



**Title: Outdoor lighting for pedestrians: Project owner: Environmental Psychology, LU**

## What was the purpose of the research?

Outdoor lighting has an important role in the development of a sustainable urban environment. In the UN Global Development Goals it is stressed that cities should be inclusive, safe, resilient and sustainable. This implies that people of different age, gender and vulnerability should be able to participate in urban life also after dark. The environmental psychology research within Lighting Metropolis takes a user perspective on outdoor lighting and has the overarching aim to identify and develop tools to assess pedestrian's perception, evaluation and behaviour in responses to outdoor lighting applications in urban environments.

## Chosen methodology & scope.

The research includes theoretical development and empirical work in full-scale laboratory as well as field studies on pedestrian paths. Conventional technical environmental assessments such as measures of illuminance, luminance, colour rendering and energy use are complemented with observer based environmental assessment, visual and behavioural tasks.

Observer based environmental assessments rely on self-report tools through which people express perceptions, observations and impressions, i.e. it employs human perception to define the environmental quality. Integration of users' understanding of their physical environment is important since this understanding is more holistic, embedding interacting social processes within the context of their places. In this research methods stressing user perspectives are in focus including pedestrians' assessments of perceived outdoor lighting qualities, i.e. perceived strength quality and perceived comfort quality, previously shown to be associated with pedestrians' perceived accessibility and perceived safety of the environment. Tasks considered important for pedestrian safety and security are employed including identification of obstacles, orientation and facial recognition. Moreover, the behavioral measures walking speed and placement at paths in relation to other road users are applied, supplementing previous approaches using only measures of pedestrian flow.

## Was the project attached to a demo project, and if so – how did the research support/benefit the demo project?

The research links to three different projects

People's perception of outdoor lighting in Pildammsparken, in collaboration with Malmö Stad

Lighting for vulnerable road users in Dammfri, in collaboration with Malmö Stad, Global Lighting Standard, Dept of Transport and Roads, LU, and the Swedish Energy Agency

Gröna Stråket, Lunds Kommun, Environmental Psychology serves as partner.

**Did the research overturn any pre-conceptions about the investigated topic?**

Current lighting standards are insufficient to guide the design of outdoor lighting for pedestrians. Additional information about the pedestrians' perceived qualities of the light and pedestrians' performance is necessary. Elderly and people with visual impairments have difficulties in performing fundamental visual tasks at pedestrian paths illuminated in accordance with present requirements.

**Which were the key findings – and were there any surprises/controversies? Any evidence established?**

Pedestrian's experience of outdoor lighting should be considered with regard to perception the perception of the lit environment, the evaluation of the lit environment and the behaviour within the lit environment. Observer based assessments show that pedestrians' perception, evaluation and behaviour of paths with new energy efficient LED-lighting applications may differ widely.

Significant differences were identified between lighting applications regarding the perceived lighting qualities of perceived strength quality and perceived comfort quality. Lighting applications also significantly differ in how well they support critical visual tasks e.g. recognition of emotional expressions, identification of obstacles and sign-reading. Pedestrian's perception and evaluation also differ between age groups. Similar results have been obtained under controlled conditions in a full-scale laboratory and in field studies.

**Has the research been published, and if so - where? If not, what are the plans?**

The research is under review in two scientific papers and two papers are in manuscript. The papers are part of a PhD-thesis in environmental psychology to be presented 2019 respectively a post-doc in environmental psychology.

Popular science reports from the research projects are under way.

**What is the next step within this specific research field?**

A new PhD-project starting June 2018 with the objective to a holistic perspective on outdoor lighting for public space in neighbourhood centres. The project is funded by the Swedish Energy Agency and will result in suggestions for new energy efficient lighting that build on collaboration

with residents, theoretical and methodological development including individual and social aspects of lighting, and knowledge building on lighting in neighbourhood centres in research and practice.

**How can the wider lighting community benefit from the research?**

Outdoor lighting for pedestrians that do not support their needs will result in energy use and costs without contributing to sustainability of the urban environment. This research makes the lighting community aware of the large variation in pedestrian experiences of artificial outdoor lighting. The research results can guide the lighting community to directly address pedestrians' perception, evaluation and behaviour in relation to the lit environment as a complement to lighting standards for pedestrian paths, and to consider this information in relation to energy use and costs.

**Can the results be applied practically by cities or companies, and if so - how?**

Both observer-based and technical assessments to get information about characteristics of outdoor lighting can be useful for lighting designer. Taken together our results suggest that pedestrians' experiences should be systematically assessed and reported as a complement to technical environmental assessments before large scale investments in new outdoor lighting applications. The research has developed and made different assessment tools available, including the Perceived Outdoor Lighting Quality Scale, POLQ. The assessments should be observer-based and preferably include people of different age groups and visual functionalities. The outcome of the assessments should be used to guide lighting designers before arriving at the final solution.

**What is the next step within this specific research field?**

Please see the answer to the same question above

**Planned future collaborations with potential partners?**

**Main persons to be credited for the research.**

In alphabetical order:

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