



International Commission on Illumination  
Commission Internationale de l'Éclairage  
Internationale Beleuchtungskommission



DANISH BUILDING RESEARCH INSTITUTE  
AALBORG UNIVERSITY COPENHAGEN

## CIE Expert Tutorial and Workshop on Research Methods for Human Factors in Lighting

13-14 August 2018, Aalborg University Copenhagen, Denmark

### TUTORIAL INFORMATION



**Dr. Robert Davis**

*Pacific Northwest National Laboratory*

Dr. Bob Davis is a Senior Staff Lighting Engineer at Pacific Northwest National Laboratory, where he serves as Technical Director for the US DOE solid-state lighting program. His 30+ years of experience include working at two lighting manufacturers and faculty positions at RPI's Lighting Research Center and the University of Colorado. His research interests reflect his dual educational background in architectural engineering and cognitive psychology.

13 August 8.45am

#### **Critical Analysis of a Research Paper**

The breadth of disciplines that address research topics related to lighting continues to expand, and that expansion naturally includes the number of journals that publish scholarly papers with lighting variables as part of the research. This growth means that those who focus on lighting research must be able to critically evaluate research papers where the questions being asked, the variables being manipulated, the protocols being used, the outcomes being measured, and the data analytic techniques being practiced may be unfamiliar to the reader since they are grounded in other disciplines. Given this situation, how can you evaluate the quality of the paper? What are some indicators that generally indicate a strong paper? Are there "red flags" along the way that can alert you to underlying problems with the research or communication? This session will explore these considerations, using some real-world examples from published works.



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**Professor Yvonne A. W. de Kort**  
*Technische Universiteit Eindhoven*

Yvonne de Kort is full professor environmental psychology in the Human-Technology Interaction group Eindhoven University of Technology, The Netherlands. She investigates effects of lighting conditions on mood, performance, and behaviour, combining insights and methods from psychology, chronobiology and neuroscience. Yvonne manages the Sound Lighting research program in TU/e's Intelligent Lighting Institute and the Mental Health program in TU/e's Center for Humans and Technology. Her work has resulted in over 50 peer-reviewed journal articles and over 200 publications.

13 August 9.15am

### **The Role of Theory in Lighting Research**

Research on human functioning is notoriously difficult. This particularly holds for the study of light effects, at least if one wants to go beyond establishing that changes in light 'have an effect' and understand why this effect occurs – in other words, if one wants to make causal inferences about the mechanism behind it. The latter is crucial for generalizing insights and using them effectively in other contexts. The culmination of decades of research has taught us that light affects psychological functioning in numerous ways and through various pathways. This implies that, regardless of the investigator's particular interests in either of those mechanisms, generally all will be at play, simultaneously, for participants in any lighting study. The present tutorial aims to address this complexity and how to deal with it, first by concisely describing the various pathways we currently are aware of, second by indicating methodological strategies to help disambiguate one's findings when performing studies in the lighting domain.



**Dr. Jennifer A. Veitch**

*National Research Council of Canada*

Dr. Jennifer Veitch investigates interactions of people and their physical environments, including lighting quality and light source effects on performance, mood, and health. She served as the lead author for four CIE publications, including CIE 213:2014 *Protocols for describing lighting*. Among various leadership roles in both the lighting and psychology communities, she currently serves as Director of CIE Division 3, Interior Environment and Lighting Design, and is a Regional Associate Editor (North America) for *LEUKOS*.

13 August 9.45am

#### **Ethical Considerations for Applied Lighting Research**

By its nature, applied lighting research is not an exercise in simulation. To understand how people respond to the lit environment, whether in the laboratory or in a naturalistic setting, one must involve people as research participants. As investigators we are privileged to have individuals contribute their time and personal data to answer questions that we find to be interesting. Our conduct as researchers must make us worthy of their participation. This presentation will provide a framework for thinking about research ethics and guidance for how researchers might address the key considerations: free and informed consent, privacy, and assessing the risks and benefits for participants. Ethical conduct also extends to the manner in which we treat our fellow researchers, both those on our research teams and those who read published work; the presentation will also briefly introduce publication ethics concepts in relation to the ethical framework.

14 August 8.30am

#### **Drawing Causal Inferences in Applied Lighting Research: Threats to Validity**

In most scientific inquiry, investigators seek to draw causal inferences. That is, they wish to determine what conditions X lead to the outcomes of interest Y. In applied lighting research, investigators most often wish to apply those conclusions to a broad range of settings, people, and times. In the post-positivist tradition, strong causal inferences demand that one exclude alternative explanations by addressing possible threats to the internal validity of the investigation through research design choices. Inferences concerning the possible applications of the revealed relationships depend on the degree to which the research design has addressed threats to external validity. This presentation will provide a brief primer to research design principles for both experimental and correlational investigations, and will focus on internal and external validity considerations and the inevitable trade-offs between them. Other validity threats, such as statistical conclusion validity and construct validity will be addressed by other tutorial speakers.



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**Professor Kevin Houser**  
*Pennsylvania State University*

Kevin Houser (PhD, PE, FIES, LC, LEED AP) is a Professor of Architectural Engineering at Penn State University and editor-in-chief of LEUKOS, the journal of the Illuminating Engineering Society (IES). He has published more than 125 publications about light and lighting. His recent work focuses on human responses to optical radiation and the application of that knowledge to the spectral design of light sources.

13 August 13.30

#### **Choosing and Defining Variables for Lighting Experiments**

In applied lighting research we often want to identify causal relationships in the form of "X causes Y", where lighting conditions are "X" and outcomes or responses are "Y". Other conditions, let's call them "Z", are intentionally controlled so that the effect of "X" on "Y" can be isolated. This talk will outline the selection, definition, measurement, and reporting of the "Xs", "Ys", and "Zs" in applied lighting research. Examples from the lighting literature will be used to illustrate best practices and pitfalls in the application of these underlying concepts.



**Professor Myriam Aries**

*Jönköping University*

Myriam Aries is a Full Professor Lighting Science at Jönköping University (JU) at the Department of Construction Engineering and Lighting Science. Her expertise lies mainly in the field of (day)light application, visual comfort, and human light and health demands in the built environment. Her research efforts focus on the interaction between humans and the integration of (day)light in diverse architectural environments.

13 August 14.00

#### **How to Measure the Visual Stimulus**

A stimulus is a detectable change in the environment which occurs according to a standard pattern, from stimulus detection to transmission to causing a response. Humans receive most of their information visually and the ability to respond to external visual stimuli is called light sensitivity. In daily life, people receive visual stimuli from lighting, either directly from the source or indirectly after reflections. The effects of visual stimulation on the human body and brain have been investigated in many scientific studies. For a stimulus to be detected with high probability, its level must exceed an absolute threshold to be transmitted to the central nervous system and trigger a response. Different measures, such as Reaction Time (RT) or altered brain waves shown on electroencephalogram (EEG) are used to quantify the response to a visual stimulus. This tutorial will address different methods to measure the visual stimulus.



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**Professor Werner Osterhaus**

*Aarhus University*

13 August 14.30

#### **Methods for Assessing Daylighting Performance Metrics in Real Building Case Studies**

This tutorial explains how to assess the daylighting performance of real buildings. Such assessment might be required to compare results achieved in real life with daylighting simulation results obtained before construction, to investigate specific daylighting concerns raised by building occupants, or to confirm compliance with applicable building codes and standards. Example situations are presented and discussed. Knowledge of the material presented in the tutorial would be relevant for students and professionals working in the field of lighting design, building services engineering, interior design, and architecture. Some sections of the tutorial will also provide useful insights into suitable measurement procedures and methods for experimental research activities in living laboratories or full-scale mock-ups.



**Dr. Peter Blattner**

*Federal Institute of Metrology METAS*

Peter Blattner holds a Ph.D in the field of applied optics from the University of Neuchâtel, Switzerland. He joined the Federal Institute of Metrology (METAS) in 2000 where he is currently the head of the optics laboratory. Since 2011 he is the Director of Division 2 (Measurement of Light and Radiation) at the Commission Internationale de l'Éclairage (CIE). In this role he represents CIE at the Consultative Committees for Units (CCU) and for Photometry and Radiometry (CCPR). Furthermore he is active in several standardization committees (ISO TC169, IEC 34, IEC 76, CEN TC 169,...) and chairs the Swiss Standardization Committee on light and lighting. In 2015 he received the CIE Wyszecki Gold Pin award for outstanding contribution in fundamental research. In October 2017 Peter Blattner was elected CIE President for the period 2019 to 2023.

13 August 15.00

#### **Quantifying Photobiological and Photochemical Effects**

In order to be able to compare research results and to define recommendations for lighting installation it is essential that researchers are using well defined and internationally agreed quantities that are traceable to the International System of units (SI). For visual tasks usually photometric quantities expressed in photometric units are used. There is strong scientific evidence that light is not only essential for vision but also achieves important biological effects relevant for human health, performance and well-being. Some of these photobiological effects are based on skin-mediated responses to optical radiation, other effects are elicited by stimulation of ocular photoreceptors. Depending on the type and location of the acting photoreceiver different photometric and radiometric quantities have to be used. Setting up a visual experiment includes also some considerations on the uncertainties associated with the definition of the quantities and their experimental determination. This talk will provide the basic concept of quantifying photobiological and photochemical effects. It also includes some considerations on "non-image-forming" (NIF) effects of light originate in the eye using the metric defined by JTC9 "CIE system for Metrology of ipRGC influenced light response"



**Professor Steve Fotios**  
*University of Sheffield*

Steve Fotios is Professor of Lighting and Visual Perception at the University of Sheffield. His research focuses upon lighting for pedestrians and cyclists, and the experimental procedures used in research of lighting and human factors. He established the LumeNet symposium for PhD students to encourage critical thinking about methods. He is associate editor of Lighting Research and Technology and associate director of CIE division 4.

14 August 9.00am

**Miss-use of Category Rating Scales (continuing TC 1.80)**

Do responses gained using category rating accurately reflect respondents' true evaluation of an item? 'True' in this sense means that they have a real opinion about the issue, rather than being compelled by the survey to speculate an opinion, and that the strength of that opinion is faithfully captured. This presentation describes some common issues which suggest that it should not be simply assumed that a response gained using category rating reflects a true evaluation. That assumption requires that an experiment has been carefully designed and interpreted, and examples are shown where this is not the case.





**Dr. Jim Uttley**  
*University of Sheffield*

Jim Uttley is currently a postdoctoral researcher in the lighting research group at Sheffield University. He completed his PhD at Sheffield, in which he used his background in psychology to investigate human factors related to road lighting for pedestrians. Jim Uttley's research currently focuses on understanding how lighting can encourage active travel and make it safer. He is also interested in more fundamental aspects of human perception and cognition.

14 August 9.30am

#### **Good Statistical Practices in Human Factors Lighting Research**

The current reproducibility crisis, which affects many scientific disciplines including behavioural and human factors science, highlights the need for good understanding about the statistical implications of research studies. In this presentation I will discuss statistics and statistical reporting within a lighting research context, focusing on key topics related to sample sizes, effect sizes, and assumptions of statistical tests. Research in the field of lighting is frequently underpowered and unable to reveal small effects. Many studies also fail to report measured effect sizes. I will discuss the links between sample and effect sizes, and approaches to determining appropriate sample size. I will also discuss how to ensure statistical testing of your sample is appropriate, for example by assessing the assumptions of parametric tests such as normally-distributed data. We can improve the evidential value of lighting research by ensuring robust statistical methods and reporting are followed.



**Dr. Martine Knoop**

*Technische Universität Berlin*

Martine Knoop is a lecturer at the Chair of Lighting Technology, Technische Universität Berlin (TUB), Germany. She is responsible for research and education on indoor lighting, daylighting and colorimetry. Her current research focuses on the unique characteristics of daylight. It aims to promote and improve daylight design, as well as to develop new adaptive electric lighting solutions, to enhance user well-being and performance in interiors.

14 August 13.30

**What to Report? Details of Experimental Apparatus and Procedure to Enable Repetition**

Precise and detailed documentation of an experiment allows validation as well as replication and indicates the application range of research findings; all relevant aspects to expand the value of your research. This presentation will show, by means of a few examples, how to define what is necessary to report. It will provide information about guidelines available to describe lighting conditions, and give examples of good documentation. The presentation will conclude with present-day topics; big data and the documentation of measurement data for retrospective analysis.



PhD, FSSL, FIES Peter Boyce

Peter Boyce has spent most of his career working in the field of lighting. He is a Professor Emeritus at Rensselaer Polytechnic Institute, Troy, New York. He is also Editor-in-Chief of Lighting Research and Technology. He is a recognized authority on the interaction of people and lighting, being the author of the classic text "Human Factors in Lighting".

14 August 14.00

#### How to Write a Good Paper

If, after you have designed your experiment, collected all your data and decided what they mean, you fail to communicate your findings clearly and effectively you might as well not have bothered to start. This presentation will spell out what is required to produce a good paper, one that will gain the approval of referees and the support of editors as well as advance the science. Good papers are those that combine comprehensiveness with conciseness while demonstrating clarity and relevance. The essential features of papers of various types will be reviewed as will the process by which papers are evaluated for publication.