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LIGHTING IN ARCHITECTURE

Stairway to Heaven

18 Degrees use light to take clients on a visual journey through Freshfields Bruckhaus Deringer offices.

In Search for Answers: Light4Health Online Course of Health Research for Interior Lighting Design

Asst. Prof. Dr. Karolina M. Zielinska-Dabkowska IALD, IES, CIE, MSLL, RIBA, presents the work of Light4Health Consortium. She explains how the dialogue that was initiated by this project will continue to share research knowledge and exchange best practices across the lighting community.
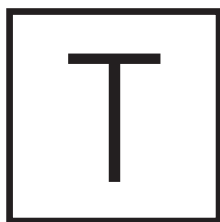
T hree years ago, when I wrote an article in **arc** called: *Human Centric Lighting. The New X Factor?* (arc no. 108 Feb/Mar 2019), my intention was to raise questions in relation to the new topic and to find solid, research-based answers in the years to come. Today, I am happy to report that the lighting community, with the Light4Health Online Course of Health Research for Interior Lighting Design, has a useful tool, and consortium members have managed to close the gap between research and practice/application, and translate complex research into an 'easy to digest' format for end users.

What assured me about the quality of the content, is the fact that scientists such as Dr George Brainard and his Lighting Research Lab team, have joined this project as worldwide experts to advise about the physiological aspects of light and lighting. They also provide guidance on the use of appropriate lighting matrices. This includes tutorials on the use of CIE α-opic Toolbox. Thanks to this knowledge, I'm hopeful lighting professionals will be confident enough in using circadian protocols. The course content is open access and free to use by either lighting students or practitioners through self-study. This includes the syllabus and materials for Higher Education providers and external designers to use in whole, or in part, within their designs or lecturing.

Course Description and Goals

'Light4Health' (L4H) was a three-year Erasmus+ Strategic

Partnership Project, which investigated the impact of light on health, wellbeing, and the indoor environments we live in. A novel cross-disciplinary course was developed, intersecting lighting design and health research via the selection of the most relevant health research methods, tools, and findings in Neurology, Photobiology, Neuroendocrinology, Neurobehavioral Studies, and Psychophysiology of Perception, as well as Behavioural, Cognitive and Environmental Psychology. This knowledge was then introduced into lighting design curricula that higher education institutions can adopt. The project involved experts from Neurology, Light and Health Research, Lighting Design, Architecture, and the Built Environment. Underpinned by scientific research, the light4Health project, supports richer understanding about informed lighting designs for domestic, educational, healthcare and other types of premises. The project's inclusion of work by TJU for NASA, ensures that lighting design and performance will now be optimised for human health and wellbeing.

Course Content

The online course includes five educational modules. It presents different available tools, concepts, and research findings to inform lighting design. This is achieved in two distinct ways: (1) by exposing students to knowledge and examples of lighting-related health research in different fields of psychology and physiology; and (2) by guiding students to learn how to conduct their own evaluation and data collection: by identifying what can be measured, and how measurements are interpreted.

"Great foundation and online platform. Would expect more content, as well as depth, to further develop and build upon over time, along with new research findings."

Florence Lam, Fellow and Global Lighting Design Director, Arup

Course Modules

Module 1: Introduction to health-related research for lighting design
Provides participants with a short history about light and health, and why we need to consider health as part of lighting design. The effects of light on the human body are also covered with an introduction to aspects of the physics of light and the physiology of vision.

Module 2: Review on lighting basics and health and wellbeing research topics
Provides a review of lighting basics and lighting-related aspects of health. Included is daylight in architecture, daylight's impact on health, and, in general, the neuroendocrine, neurobehavioral, and circadian effects of light on the human body. The psychology of light is also introduced; more specifically, how light is used as a visual trigger for psychological and behavioural impact. In addition, the topics of glare and flicker are discussed.

Module 3: Software, measuring devices and evaluation tools
This module investigates software, measuring devices, and evaluation tools. Metrics are presented which can be used to assess the potential for the physiological impact of lighting, and different software and measurement tools are discussed. In addition, some assessment techniques for subjective impressions of a space are presented. Finally, a tour is given of the Jefferson Lighting Research Lab.

Module 4: Standards and best practices
Provides an overview of standards and good practices. Metrics for daylight evaluations are presented, and the "Manchester Recommendations" for healthy daytime, evening, and nighttime indoor light exposure are introduced. Moreover, design integrations are discussed. This involves employing measurements and design criteria for physiological impact and visual perception.

Module 5: Application and examples from research and practice
Provides application examples and case studies from research and practice. In this context, several examples of light and health research are presented. This includes project examples from workspaces, and educational and healthcare environments. Specialty applications (e.g., space travel, users with autism), and concepts of spectral modelling for light and health considerations, double dynamic lighting, biophilia and information on therapeutic lighting applications are also included.

#	Title	Speaker
Module 1: Introduction to health- related research for lighting design		
1.1	Introduction. Why do we need to discuss health as part of lighting design?	Karolina M. Zielińska-Dąbkowska, PhD, Assistant Professor (HSW)
1.2	History of light and health	Michael F. Rohde, Professor (HSW)
1.3	The effects of light on the human body. Part 1: Physics of light and physiology of vision	Lyn Godley, Associate Professor (TJU) / George C. Brainard, PhD, Professor (TJU) / John P. Hanifin, PhD, Assistant Professor (TJU) / Ben Warfield, Operations Support Specialist (TJU)
Module 2: Review on lighting basics and health and wellbeing research topics		
2.1	Daylight and lighting complementing the qualities of dynamic light in a space	Ellen Hansen, PhD, Associate Professor (AAU)
2.2	Daylight. Interplay of daylight in architecture	Rodrigo Muro, Lecturer and Program Director (KTH)
2.3	Effects of daylight on health. Nature and architecture impact on health	Federico Favero, Lecturer and PhD Candidate (KTH)
2.4	Psychology of light. How light is used as a visual trigger for psychological and behavioral impact	Lyn Godley, Associate Professor (TJU)
2.5	The effects of light on the human body. Part 2: Neuroendocrine, neurobehavioral, and circadian effects	Lyn Godley, Associate Professor (TJU) / George C. Brainard, PhD, Professor (TJU) / John P. Hanifin, PhD, Assistant Professor (TJU) / Ben Warfield, Operations Support Specialist (TJU)
2.6	Glare from artificial light sources in indoor environment	Bipin Rao, Research Associate (Presenter) (HSW) / Karolina M. Zielińska-Dąbkowska, PhD, Assistant Professor (HSW)
2.7	Understanding flicker from artificial light sources in indoor environment	Karolina M. Zielińska-Dąbkowska, PhD, Assistant Professor (Presenter) (HSW) / Bipin Rao, Research Associate (HSW)
Module 3: Software, measuring devices and evaluation tools		
3.1	Physiological metrics	Lyn Godley, Associate Professor (TJU)
3.2	Software options	Georgios Triantafyllidis, PhD, Associate Professor (AAU)
3.3	Subjective impressions. Assessment techniques for subjective impressions of lighting in a space	Ute C. Besenecker, PhD, Associate Professor (KTH) / Foteini Kyriakidou, Lecturer (KTH)
3.4	EEG measurements for lighting	Georgios Triantafyllidis, PhD, Associate Professor (AAU)
3.5	LIMO test	Bipin Rao, Reasearch Associate (HSW)
3.6	Tour of Jefferson Lighting Research Lab	Ben Warfield, Operations Support Specialist (TJU)
Module 4: Standards and Best Practices		
4.1	Daylight. Metrics and evaluation	Niko Gentile, PhD, Associate Senior Lecturer (Lund U, KTH L4H guest lecture)
4.2	Manchester recommendations. Part 1: Recommendations for healty daytime, evening, and nigth-time indoor light exposure	Lyn Godley, Associate Professor (TJU)
4.3	Manchester recommendations Part 2: Additional background	George C. Brainard, PhD, Professor (TJU)
4.4	Design integration. Measurement and design criteria, criteria for physiological impact and visual perception	Ute C. Besenecker, PhD, Associate Professor (KTH)
4.5	Best practices. An introduction to healthcare lighting	Karolina M. Zielińska-Dąbkowska, PhD, Assistant Professor (HSW)
Module 5: Application and examples from research and practice		
5.1	Architectural Lighting Design Examples: For Working and Educational Environment	Bipin Rao, Research Associate (HSW)
5.2	Healthcare lighting design: Maggie's Cancer Care Center and Old See House	Arve Olsen, Design Director (Light Bureau, KTH L4H guest lecture) / Paloma Plumed Martin, Lighting Designer (Lightbureau, KTH L4H guest lecture)
5.3	Lighting & Autism	Gergios Triantafyllidis, Associate Professor (AAU)
5.4	Case Study. Therapeutic lighting applications for hospitals	John P. Hanifin, PhD, Assistant Professor (TJU)
5.5	NASA Case Study. Therapeutic lighting applications for space	John P. Hanifin, PhD, Assistant Professor (TJU)
5.6	Spectral modelling. Energy Impacts and Considerations for Light and Health Spectral Modelling	Sarah Safranek, Lighting Research Associate (PNNL, KTH L4H guest lecture) / Jessica Collier, Associate Lighting Research Engineer (PNNL, KTH L4H guest lecture)
5.7	CaseStudy. Double Dynamic Lighting Part 1+2	Ellen Hansen, PhD, Associate Professor (AAU)
5.8	Dynamic Lighting. Studies on dynamic light, biophilia, and beauty, and applications for their combined use in healthcare	Lyn Godley, Associate Professor (TJU)

Table 1 This table provides a detailed overview of the lectures within the programme, divided by module, alongside the speaker's name. © Light4Health Project

Who is behind the course?

The Light4Health consortium partners consisted of six universities, University of Wolverhampton (UK), Thomas Jefferson University (USA), KTH Royal Institute of Technology in Stockholm (Sweden), Hochschule Wismar, University of Applied Sciences: Technology, Business and Design (Germany), Aalborg University in Copenhagen (Denmark), and ITMO University in Saint Petersburg (Russia). Each partner was selected according to their contributions to the project topics. All of them have a vast and fruitful experience of higher education transdisciplinary curriculum innovation development with international partners, using digital educational platforms. All participating personnel members have research expertise in fields related to lighting and design, including some EU-funded projects. Four out of six partner organisations have strong Master's study programmes in Lighting Design. UoW and TJU have no Lighting Design Master's study programme as yet, however, TJU's concentration in Lighting Design addresses developments in multidisciplinary approaches for lighting with a hands-on curriculum with students from a range of academic programmes. Spearheaded by Jefferson's Industrial Design Department, this Lighting Design Education curriculum applies cross-discipline education to Lighting Design across 10 departments, including Industrial Design, Architecture, Interior Design, Engineering, Animation, and Medicine.

"This would be an invaluable resource for anyone working with light, as there are gaps in everyone's knowledge that could be at least partially addressed by this course."

Ruth Kelly Waskett, SLL President, Senior Associate, Hoare Lea

Members of the L4H consortium during a project transnational meeting in Copenhagen, Denmark in 2020.
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The following individuals were involved in the preparation of the course contents that were created and piloted during the summer schools:

Thomas Jefferson University
· Lyn Godley, Professor
· George C. Brainard, PhD, Professor
· John P. Hanifin, PhD, Assistant Professor
· Ben Warfield, Operations Support Specialist

KTH Royal Institute of Technology
· Ute C. Besenecker, PhD, Associate Professor
· Foteini Kyriakidou, Lecturer
· Iris Molendijk, Research Engineer,
· Federico Favero, PhD Candidate, Lecturer

Hochschule Wismar
· Karolina M. Zielińska-Dąbkowska, PhD, Assistant Professor
· Michael F. Rohde, Professor
· Bipin Rao, Research Associate

Aalborg University (AAU)
· Georgios Triantafyllidis, Associate Professor
· Ellen K. Hansen, Associate Professor
· George Palamas, Assistant Professor
· Emmanouil Xylakis, Research Assistant

University of Wolverhampton
· Ezekiel Chinyio, Senior Lecturer
· Paul Hampton, Head of Department

ITMO University
· Natalia Bystriantseva, Associate Professor
· Dmitrii Ingi, Research Assistant
· Valeriia Lukinskaya, Research Assistant

There are also 10 associated partners who supported the project with various expertise, equipment, and feedback: VIA-Verlag company/DE, (until January 2020), Università Iuav di Venezia/IT, Vicenza Institute of Architecture/IT, Roma Tre University/IT, Tallinn University/EE, Janowicz Architekci/PL, eldoLED/NL, Seoul Semiconductor/EU, QLAB Laboratory of Light/PL, Solemma/US, GL Optic/PL.

This course has been extensively reviewed by design practitioners e.g. architects and lighting designers, academics in the fields of lighting and health research, and students. The course was launched in August 2021 and it received a very positive response. As the online course becomes embedded in higher education curricula, it will continue to inform designers and young practitioners to develop innovative ideas to improve building performance and improve environments that support light for health.

Several of the partner universities are already using Light4Health resources in their teaching, and indications are that it will be more widely incorporated (e.g. 73% of academic reviews indicated they are likely/highly likely to incorporate the materials in their teaching). Architects, lighting manufacturers, and lighting practitioners that attended launch and dissemination events, or reviewed the materials, expressed a strong interest in using the materials to inform their activities.

The L4H consortium partners acknowledge that the content, while extensive, does not encompass the full extent of the work undertaken in health-related lighting design research. The current course content is subject to refinements, updates, and additions in the future. Comments and suggestions are still welcome. ■
www.light4health.net

The course is accessible from a Moodle learning management system online at https://course.light4health.net

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Asst. Prof. Dr. Karolina M. Zielinska-Dabkowska is a chartered RIBA architect and an award winning practicing lighting designer. She is also an Assistant Professor at the Faculty of Architecture, Gdansk University of Technology, Poland, and co-founder of GUT LightLab, where she conducts research on various aspects of light and lighting in the built environment. She is actively engaged in the work of international organisations such as the International Association of Lighting Designers (IALD), the Illuminating Engineering Society (IES), International Commission of Illumination (CIE) and International Dark-Sky Association (IDA), providing guidelines and sharing best practice for nighttime illumination in the built and natural environment. She has participated in a number of international conferences, and has written articles for national and international publications. Karolina joined Women in Lighting (WiL) in March 2018 as an Ambassador for Poland.