**Submission ID: 39**

Lund, Sweden
10-12 November 2021
ICSC International Cycling Safety Conference

# Evaluation of bicycle lighting

*Katja Kircher and Anna Niska*

**Keywords:** bicycle light, visibility, vision, safety, method development

Background
Bicycle lights can be used both to enhance the visibility of the cyclist and enable the cyclist to see (vision). Bicycle light requirements vary between countries and are often not well specified. Additionally, the specifications are not necessarily based on scientific results for neither visibility nor vision enhancement. Consumer tests typically pick a number of lights available on the market and compare them with respect to an arbitrary list of features. However, technological developments can make individual lamps obsolete quickly.

Aim
This study investigates which methods are best suited to evaluate bicycle lights with respect to their ability to enhance visibility and vision. The focus is on generic features like brightness, beam shape, flashing versus steady beam and mounting position. Robustness, handling etc. are not considered.

Method
Several testing methods, from lab to field, are compared with each other, where a selection of lamps with various relevant qualities are used as examples:

Lab indoors: Lux measures are taken in nine pre-defined spots and the light field is photographed with camera settings kept constant.

Lab outdoors: Participants judge visibility and subjective quality for various lights and modes in a static setting in darkness, based on Swedish lighting requirements (visibility at 300 m distance). The light field is photographed with camera settings kept constant and with camera settings adapted to the lighting conditions (to simulate visual adaptation).

Field outdoors: Participants positioned in an intersection estimate their minimum gap acceptance for different front light setups (brightness, flash vs steady, mounting height). To this end, an experimenter cycles through the intersection at different speeds with varying light setups. The participants also give a live commentary about their subjective impression of the bike light and its functionality.

Demonstration: Additional features are demonstrated, but not investigated scientifically. These include the mounting angle for glare, flashing vs. steady rear lights for visibility, glare and irritation, and visibility from the side, depending on lamp design.
Expected Results
Advantages and disadvantages of the different methods will be discussed with respect to the results they can be expected to produce, time and effort needed, replicability, etc. A side product is a preliminary evaluation of different generic bike lighting features. The lab tests are already conducted and indicate that the indoor lab method is cost effective, replicable, and can provide a good indication of how useful the light beam is for vision. The outdoor lab test showed that all tested lights fulfilled the criterion of being visible from 300 m, but that the subjective assessment varied between lights where brighter lights did not necessarily receive higher ratings.

Conclusions
Bicycle light requirement regulations should reflect practical requirements like visibility and vision, but also the avoidance of glare. In addition, safety is likely to be enhanced if the light aids other road users in correctly estimating the cyclist's position and speed.

Additional remark:
The field test will be conducted in spring 2020 and the results are expected to be available by summer 2020.