Psychological building blocks for dynamic road lighting: Understanding light's role in feelings of safety at night

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ABSTRACT

Road lighting serves a host of functions at night, yet puts a substantial burden on our total energy consumption. Without exception, technical solutions to reduce the use of energy (e.g., new light sources, interactive road lighting) impact user perceptions and acceptance in ways that are not yet understood. In an experimental field study, conducted in our interactive road lighting testbed, we investigated pedestrians' preferences for various static road lighting scenarios, in particular as they relate to feelings of safety, and the psychological mechanisms behind them. The testbed enabled us to manipulate the light, keeping other factors constant, thus offering experimental rigor and control. Following a paired-comparison paradigm, fifty female participants rated three light distributions on two street segments according to perceived safety. They then assessed each light distribution for each street segment on psychological and perceptual attributes. Research is ongoing; results will be reported at the conference.

INTRODUCTION

Road lighting needs to provide light and safety for all users. In particular to those vulnerable to or fearful for personal attacks, roadway lighting is essential for experiencing safety and the freedom to go out at night. On the other hand, there is an increasing awareness for climate change and impending shortage of energy sources which accelerates the urge for energy use reduction. The total energy use of public lighting in the Netherlands nowadays is estimated to be 600.000 to 700.000 MWh a year. About 500.000 MWh per year is used by municipalities for the lighting of infrastructures (e.g. roads, footpaths) [1]. These conditions underline the clear and urgent need to develop more intelligent and efficient light sources and lighting systems for road lighting.

LEDs are a promising class innovation for energy conservation. Their efficiency is rising steadily and they offer new possibilities for interactive and adaptive lighting, by affording dimming for streets and/or periods with lower traffic densities, adjustment of the light output to contextual light conditions (e.g., snow), or intelligent light-on-demand scenarios. Such adaptation could result in reductions of energy use, but would require robust, accurate and intelligent sensing and recognition of use, type and number of user(s). Yet in addition to these technical challenges, a major challenge is to understand user perception and acceptance of such adaptive road lighting at night. Such understanding requires perception research for personal safety and investigations of the impact of various algorithms and scenarios on subjective personal safety and user behaviour.

People perceive light as the most important environmental feature in relation to perceived personal safety at night (e.g., [2,3,4]). Moreover, recent research (e.g., [2,5,6]) has demonstrated the importance of lighting as a determinant of feelings of safety. These studies also illustrate the complexity of relationships between lighting (illuminance, spectrum, e.g. [6,7]) and street characteristics (e.g., [2,3,4,5]). Few – if any – researchers have had the opportunity to manipulate road lighting, keeping all other factors (concealment, entrapment, etc. i.e., distal features) constant. The interactive road lighting testbed on the university campus allows us to do just that.

Rationale

In this project we focused on pedestrians as they are, in contrast to motorists, slower and hence more vulnerable. Pedestrians rely on lighting for several purposes, among which orientation and recognition of obstacles and faces [8]. As previous research has always considered constant and even light levels, it is as yet unknown how people would feel under dynamic lighting and what the optimal lighting scenario would look like: should it light mostly the direct surroundings of the pedestrian, or rather facilitate prospect farther away from him or her? This was the primary question for the current experiment. Before venturing into dynamic behaviour of street lamps, we first needed to investigate the optimal static patterns of light, so to speak as building blocks for dynamic scenarios.

METHOD

In a field experiment, participants saw and rated three lighting scenarios (5 poles evenly lit, 5 poles with levels decreasing from near to far, and 5 poles with levels increasing from near to far, see Figure 1). Since women have higher fears of crime at night (e.g., [2,3,4]), only females were recruited. Fifty females (not familiar with the campus) participated, their ages ranged between 18 and 30.

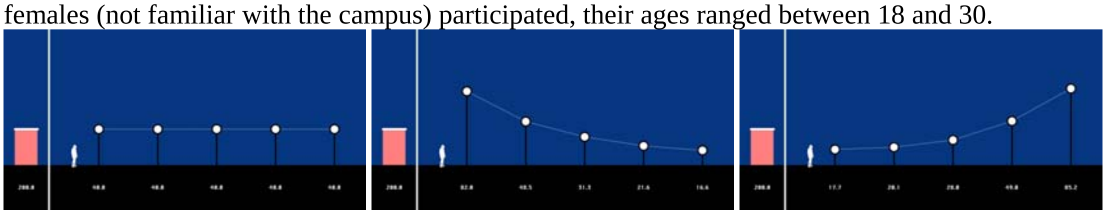

Figure 1. Three lighting scenarios used in the test (height of the poles in the picture represents the light level)

The first phase of the experiment followed a paired-comparison paradigm: two scenarios at a time were presented to participants on two street segments of the testbed, in all possible combinations (9 in total). For each pair, participants indicated on which of the two segments they would feel most comfortable/safe. In the second phase, all three scenarios were again presented to participants, on both street segments, but this time one by one. They rated every segment/scenario combination on a number of perceptual attributes and psychological experiences. Orders of the paired comparisons and scenarios for questionnaire ratings were randomised over participants.

RESULTS

The experiment is currently ongoing. Results will be available at the time of the conference.

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