Virtual reality to assess visual attraction and perceived interest to daylit scene variations

VIRTUAL REALITY TO ASSESS VISUAL ATTRACTION AND PERCEIVED INTEREST TO DAYLIT SCENE VARIATIONS

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Abstract

Façades and light pattern composition have been shown to influence the spatial experience and physiological responses of humans [1,2]. The present study examines the effect of sunlight penetration and window size on fixations to the floor of the scene, and the relation between visual interest and fixations in an experiment using 360° scenes displayed in Virtual Reality.

One hundred participants were shown the same daylit interior space with varying presence of sun patches (based on sky type and time-of-day variations) and window size in a mixed experimental design. Participants' head movements were recorded during the first 25 seconds of silent free-viewing exposure to each scene, after which they rated the visual interest of the scene. Fixation areas were derived from head movement data and were used to extract the percentage of fixations towards different areas in the scene.

Linear Mixed Model (LMM) analyses showed that sun patch presence influenced the percentage of fixations towards both the front part of the floor (near the façade) and the whole floor. Pairwise comparisons showed that participants spent more time fixating towards the floor in the presence of small sun patch compared to no sun patch. Adding visual interest as a fixed factor in the LMM did not show a statistically significant relation between fixations towards the floor and visual interest ratings.

Although limited to Virtual Reality and thus to its relatively small luminance range, these findings show that the presence of a sun patch in one's field of view elicits visual attraction.

References

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Brief biographical narrative of the authors

Caroline Karmann is a post-doctoral researcher at the Laboratory of Integrated Performance in Design (LIPID), École Polytechnique Fédérale de Lausanne (EPFL). She holds PhD in Building Science in Architecture from UC Berkeley and a dual Master's degrees in Architecture and Climate and Energy Engineering from National Institute for Applied Sciences (INSA) of Strasbourg. Caroline practiced as a daylight consultant for four years at Transsolar in Stuttgart, and as a senior research scientist for one year at Arup in London. Her research focuses on the gap between visual comfort, preference and interests based on the subjective and behavioral responses of occupants.

Kynthia Chamilothori is an Assistant Professor in the Human-Technology Interaction (HTI) group at the Eindhoven University of Technology. She received her PhD in Architecture from the Laboratory of Integrated Performance in Design (LIPID) at the École polytechnique fédérale de Lausanne (EPFL) in 2019, and her Master's degree (Dipl-Ing) in Architectural Engineering from the Technical University of Crete in 2014. Her research interests lie in the intersection of lighting, architecture, human perception and wellbeing, with a particular focus on how the characteristics of light in space can influence the subjective and physiological responses of occupants. Her work bridges architecture and lighting research by incorporating innovative technologies and knowledge from different fields —such as virtual reality and wearable biometric sensors— to provide empirical evidence on the role of lighting in creating spaces that not only energy-efficient, but also healthy, comfortable, and pleasant.

Sanne Schoenmakers is an Assistant Professor in the Human-Technology Interaction (HTI) group at the Eindhoven University of Technology. She did a postdoc in computational cognitive neuroscience in Maastricht University. She received her PhD in artificial intelligence from the Donders Institute for Brain, Cognition and Behaviour at the Radboud University Nijmegen in 2019, and her Master's degree in Human-Technology Interaction from Eindhoven University of Technology. She has a background in computer science and neuroscience, which she applies in the domain of artificial intelligence and the field of human-technology interaction. Through biology-inspired engineering, she translates biological processes to the world of intelligent robotics and AI. She has a thorough understanding of the brain and mental processes and how they lead to behaviour. Her current focus is on explainable AI with Bayesian modelling for data fusion and creating more robust and flexible neural networks for AI, as well as using computational models to understand human behaviour and facilitate humans in daily life with computer technology.

Bahar Aydemir received B.Sc. degree in Computer Engineering from Middle East Technical University (METU), Ankara, Turkey in 2018. She is currently pursuing her Ph.D. studies in, Image and Visual Representation Lab (IVRL), École Polytechnique Fédérale de Lausanne (EPFL). She is conducting research on saliency estimation on natural images, European comics and architectural scenes. Her current research interests include measuring human attention, style transfer, computer vision and machine learning.

Marilyne Andersen is Full Professor at EPFL and Head of the LIPID Laboratory. Her research lies at the interface between science, engineering and architecture with a dedicated emphasis on the impact of daylight on building occupants. Focused on questions of comfort, perception and health, these research efforts aim towards a deeper integration of the design process with daylighting performance and indoor comfort, by reaching out to various fields of science, from chronobiology and neuroscience to psychophysics and computer graphics. With a background in physics, she was a professor at MIT from 2004 to 2010, was Dean of ENAC at EPFL from 2013 to 2018, is Academic Director of the Smart Living Lab and co-founder of the consulting startup OCULIGHT dynamics.