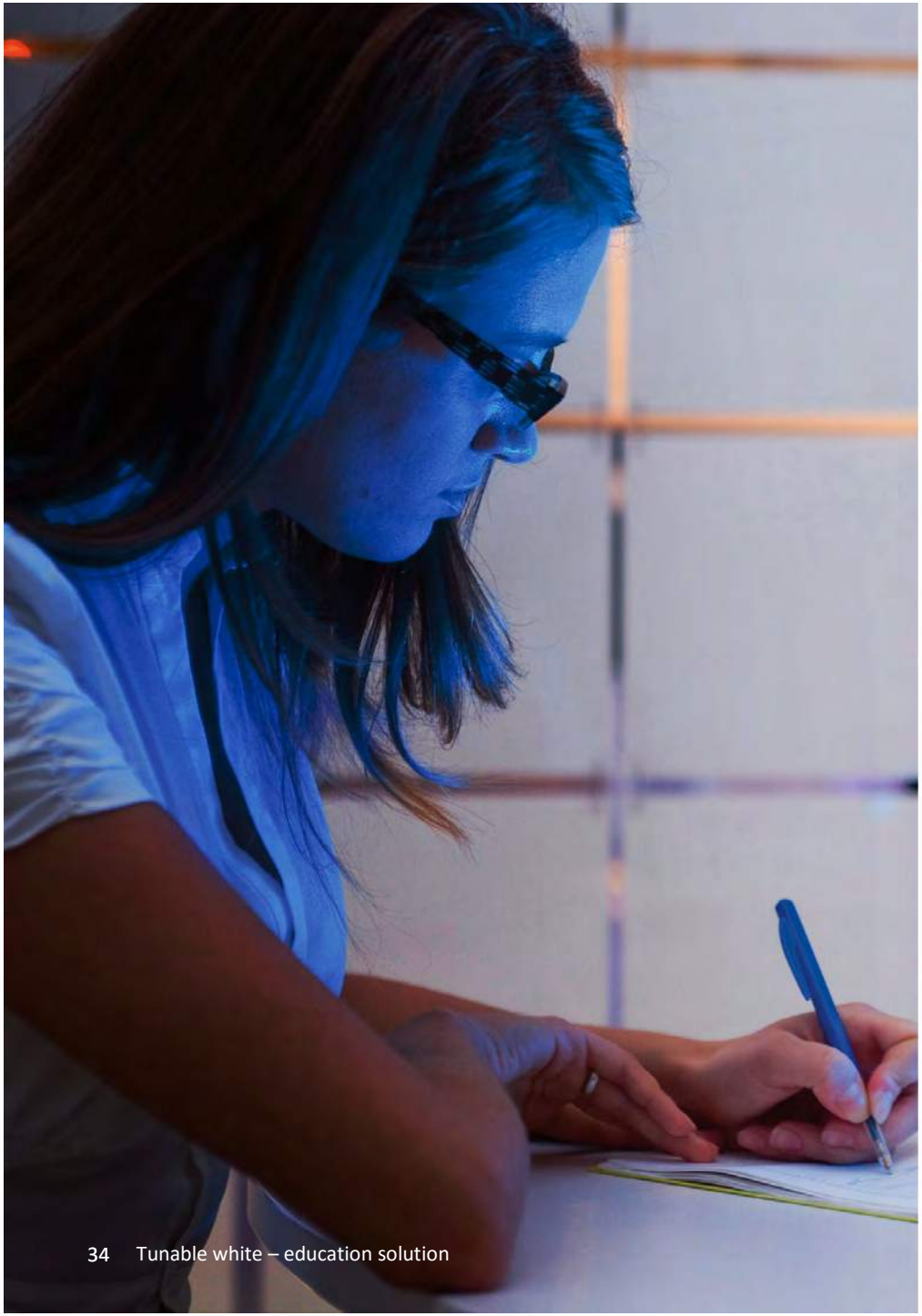

Comfortable light

creates satisfaction

- Visual comfort is related to the illumination of the space
- Research has demonstrated that satisfaction with lighting contributes to greater environmental satisfaction which leads to a greater job satisfaction[1]
- Lighting appraisal is linked with organizational commitment and employee engagement[2]
- Research has demonstrated that lighting appraisal is linked with motivation, work engagement, and productivity[3]

Source: [1]Charles, 2003 [2]Veitch, 2010 [3]Newsham

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People who appraise their lighting as good will also appraise the room as more attractive, be in a more pleasant mood, be more satisfied with the work environment, and more engaged in their work."

Extract from: "Linking Lighting Appraisals to Work Behaviors" Jennifer A. Veitch, Mariska G. M. Stokkermans and Guy R. Newsham Environment and Behavior2Ol3 45: 198 originally published online 16 September 2011

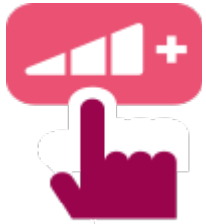
Tunable white concepts
in various environments

Dynamics

Supporting the user by providing lighting designed to support mental resources throughout the day

Scene set

Maximize efficiency of meeting rooms by providing preset lighting conditions tailored to common activities



Personal control

Providing maximum control to the user to tune the lighting to his/her needs

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Dynamics

Automatically mimic daylight patterns by adjusting color temperature and brightness levels with respect to the time of day.

Visual variation

Achieve more visual variation in the office by gradually changing intensity and color temperature during the day and promote employee satisfaction. In a retail environment highlight various store areas in the most visually engaging manner possible.

Greater well being

Being able to mimic the natural cycle of our bodies with the right light promotes increased wakefulness and greater well being.

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Dynamics

application proof points

Employees exposed to bright light during the day (TC and I) report:

- A higher alertness especially in the morning
- A higher self-rated performance
- Less evening fatigue
- Improved sleep quality

Viola, 2008: Viola AU, James LM, Schlangen LJ, Dijk DJ (2008) Blue-enriched white light in the workplace improves self-reported alertness, performance and sleep quality Scand. J Work Environ. Health 34(4):297-306.

Lowden 2015: The effect of high quality indoor LED lighting on visual comfort, environmental appraisal, cognitive performance and wellbeing In preparation.

Rautkylä et al 2010: Rautkylä E, Puolakka M, Tetri E, Halonen L (2010) Effects of correlated colour temperature and timing of light exposure on daytime alertness in lecture environments J. Light & Vis. Env. 34(2):59-68.

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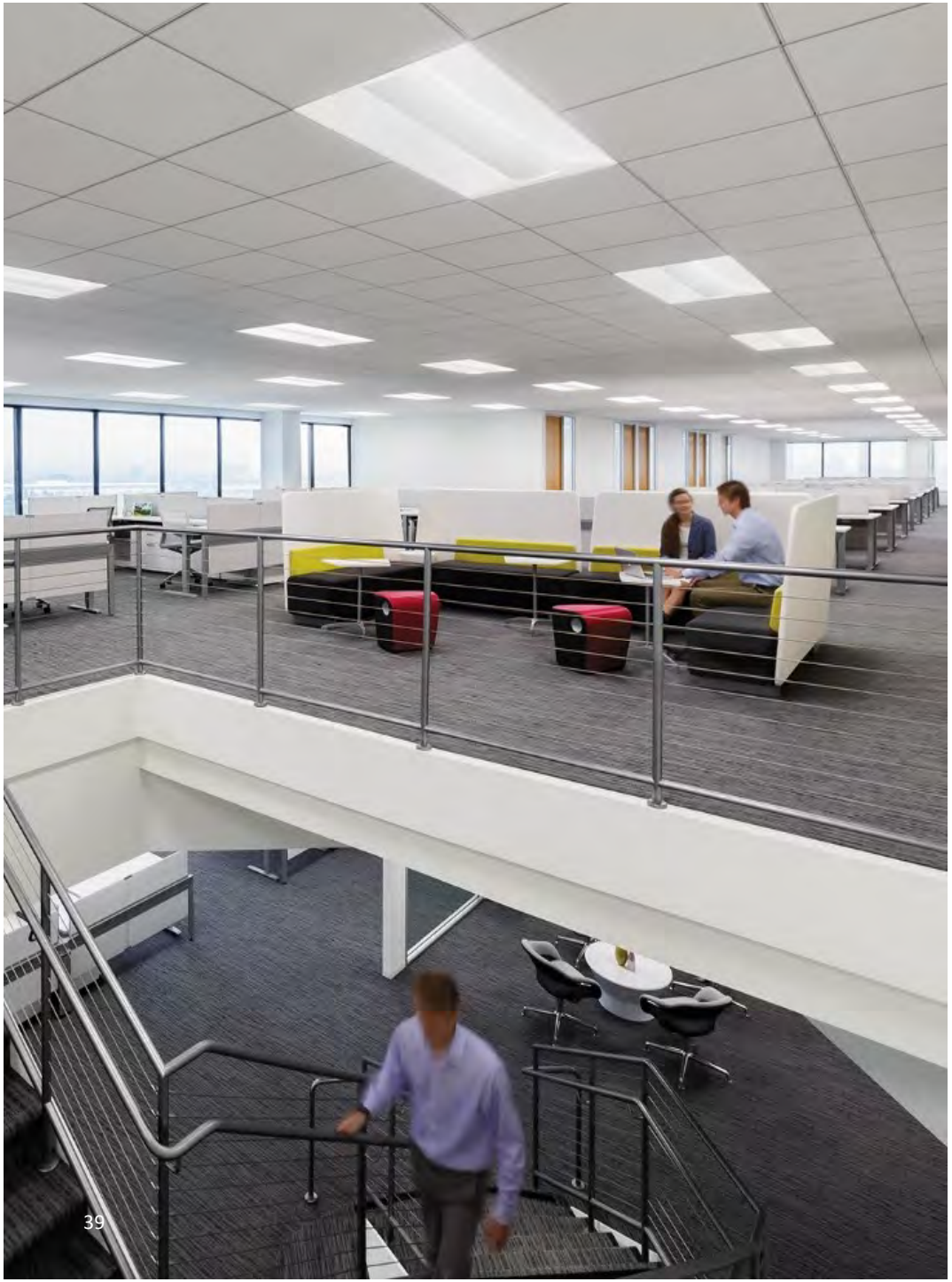

Personal control

the benefits

Visual Comfort

personal control allows us to create the most preferred task illumination for each individual resulting less fatigue at the end of the day

Qualitative research confirms that personalized light tones and intensities leads to optimal visual comfort[1]

Productivity

Personal control leads to higher job satisfaction[2], improved mood and comfort[3]; higher perceived productivity[4]

Source:

[1]internal Philips research

[2]Lee and Brand 2005; HermanMiller 2007

[3]Newsham, 2003

[4]Bordass, 1993

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Tunable White

application examples

Deliver high quality
care environments

- As many as **20%** of teenagers report a lifetime prevalence of depression[1]
- **Almost 50%** of the elderly population suffer from sleep disorders[2]
- Morning sunlight reduces length of hospitalization for bipolar depression
- Patients getting more sunlight experience **less stress and lower analgesic medication use**[3]
- Incidence of delirium was almost **3x** higher in a room without visible daylight[4]

1 Bansal V, 2009
2 Neikrug AB 2010
3 Walch JM 2005
4 Richard L Miller 2002

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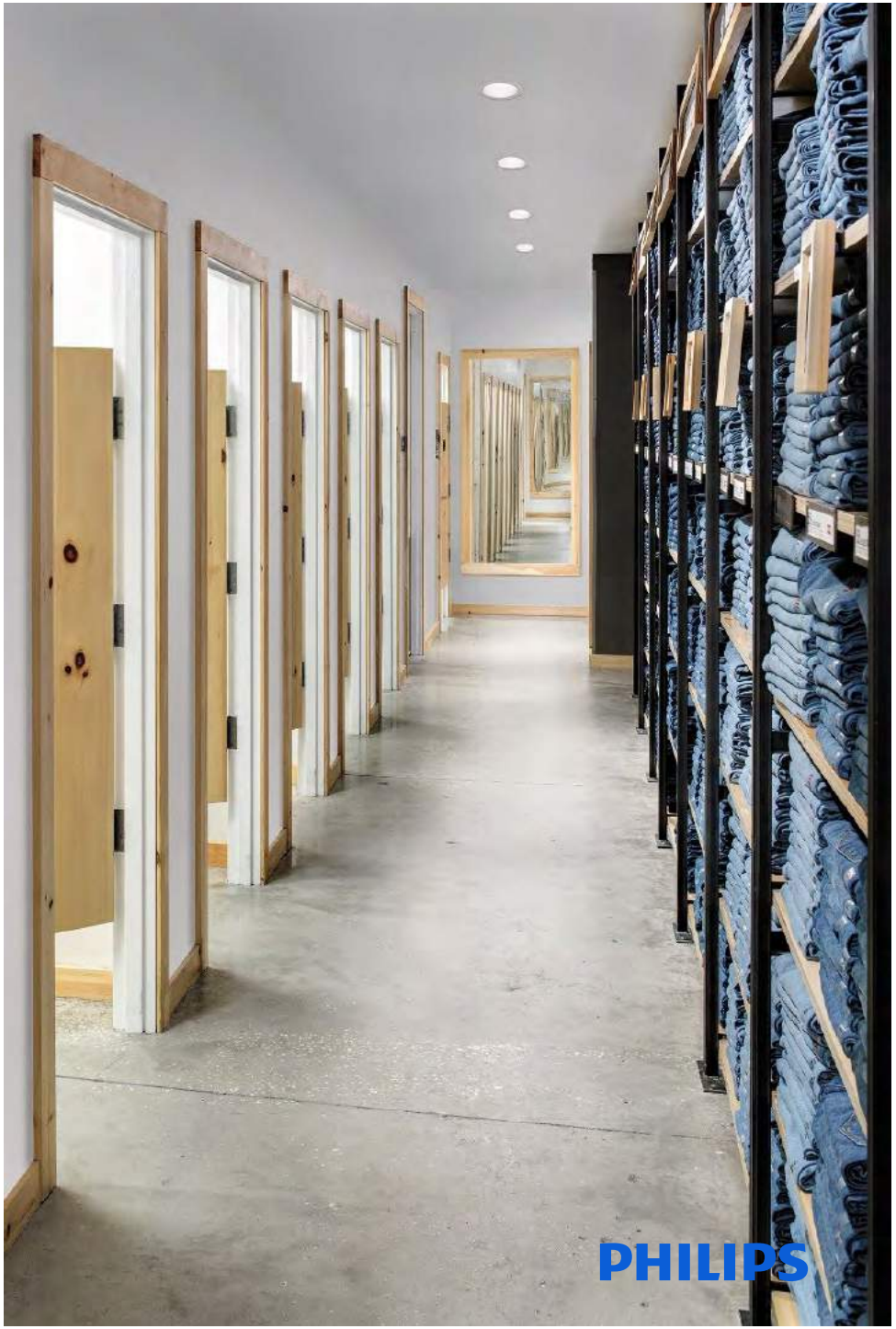
Distinguish
the retail experience

Ability to instantly change lighting ambiances to align with merchandising, seasons, special events.

Allowing customers to view merchandise under varying light conditions.



Create engaging
work spaces

- The need for flexibility to support all activities
  and types of workers: generation X, Y, Z
- Different working styles and needs
- Digital revolution, mobile working, and emphasis on screen work
- Need to stimulate productivity and wellbeing
- Reduction of the office area available per employee while maintaining a high job satisfaction
- Being attractive to work for, increasing employee retention rate

Unlock
student potential

- Children and adolescents are exposed to a high-performing culture
- They are exposed to different stimuli, distracted by social media and busier than ever
- Young people spend a lot of time indoors
- Students have behavioral issues like lack of concentration and sleep deprivation
- Teachers need to control group dynamics, capture students' attention, and manage behavioral outbursts

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Did you **know?**

- Up to **40%** of children have a problems with reading, a critical skill for academic success
- Myopia is becoming an epidemic: in China more than **90%** of students already have myopia and prevalence is increasing in Europe (while children who spent more time outdoors have less chance of developing myopia)
- Bright light was shown to improve literacy skills by up to **14%**
- The chance of developing **ADHD** is smaller in countries with high solar intensities
- Windowless classrooms are associated with student moodiness, reduced growth, and lower concentration
- Focus light was shown to improve concentration by up to **18%**

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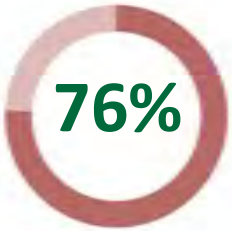
A proven tunable white solution

Increase
in reading concentration by

Increase
in reading speed by

Decrease
in frequency of errors by

Decrease
in hyperactive behavior by



Research from the University of Twente

Supported by evidence

SchoolVision was put to the test in an independent study by the government of Hamburg, Germany and the Universitätsklinikum Hamburg-Eppendorf.

A total of 166 pupils and 18 teachers took part in the year-long scientific experiment, which recorded significant improvements in student performance.

Compared to children under normal lighting, the children studying under TW system showed improvements in concentration, attention span, and behavior. In addition, they read faster and made fewer mistakes.

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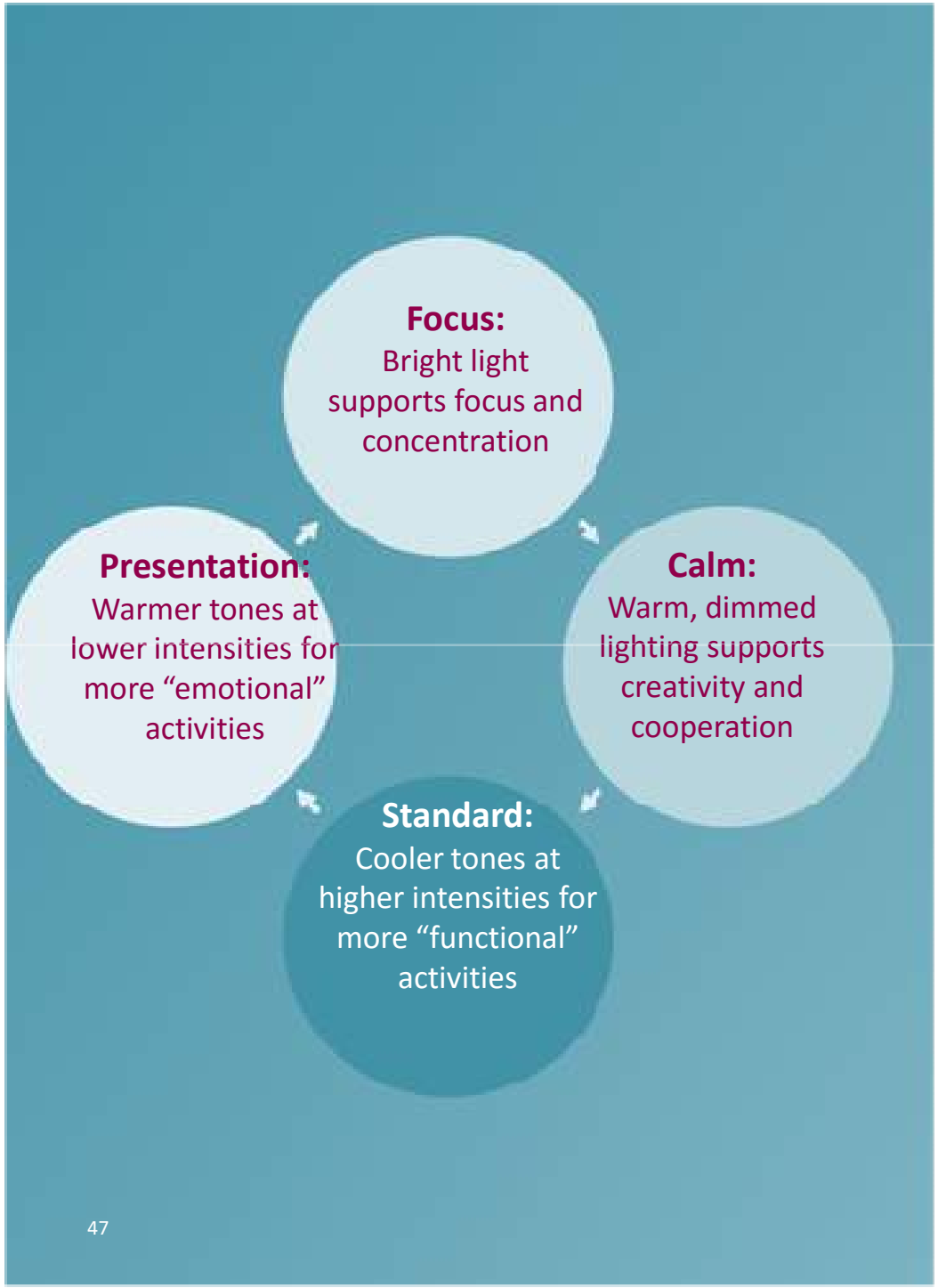

Scene Set

The right combination

- A combination of predetermined presets instantly sets the scene for room ambiance that supports the next scheduled task or spontaneous activity.
- By default the system offers 4 different presets - **Standard, Presentation, Focus and Calm.**
- These presets can be altered and customized to suit your unique needs.
- With a simple touch of a button, teachers can activate one of the presets and can easily change the lighting depending on the activity, the time of the day, or the atmosphere in the class.

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Standard:
Cooler tones at higher intensities for more “functional” activities

Presentation:
Warmer tones at lower intensities for more “emotional” activities

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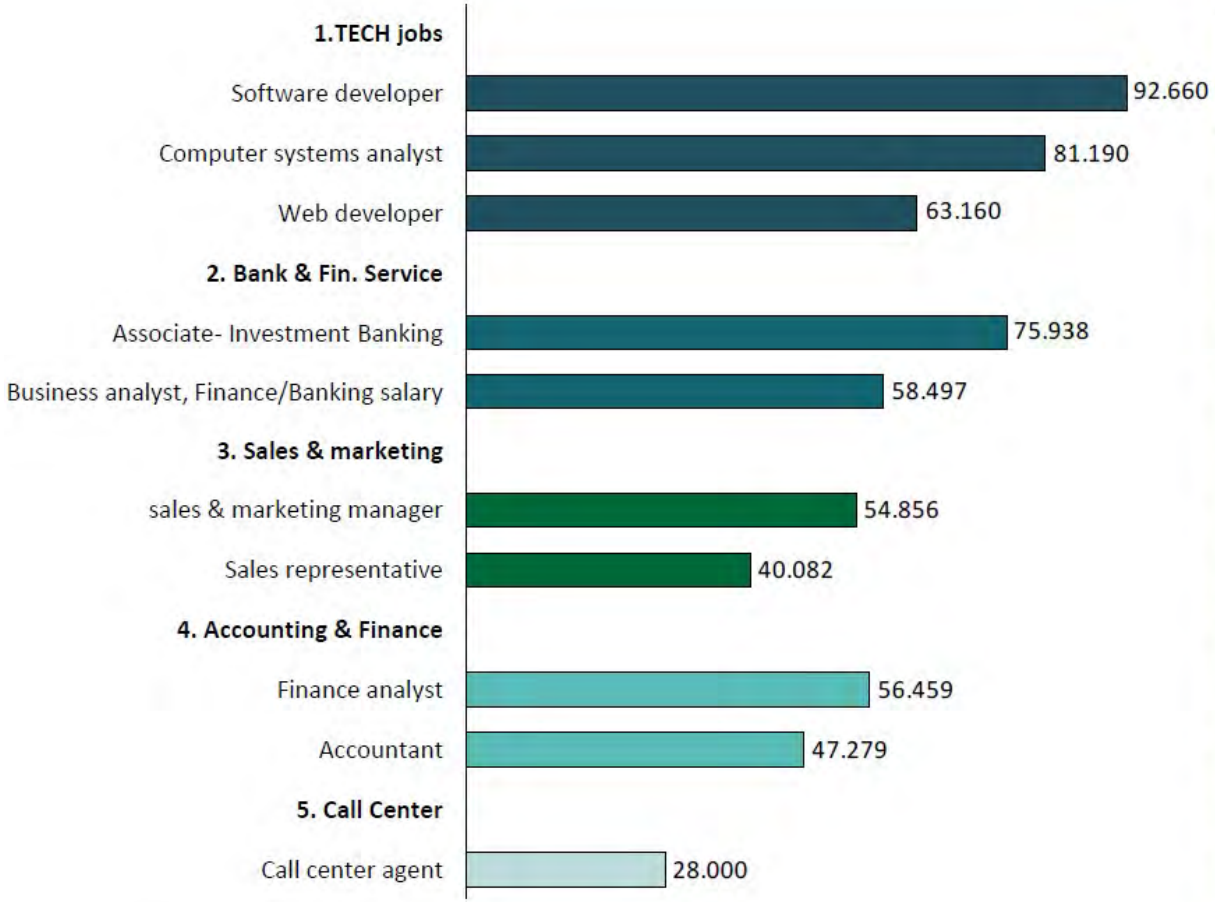
Focus:
Bright light supports focus and concentration

Calm:
Warm, dimmed lighting supports creativity and cooperation

Median Salary Amount

Values in USD/YR



Value of productivity increase by around 1%*

Type of Jobs	Value / employee	Value per SQM (108 Sq f/employee **)
TECH jobs (Avg. 80 K USD/YR)	560 USD/employee	5.2 USD/Sq f
Bank & Fin. Services (Avg. 67 K USD/YR)	470 USD/employee	4.3 USD/Sq f
Sales & Marketing (Avg. 47 K USD/YR)	329 USD/employee	3.0 USD/Sq f
Accounting & Finance (Avg. 52 K USD/YR)	364 USD/employee	3.4 USD/Sq f
Call center (Avg. 28 K USD/YR)	196 USD/employee	1.8 USD/ Sq f

**Around 1% increase out of 70% (average productivity level)*

*** Rate from New York; http://occupiermetrics.com/offices-metrics#page=calculator&country=US&city=9*

Source: from the US website - http://money.usnews.com/careers/best-jobs/software-developer/salary, www.payscale.com.

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