Karlsruhe Institute of Technology

Distraction Potential of a Construction Zone Light on Other Traffic Participants

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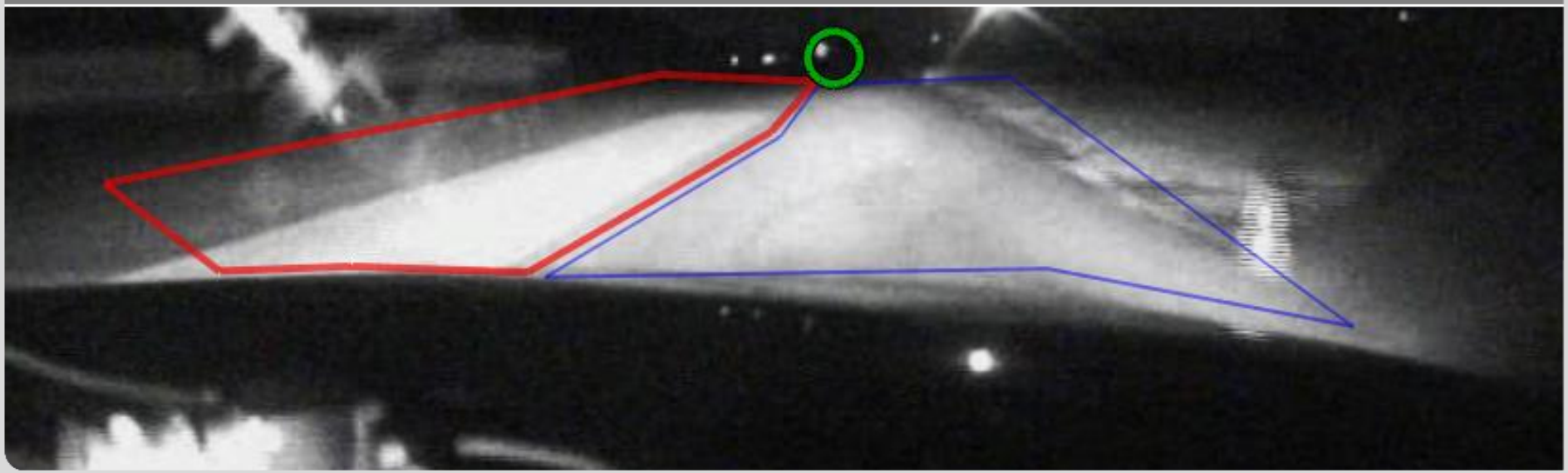
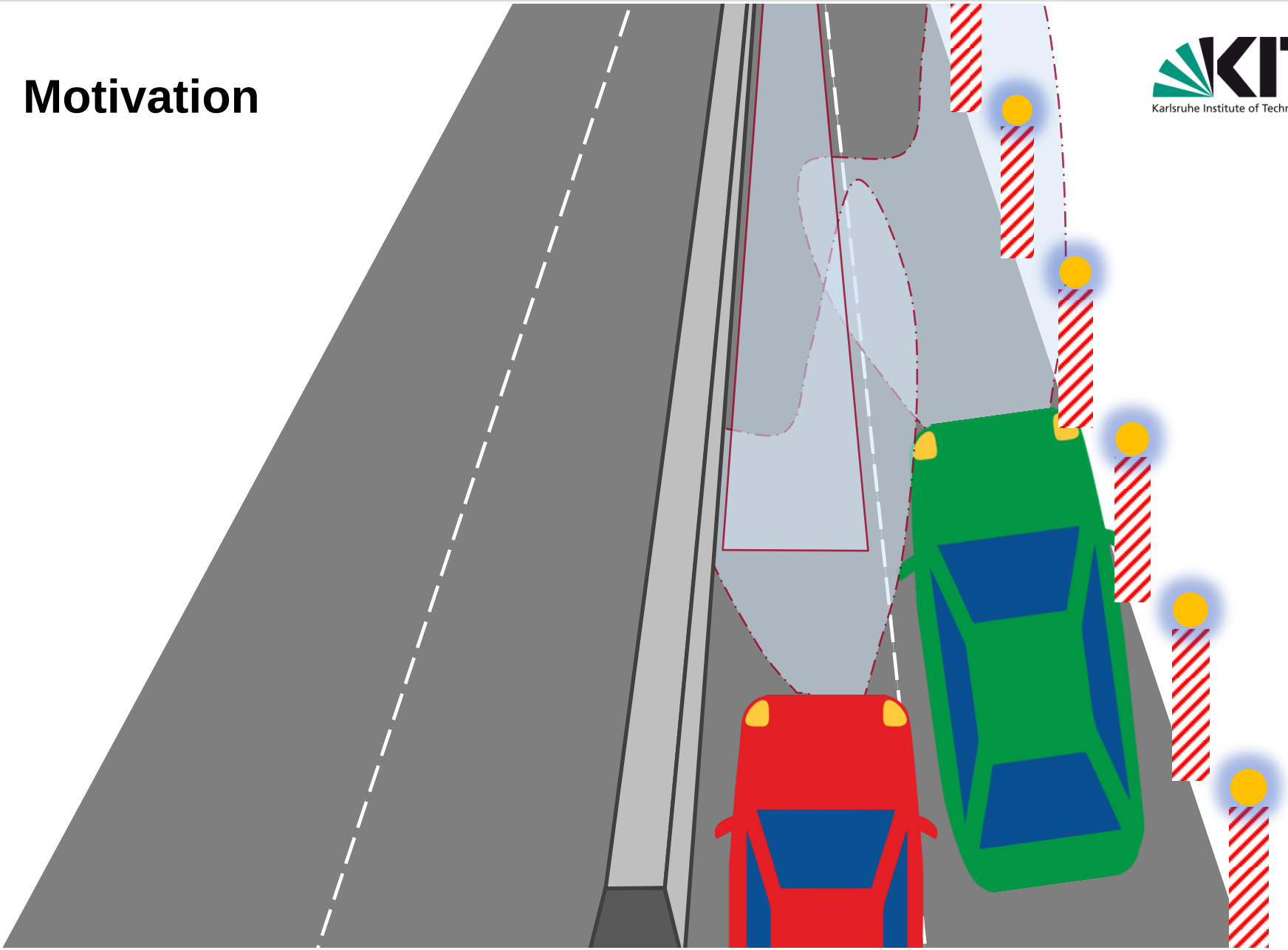
Light Technology Institute, Electrical Engineering and Information Technology

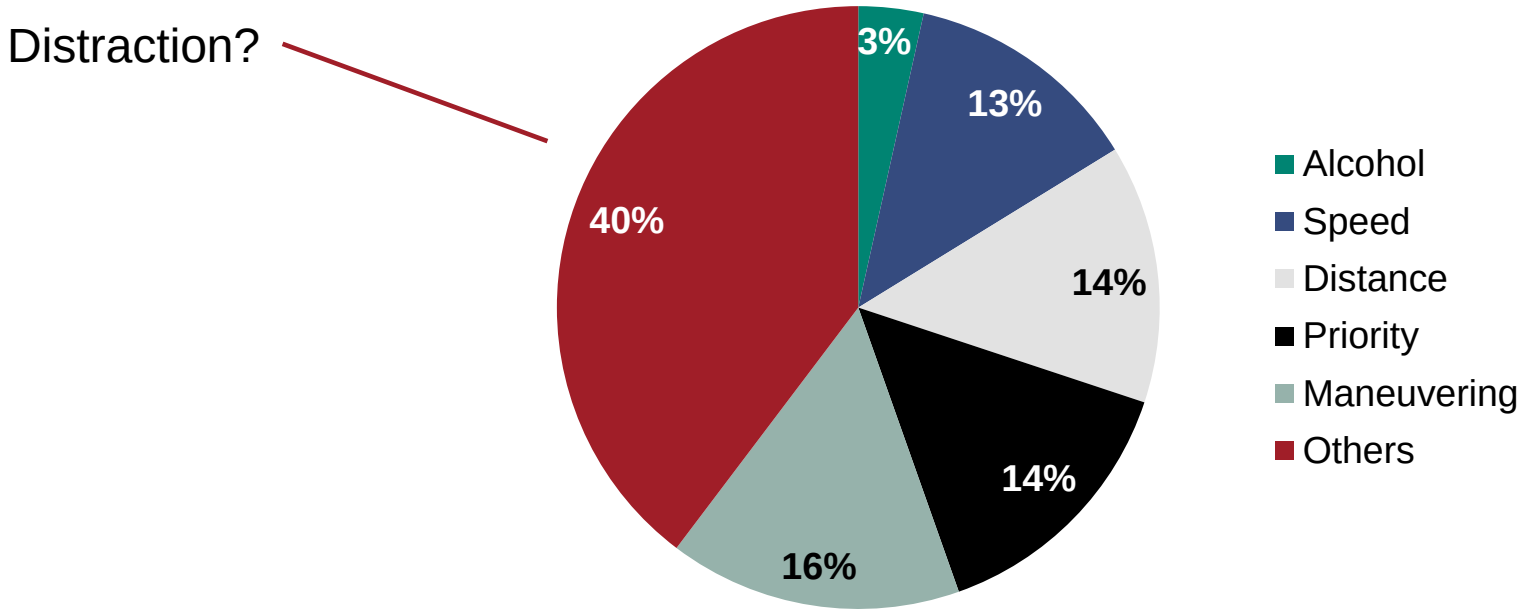


Motivation



Motivation

- Car accidents with injuries: 369,242 [1]

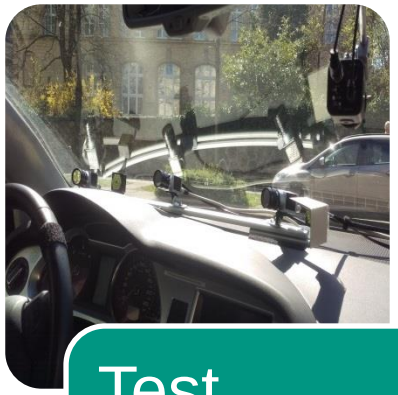


[1] Statistisches Bundesamt, Verkehrsunfälle 2016, Wiesbaden, 2017.

Objectives

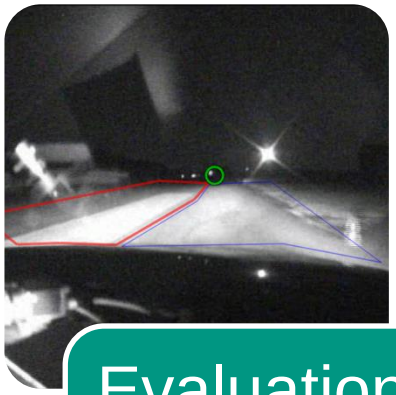
- Is there a critical distraction potential of a construction zone light?
- Will there be a fast learning effect, reducing the distraction?

➡ Study with test subject



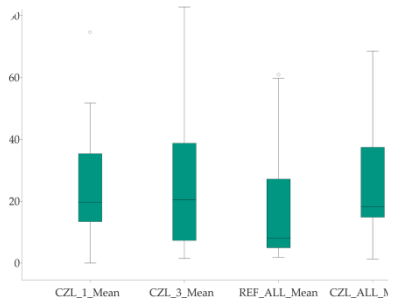
Test Design

- Constraints
- Procedure



Evaluation

- Relative
- Absolute

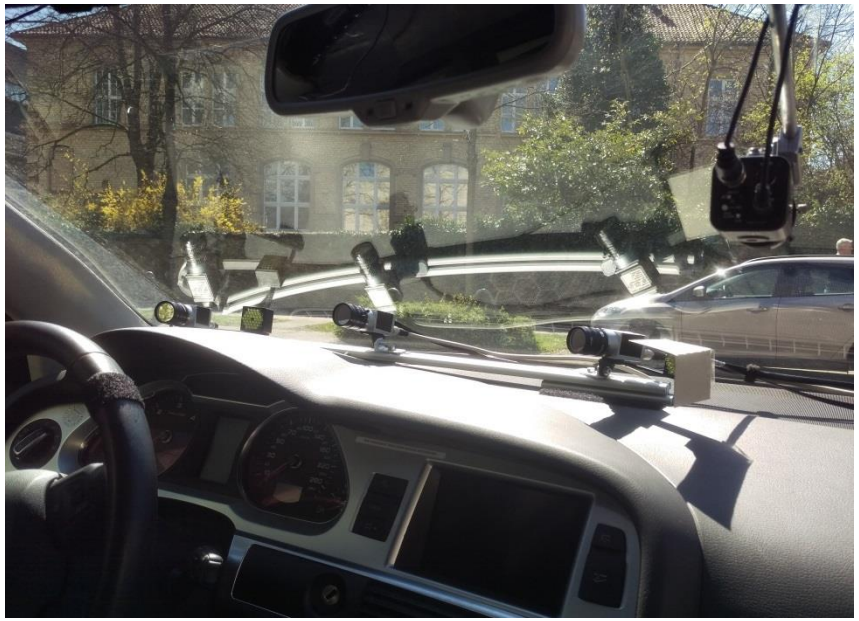


Results

- Eye-Tracking
- Question-naire

Test Design

- Fully dynamic
- Test track: Hockenheimring
  - No other traffic participants
  - No disturbing light sources
  - No potentially attractive or distracting things
- Test subjects chosen of 2 groups
  - <30 years ➔ easy to distract [2]
  - >50 years ➔ maybe more critical towards new technology
- Visual acuity >1.0 / >0.8

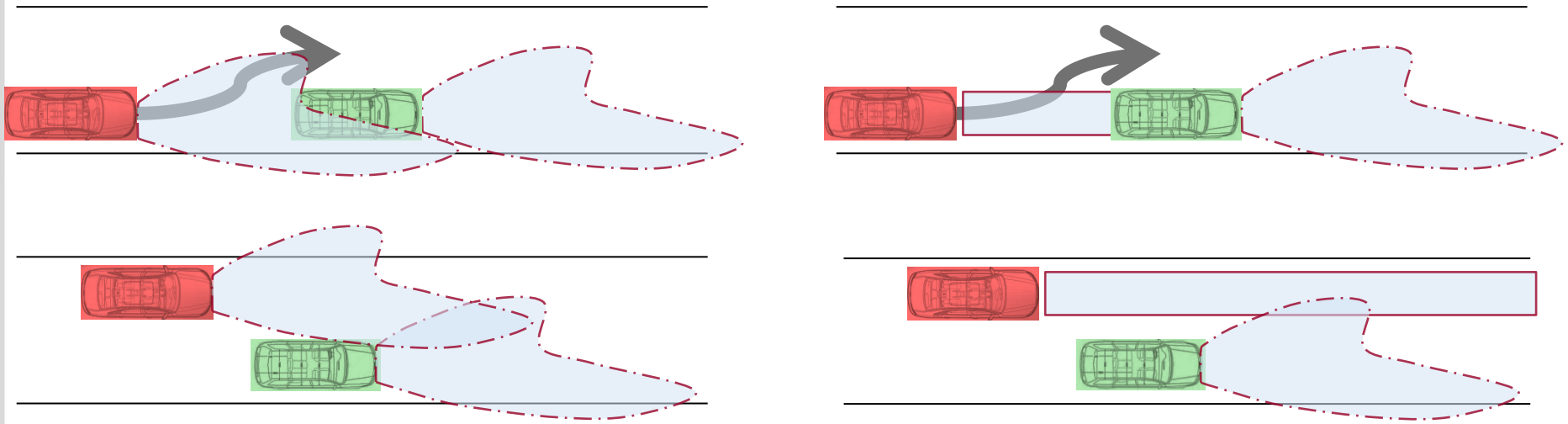


➡ Worst case scenario

[2] Stutts, J. et al., The role of driver distraction in crashes: an analysis of 1995-1999 Crashworthiness Data System Data, Annual proceedings / Association for the Advancement of Automotive Medicine, 2001.

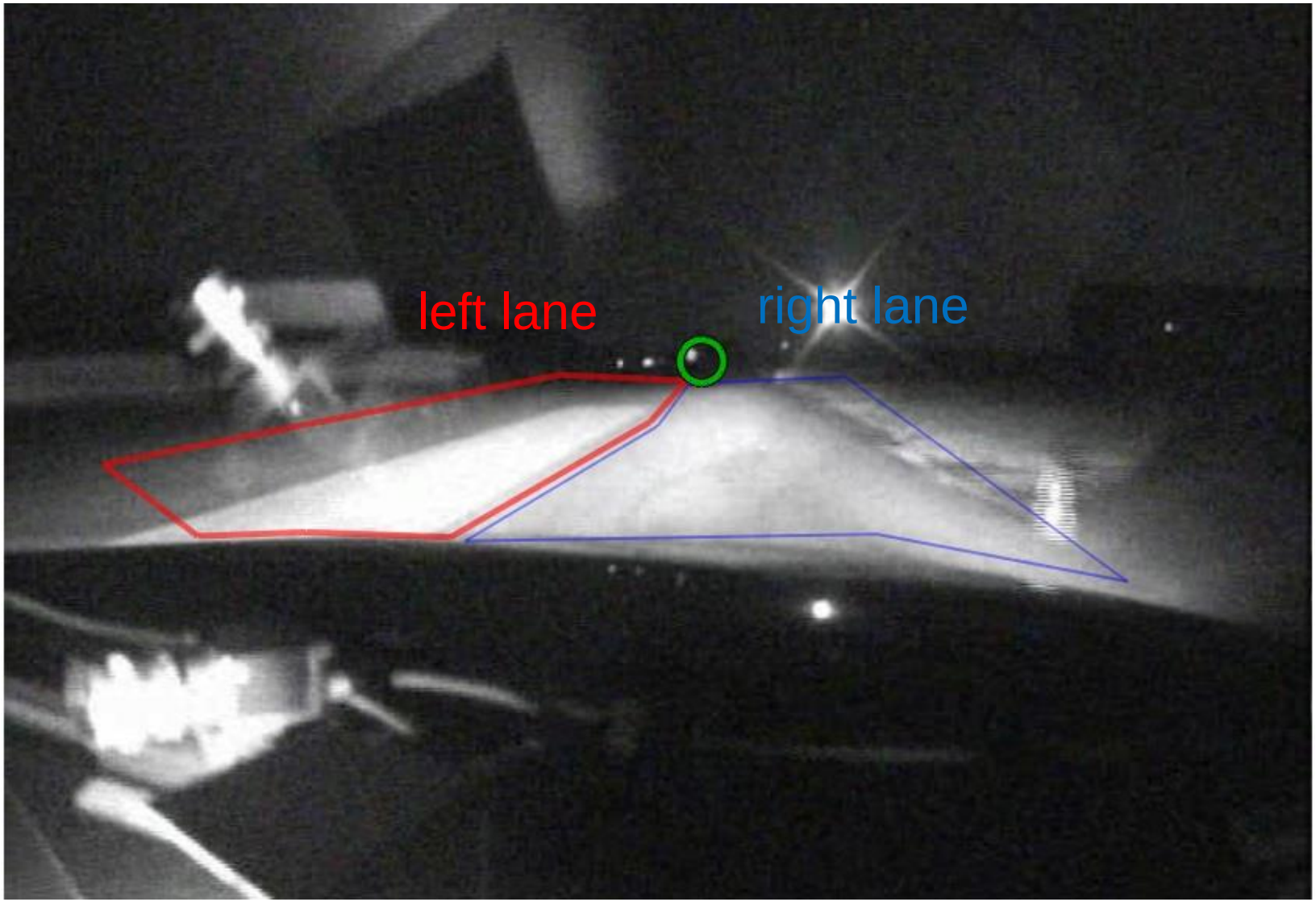
Test Design

Situations	
Scenarios	**Variations**
Overtaking	Only Low Beam
Parallel Driving	Additional Construction Zone Light

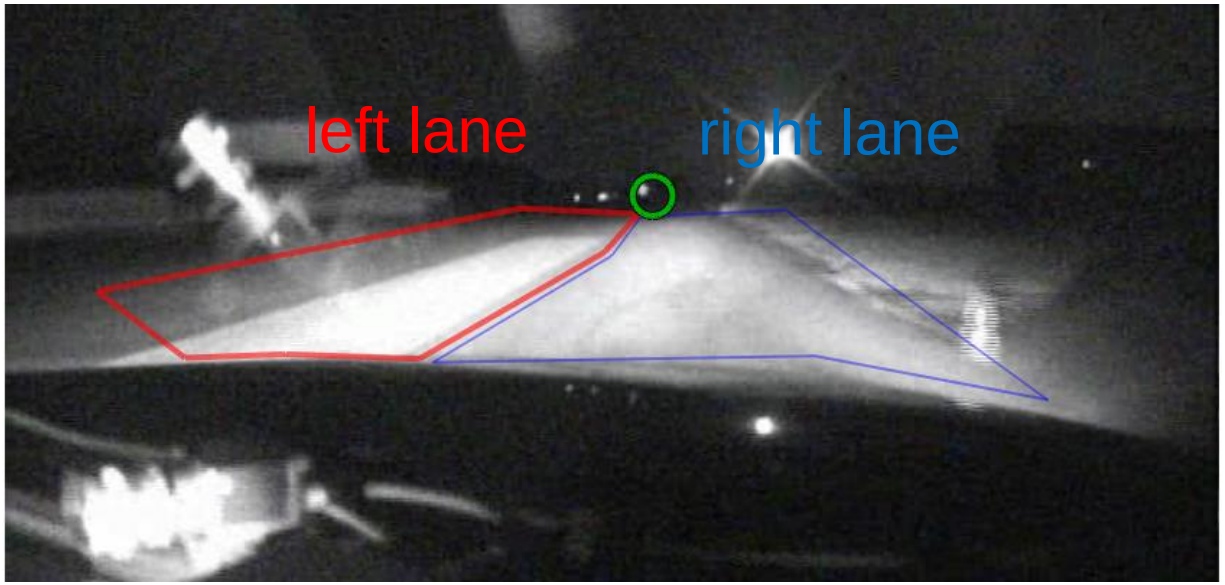


- Each situation performed 3x, fully randomized → 228 runs

Analysis



Evaluation



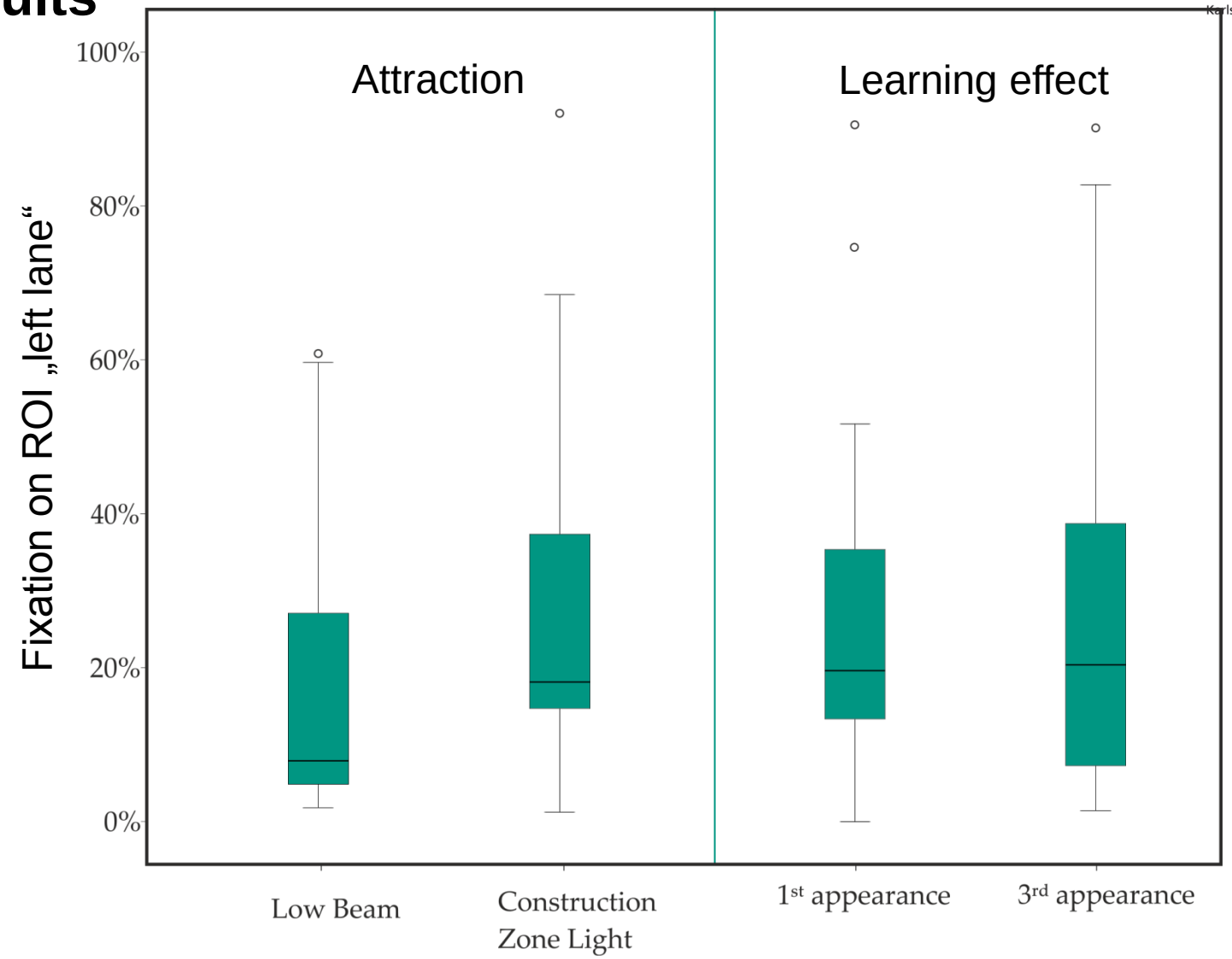
- Percentage of gaze fixation on left lane

$$Percentage = \frac{duration\ of\ gaze\ fixation\ in\ ROI\ "left\ lane"}{accumulated\ duration\ of\ gaze\ fixation\ in\ both\ ROIs}$$

- Absolute gaze fixation < 1.5 s [3]

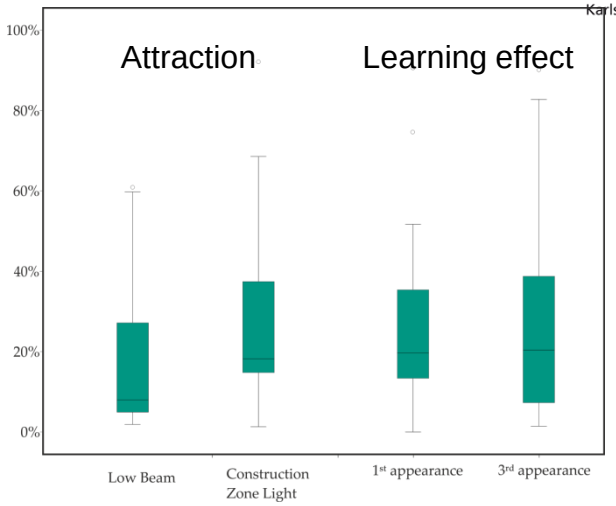
[3] Trefflich, B., Videogestützte Überwachung der Fahreraufmerksamkeit und Adaption von Fahrerassistenzsystemen, Dissertation, Ilmenau, 2001.

Results


Attraction
Learning effect
Fixation on ROI „left lane“
100%
80%
60%
40%
20%
0%
Low Beam
Construction Zone Light
1st appearance
3rd appearance

Results

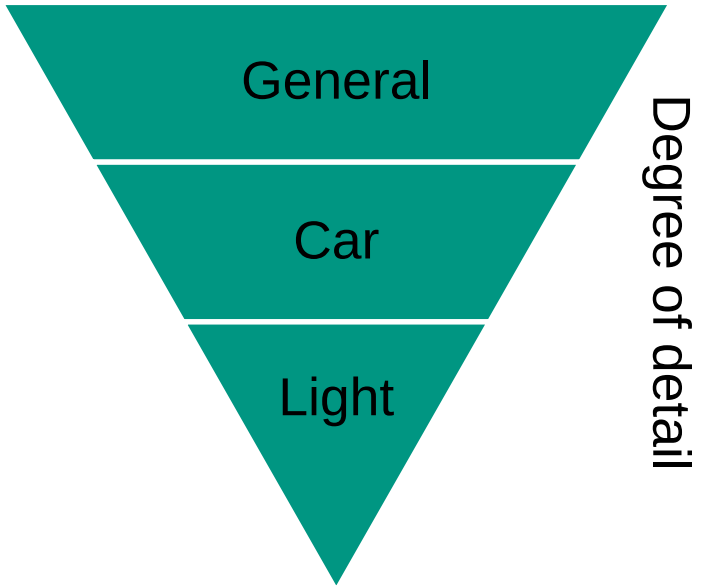
Test	*p*-value	effect size *d*
Attraction	0.001	0.494
Learning effect	0.853	0.027



- Highly significant attracting light pattern
- No immediate learning effect recognisable
- 2 potentially critical situations

Questionnaire

- Getting subjective impression of test subjects
- Evaluating how attracting the CZL was
  - Handing out questions one by one
  - Asking from general to detail



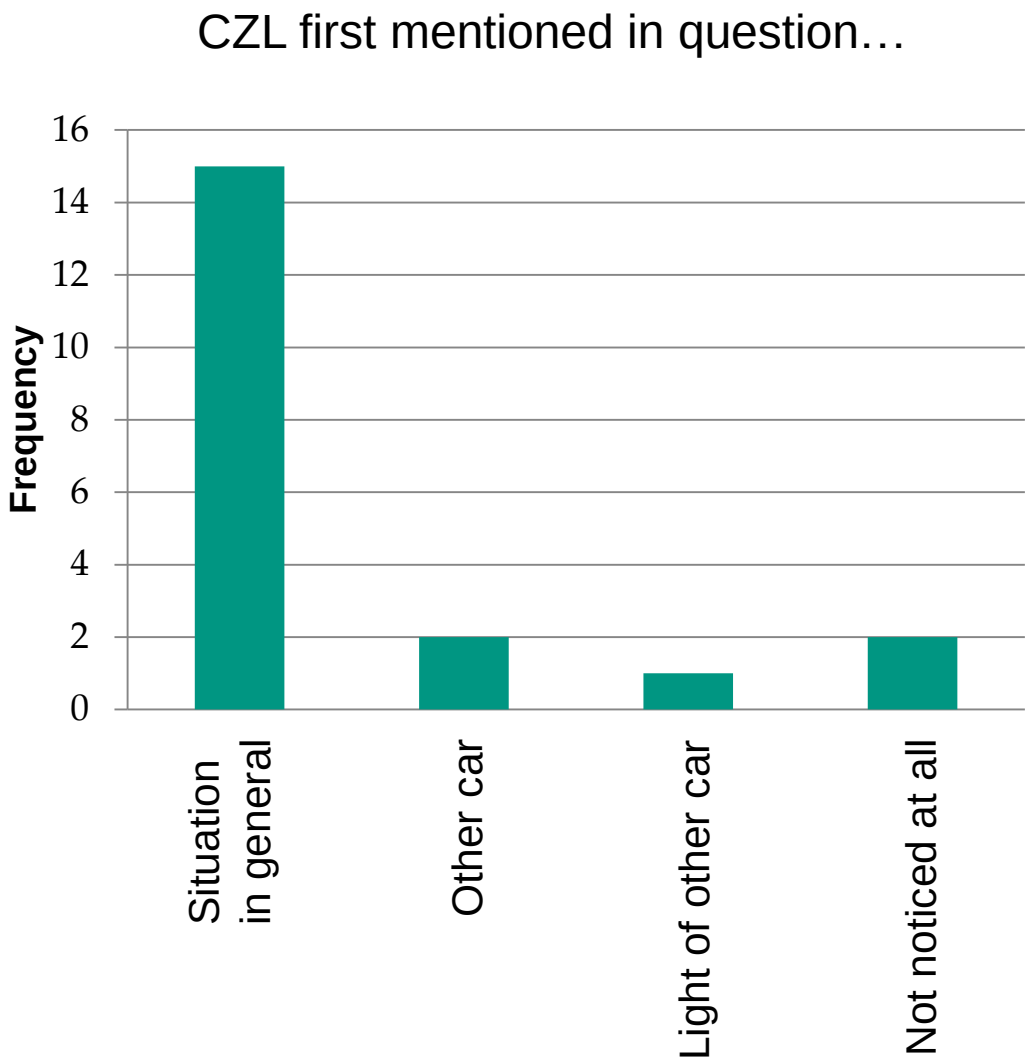
➡ The earlier it‘s mentioned, the more attracting it is!

Questionnaire

- 1) **Situation in general**
  - Could you determine differences in the different situations?
  - Did you find s.th. distracting in one or some of the situations?
- 2) **Other car**
  - Did you notice something at the other car?
  - Did you find s.th. distracting at the other car?
- 3) **Light of the other car**
  - Could you notice s.th. at the other car's light?
  - Did you find s.th. distracting at the other car's light?

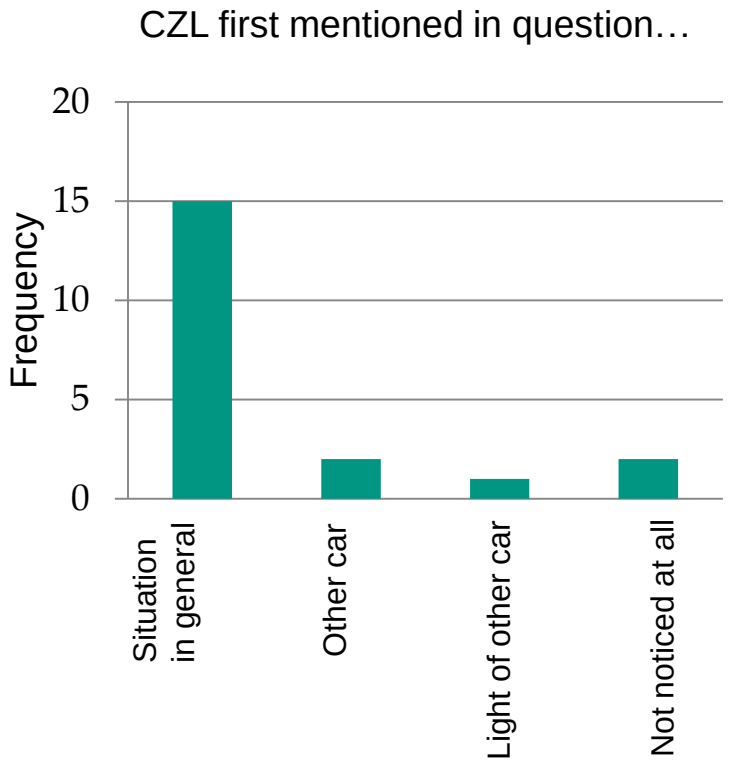
- Do you think that the light function of the other car can **increase** traffic safety?
- Do you think that the light function of the other car can **decrease** traffic safety?

Results


CZL first mentioned in question…
Frequency
16
14
12
10
8
6
4
2
0
Situation in general
Other car
Light of other car
Not noticed at all

Results

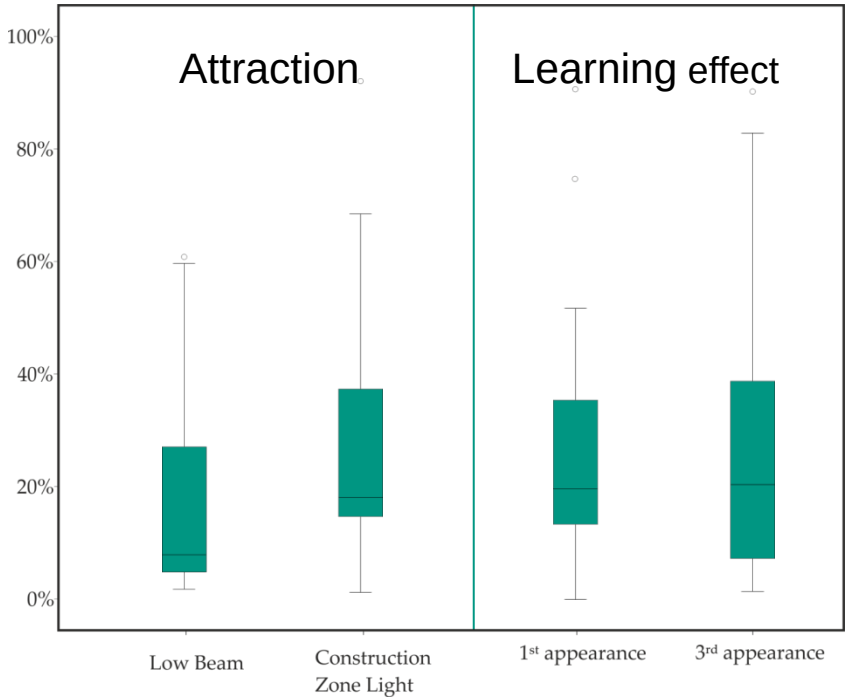
- 75% mentioned light pattern immediately
- 35% were distracted at least once
- reasons: glaring and wobbeling

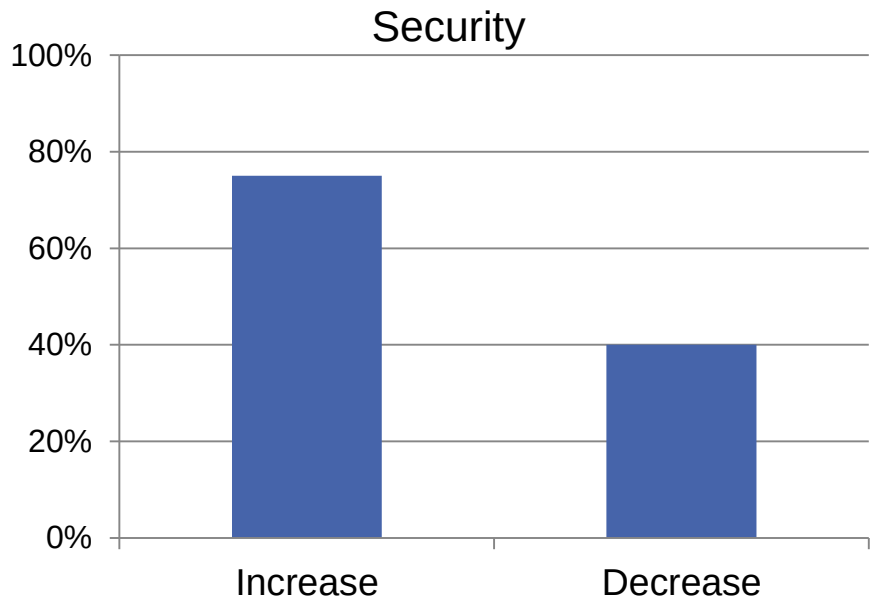


- 75% think of **increasing** security
- 40% think of **decreasing** security
- reasons: „blind spot detector“ vs. unfamiliar appearance

Conclusion

- Construction zone light is a visually attracting light pattern
- Overall gazes rated as non-critical
- Subjective evaluation: More advantages than disadvantages
- High resolution light functions should not wobble → levelling





Thank you.