



INTERVIEW | TU/E ASSISTANT PROFESSOR
JULIËTE VAN DUIJNHOFEN (BUILDING
LIGHTING BE)

By Michiel de Boer (MOESASJI)

Paving the path to healthy light exposure in buildings

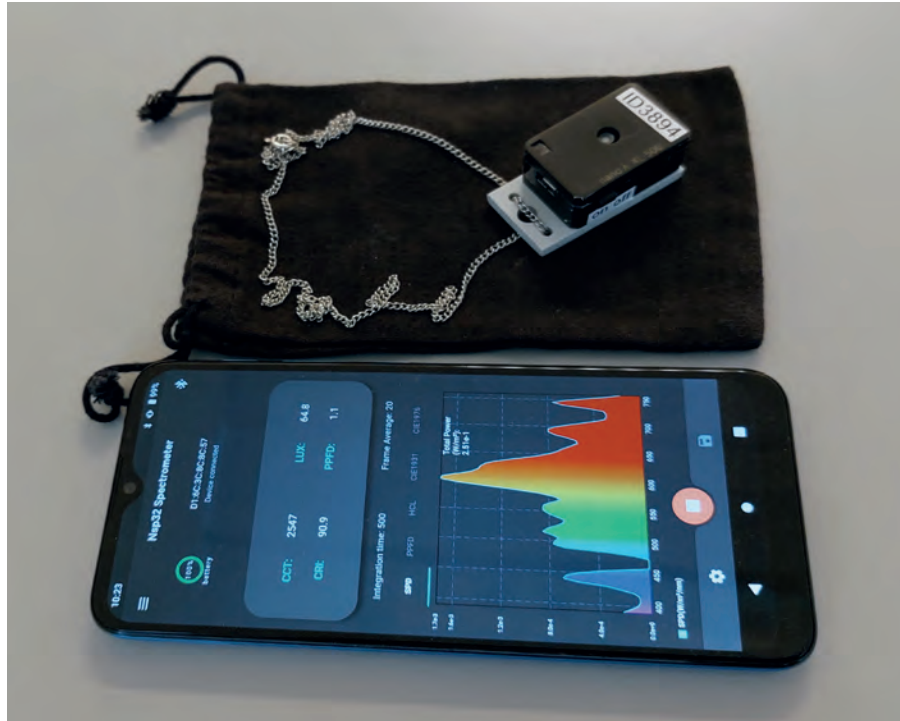
Although we cannot see light itself, it has many effects on humans. We need it to wake up and to stay alert and focused during the day.

Lighting in buildings that promotes productivity and supports health; there is much development in the field of Healthy Light Exposure. However, appropriate standards for buildings are still limited. What exactly is healthy lighting? And how do you determine healthy lighting exposure effectively for the individual? A conversation with TU/e assistant professor Juliëtte van Duijnhoven

"I initially entered university to become an architect," Juliëtte explains, "that was my childhood dream. However, I soon concluded that designing beautiful buildings wasn't exactly my thing, I much more wanted to create environments that are pleasant and comfortable for people to live and work in. Gradually, I began to explore the functional side of building physics and focused on light and lighting. That's what I am working on to this day."

Although we cannot see light itself, it has many effects on humans. We need it to wake up and to stay alert and focused during the day. Juliëtte: "It turns out that people have a hard time describing their light preferences. For temperature it might be that they can easily say whether it is comfortable or not, but for light it tends to be more difficult. Moreover, people cannot accurately describe what kind of light they need to work effectively on different tasks. This inconspicuousness makes it very interesting to me. We will have to help building users and building designers to achieve ideal lighting conditions."

>>



> Wearable sensors to record the amount and spectrum of light

Light Exposure Behaviour Assessment (LEBA): Long Form (v1.0.2, 3 June 2022)

Participant Instructions

Please indicate how often you performed the following behaviours in the **past four weeks**:

Items	Never	Rarely	Sometimes	Often	Always
01 I wear blue-filtering, orange-tinted, and/or red-tinted glasses indoors during the day.					
02 I wear blue-filtering, orange-tinted, and/or red-tinted glasses outdoors during the day.					
03 I wear blue-filtering, orange-tinted, and/or red-tinted glasses within 1 hour before attempting to fall asleep.					
04 I spend 30 minutes or less per day (in total) outside.					
05 I spend between 30 minutes and 1 hour per day (in total) outside.					
06 I spend between 1 and 3 hours per day (in total) outside.					
07 I spend more than 3 hours per day (in total) outside.					

> Questionnaire Light Exposure Behavior Assessment

Light for human health and wellbeing

At this moment, research insights and the current standards for lighting design are not on the same page. Juliëtte: "You cannot suffice with a static study of 'I measure this illuminance here' and 'we want this amount of lux per workplace'. People rarely sit still all day in the same light conditions. They move in and outside the building and experience different amounts and types of light at any given time. For example: looking out a window can result up to twenty times the amount of light at eye level compared to what you would have received looking away from the window. In addition to the image-forming effects of light (being able to see our environment), we must consider non-image-forming effects of light: what does light do to our health and wellbeing? Current lighting design tools are mostly designed for static situations and are still mostly focused on the image-forming effects of light."

Methods to quantify PLE patterns

"I started focusing on light sensing & controlling methods to be used in light effect studies, for example when investigating non-image forming effects of light. For example, we deploy wearable sensors to accurately and continuously record the amount and spectrum of light a person receives at eye level during the day, in other words the Personal Light Exposure (PLE) patterns. This field of wearable light sensors, dosimetry, is developing rapidly. The large datasets that we can gather through dosimetry can provide insights into PLE patterns which we can deploy for

better lighting measurement instruments, simulation software, and lighting designs in buildings. Moreover, we use questionnaires to capture behavior of research participants that might impact their PLE patterns. For this purpose, we have developed a 23-item questionnaire, the LEBA instrument (Light Exposure Behavior Assessment)."

PLE and Light Guidance Systems

"Whereas with dosimetry we quantify what the PLE is, but ultimately, we want to know which 'settings' can provide building users with the best lighting conditions. A number of factors that influence PLE are important here, including weather conditions, building orientation, window light transmission, shading technologies, daylight levels, and electric lighting systems. But also, people's personal needs and their behavior. This makes lighting design complex and very interesting. Even more when you consider that people find it very difficult to indicate exactly what kind of light they need. That's why we look into ways of supporting them. This can be done actively: by enabling the user himself to adjust the light conditions in a certain room or to stimulate them to exhibit certain behavior, such as: going outside for a moment during lunch. And this can be done passively: by providing lighting applications that automatically support the building occupant, such as a dimmed lamp that does not burden the sleep/wake rhythm when you need to go to the toilet at night."

New standards

In all these areas, Juliëtte is associated with research and standardization bodies, including ILI (Intelligent Lighting Institute), CIE (International Commission on Illumination), ELEA (European Lighting Expert Association) and NSVV (Nederlandse Stichting voor Verlichtingskunde). Juliëtte: "I think it is important to contribute to organizations and jointly work on

standards for healthy lighting in buildings. This helps architects and lighting designers to design 'integrative lighting' solutions. This term was introduced by the CIE and describes lighting that considers both image-forming and non-image forming effects of light and thus optimally supports people in their wellbeing at work and in their life. Just as everyone deserves to have healthy food and exercise, adequate light exposure is a prerequisite for health. Every lighting designer should have proper tools in their toolbox!" ■

