

Field Study: Glare of Headlamps with Small Light Emitting Areas

DVN Glare Workshop, Feb. 2025 | Mathias Niedling, Ph.D.

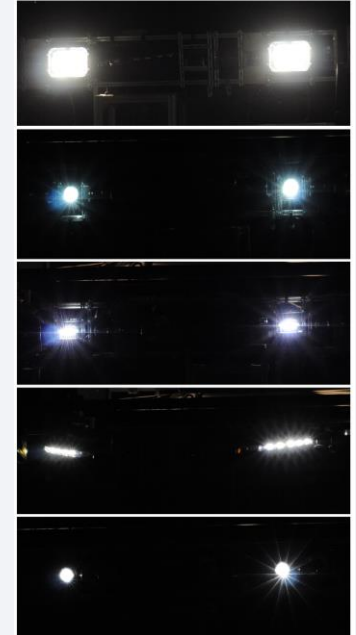


Background

- The design of headlamps increasingly features small light-emitting areas
- To get the ECE approval; certain luminous intensities in different angels have to be realized.
- Realizing the same luminous intensity: the smaller the light emitting area the higher the luminance of headlamps surface.
 - There is no limitation of luminance by the legal requirements

Research question

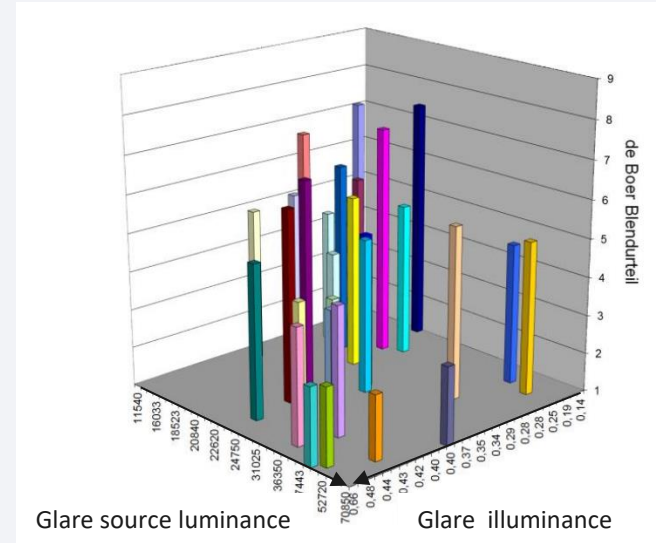
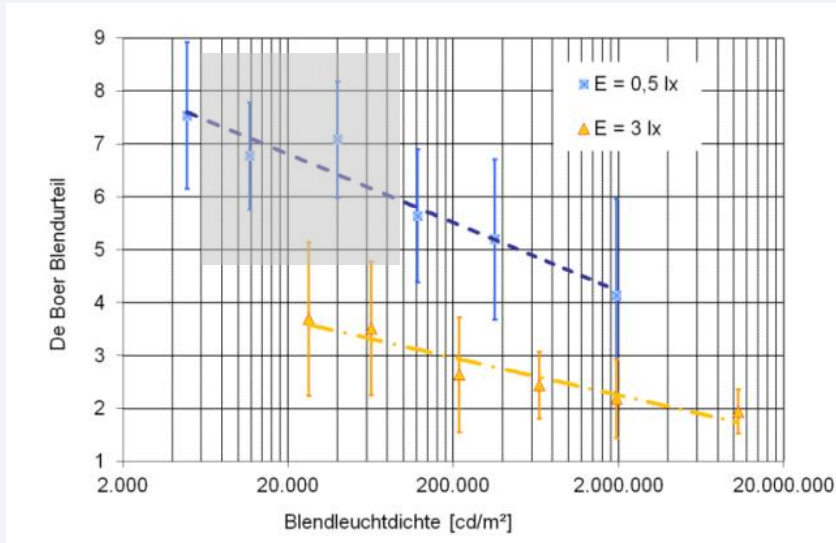
- Do headlamps with small light emitting areas produce more glare for oncoming traffic than those with large surfaces?



State of research

Laboratory setup & glare source
(E & L can be adjusted separate)

Real headlamps (look into the source)
(E & L can not be adjusted separate)



“...there is no traceable measuring method that can be used to determine the average glare luminance of real headlamps.” [1], Völker, S.

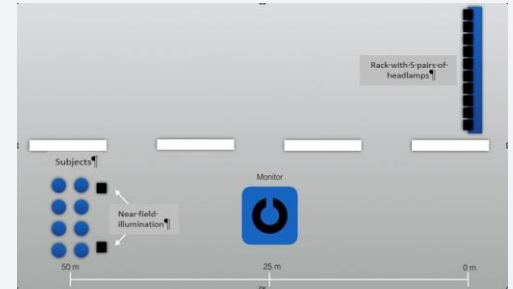
State of research

Several studies at the L-LAB:

- No influence of high luminance on disability and discomfort glare, if the legal requirements are met.
- Strong increase of disability and discomfort glare if headlamps are misaligned.

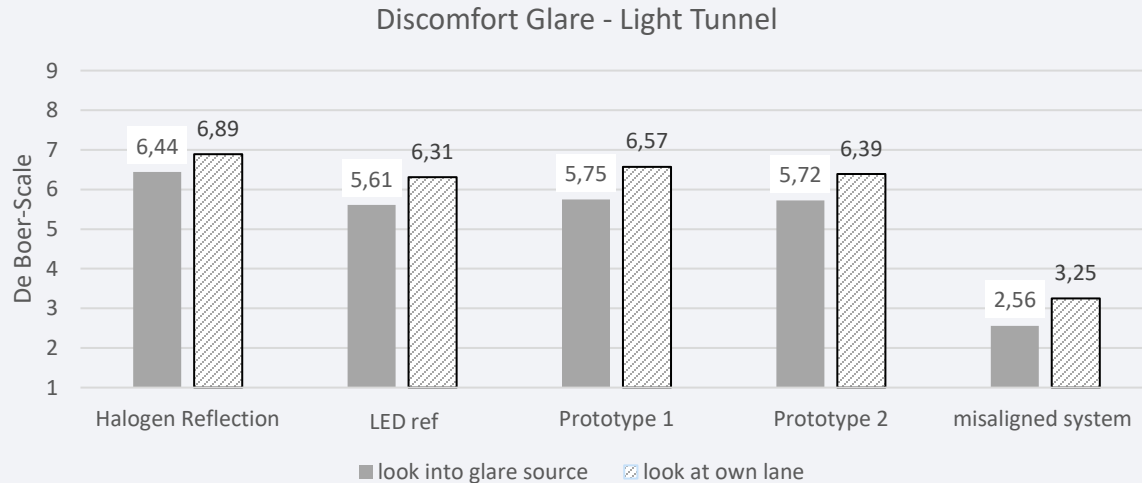
Last study with focus on light emitting surface

- Study conducted in 2019 in the HELLA light tunnel in Lippstadt [2] Sapovalov, [3] Schmidt et al.]
- Subjects (N = 61) were placed at point B50L.
- Test persons were glared with four pairs of headlamps with very different light emitting areas and one misaligned headlamp (higher E at eye)
- Discomfort glare was assessed using the De Boer scale, once looking on the subjects' own lane, once looking directly into the headlamps.



State of research

- If the legal requirements were met, disability glare was almost identical.
- If the maximum ECE illuminance values were exceeded, disability glare increased drastically.
- If the legal requirements were met, there were only slight differences in discomfort glare.
- If the maximum ECE values were exceeded, discomfort glare increased strongly.



→ Static setup

Dynamic study: operationalization of the research question and hypotheses

Operationalization

- Aim of this study: assessing the influence of high luminance on discomfort glare during driving on country roads.

Hypotheses

- Hypotheses 1: The discomfort glare of headlamps that differ in luminance but meet the legal requirements is comparable
- Hypotheses 2: Misaligned headlamps produce significantly more discomfort glare than correctly adjusted ones.



Experimental Setup and Procedure

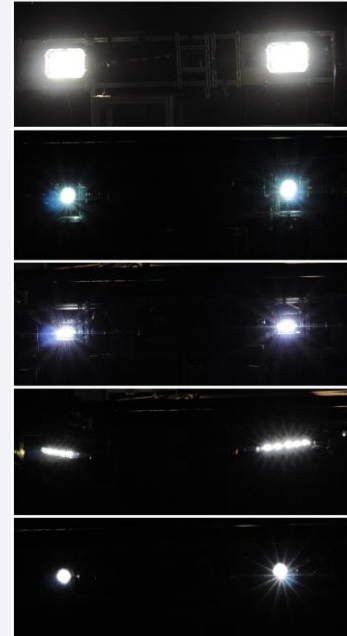
- Subjects drive between two roundabouts on a straight, dry country road.
 - 2 Test vehicles with different headlamp systems are oncoming.
 - After each pass glare has to be rated on the De Boer scale.
 - Test headlamps vary in luminance of the light emitting areas.
- Illuminance at the eye of the oncoming driver in B50L is comparable.
 - One pair of headlamps is misaligned (maximum legal illuminance value is exceeded).
- The order of test headlamps is randomized.
- Each pair of headlamps is presented twice.
- A total of five pairs of headlamp were mounted.
 - Four pairs were adjusted correctly.
 - One pair of headlamps was misaligned.



Characterization of the Headlamps used

	E_{50m}	$E_{37,5m}$	Area (cm ²)
Halogen Reflection	0.39	0.67	123
LED Reference	0.37	0.57	20
Prototype 1	0.44	0.68	35
Prototype 2	0.41	0.64	17
Hal. Proj. Misalig.	2.50	1.47	38

Illuminance assessed in a distance of 50 m and 37.5 m. Area: **light emitting area (outer dimensions) for one headlamp, does not correlate with a homogenous luminous area**

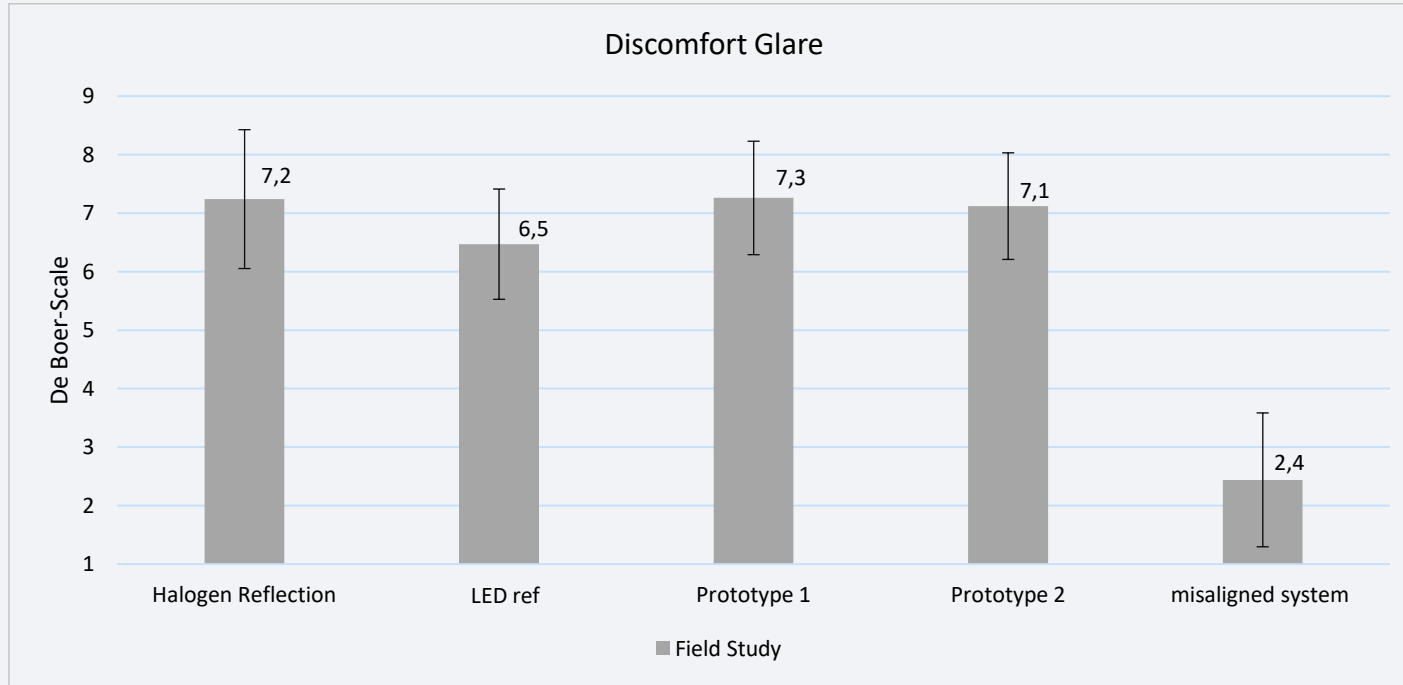


Sample description

- 17 subjects have participated, 12 male, 5 female
- Age: average 30.9 years (Median: 28 years)
- Most participants had little or no knowledge in lighting technology.
- Further variables (age, sex, glasses, driving experience etc.) had no influence in subjects' rating behaviour.
- Each headlamp was evaluated twice, the ratings were averaged.



Discomfort glare rating of the headlamps



Conclusion

- In the study presented here discomfort glare was assessed under dynamic conditions in real-life traffic.
- The results of the earlier studies were essential confirmed:
 - The luminance of the light emitting area of headlamps have only a limited influence on discomfort glare.
 - However, high illuminance levels at the eye of the oncoming driver cause very strong glare. This effect is much bigger than the effect that might be attributed to high luminance levels.
- Influence of the position of the glare sources on the test rack will be checked
- In order to minimise glare in road traffic at night it is important to ensure that the legal requirements are permanently fulfilled.

References

- [1] Völker, S.: Blendung durch Kfz-Scheinwerfer im nächtlichen Straßenverkehr: Ein Review bis 2006 – Beschreibung, Maßzahlen, Bewertungsmethoden, Universitätsverlag der TU Berlin, 2017
- [2] Sapovalov, T.: *Blendung durch KFZ-Scheinwerfer*. Master thesis. Hamburg, 2019.
- [3] Schmidt, C., Sapovalov, T., Locher, J.: *Hip but Risky? New Studies about the Influence of Small Light Emitting Areas on Headlamp Glare*, VISION 2020, 118-121, 2020.

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