Recent LSS / UAS-Gießen Studies

Introduction

Summer 2017: Psychological Glare Analysis of different Headlamp Systems

1) Survey

2) Semi-Dynamic Evaluation of Perceived Glare

   de Boers scale and Eye-Tracking System

3) Object-Detection Distance **GFHB versus LED matrix low beam**

   VBOX 3i and Eye-Tracking System

4) Summary of results obtained

5) Questions and Answers

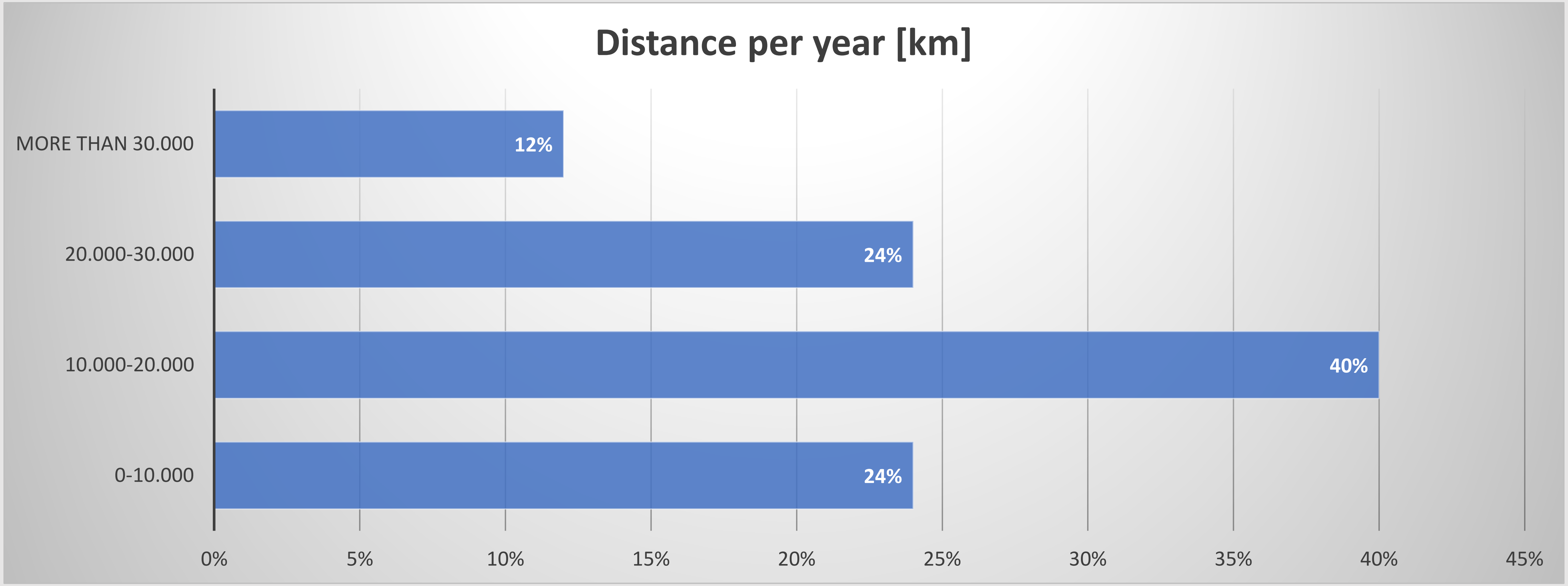
- The survey asked 25 respondents to specify their age, gender and some specific questions related to driving at night:

1. Driving Distance per year
2. Mostly used lamp type
3. Satisfaction withcurrent Headlamp system
4. Desire for better visibility
5. Frequency of night drives
6. Commonly used street type
7. Experienced Stress while driving at night
8. Level of Feeling tired while driving at night
9. Poor visibility while driving at night
10. Experienced Glare by other vehicles
11. Experienced Glare caused by street signs reflection

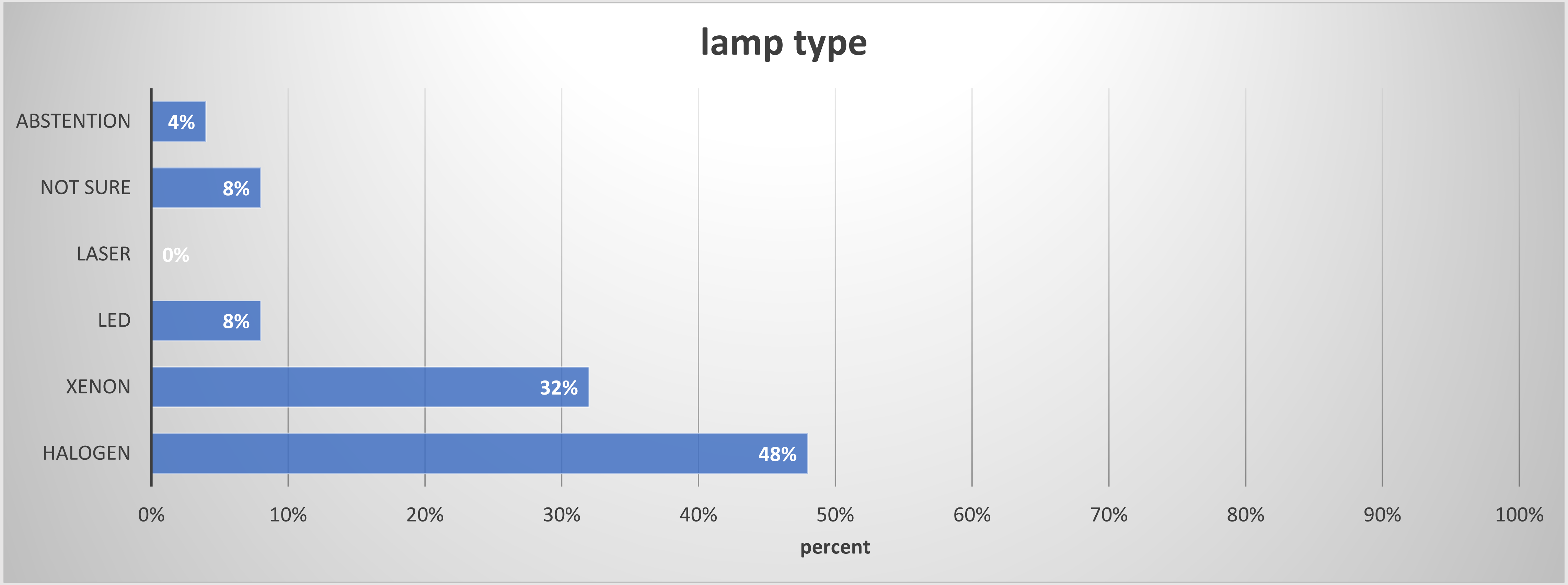
Respondents

- 25 Respondents
- 28% female – 72% male
- Age 18 – 51 in average 29.2
- 32% required glasses to drive
- Holding a driver’s license in average since 11.2 years
- 40% of respondents to drive between 10.000 – 20.000 km /year
  (6.200 – 12.400 miles/year)

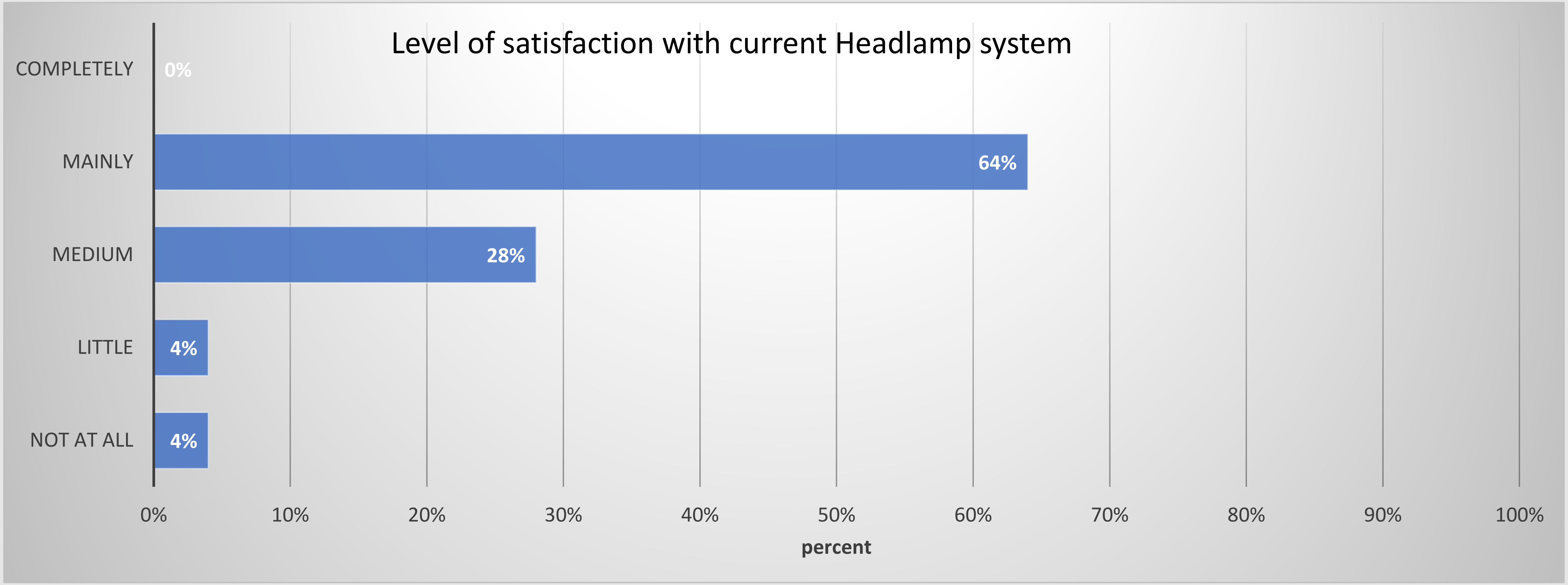
Travelled Distance Per Year



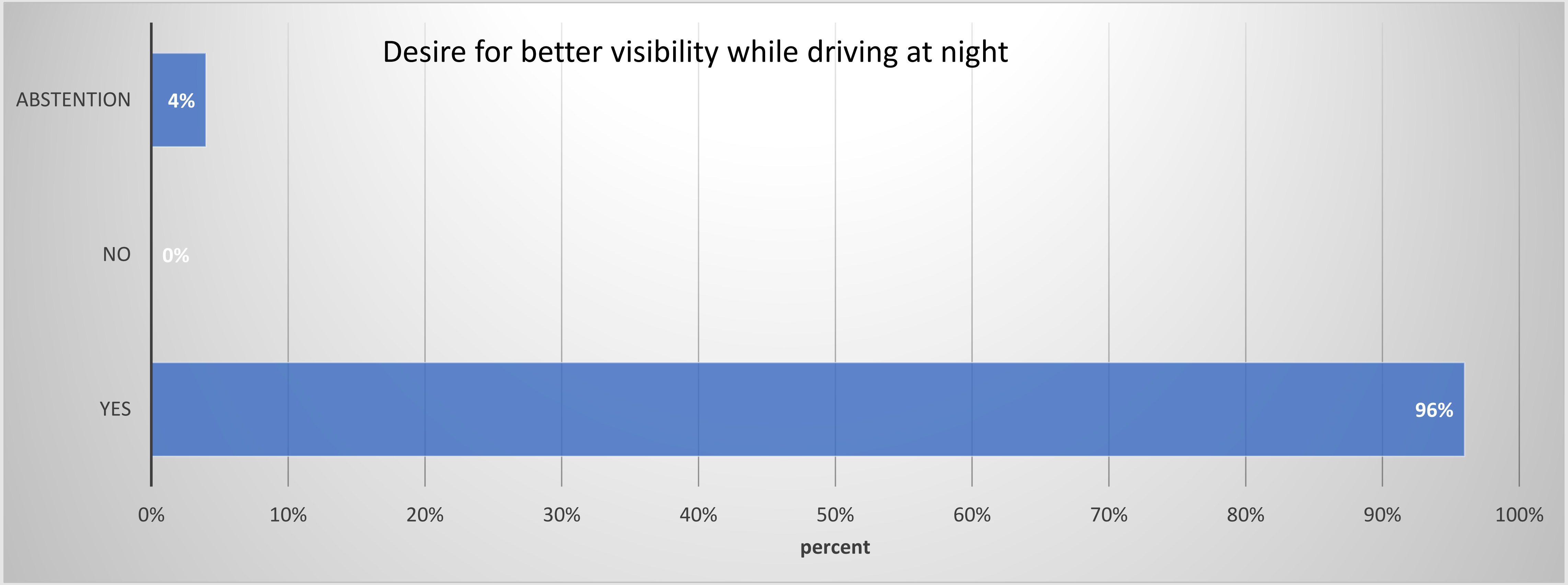
Mostly used lamp type



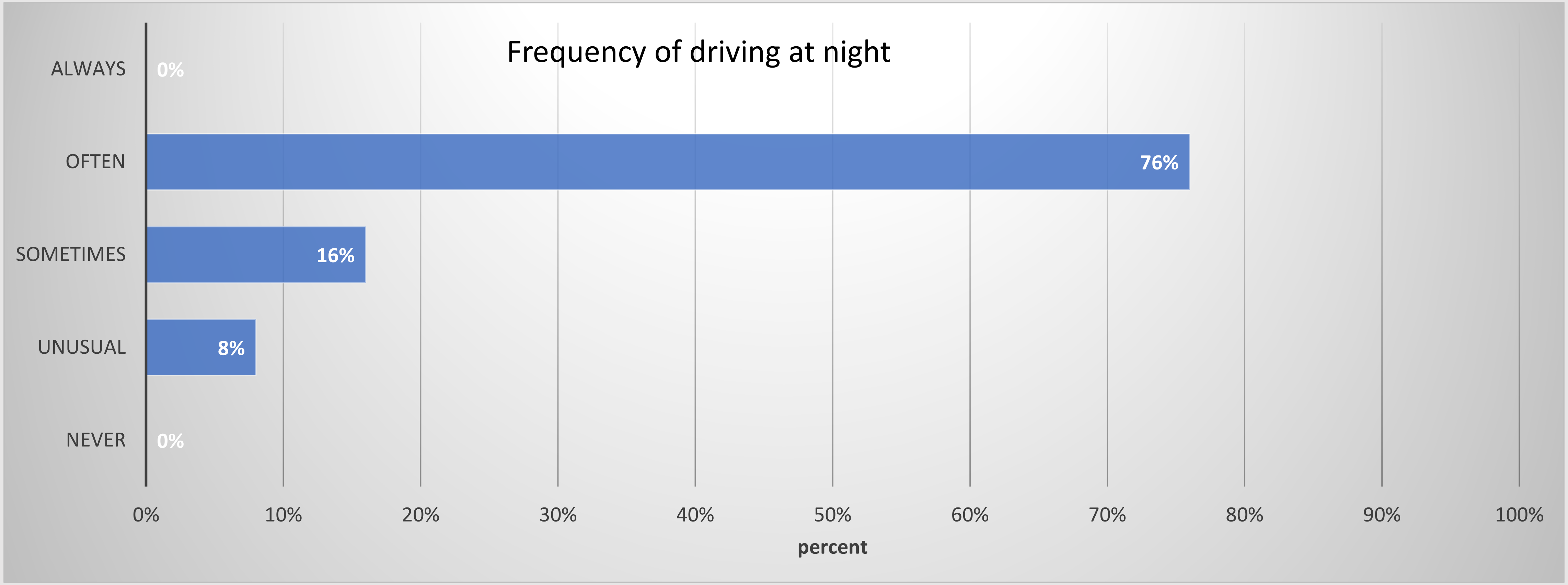
Satisfaction with the available light system



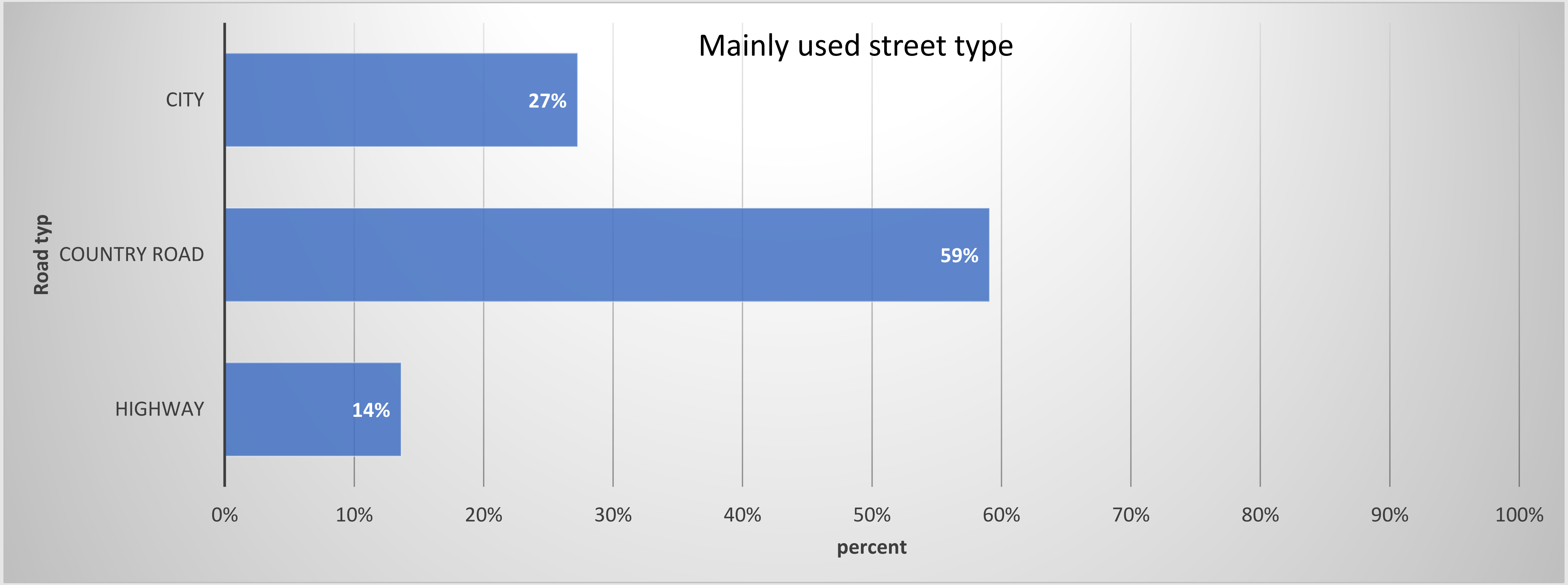
Desire for better visibility



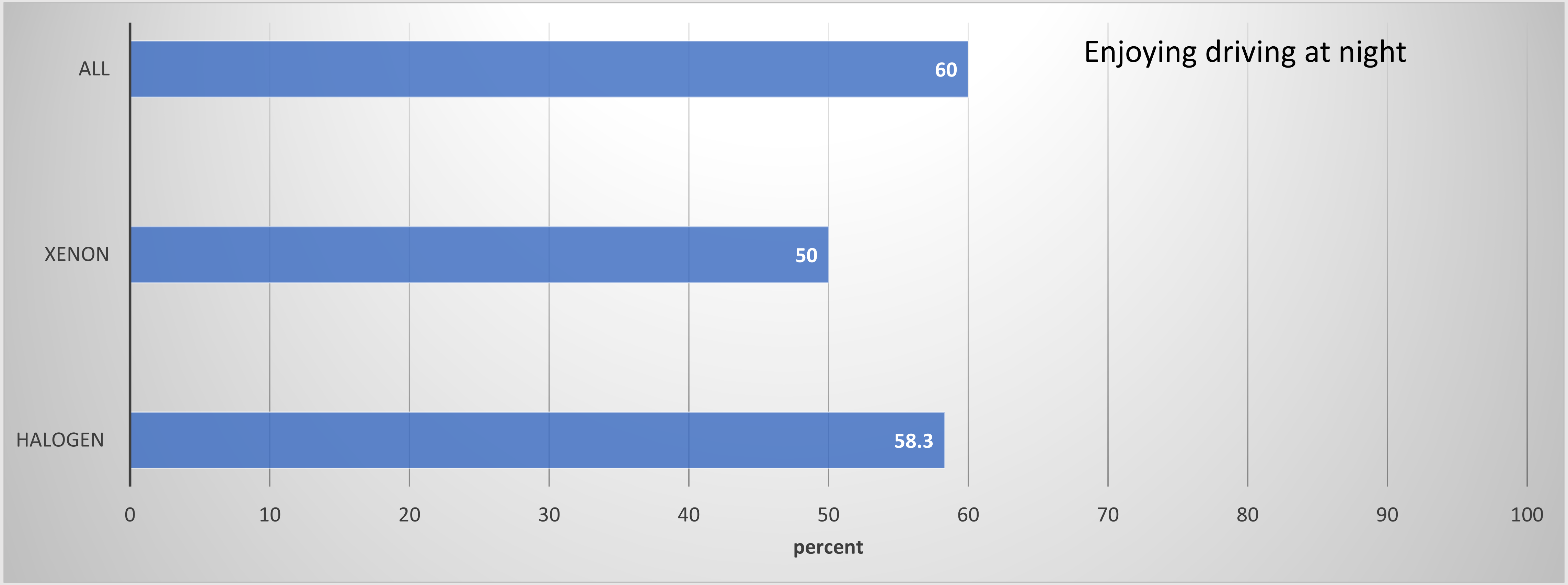
Frequency of driving at night



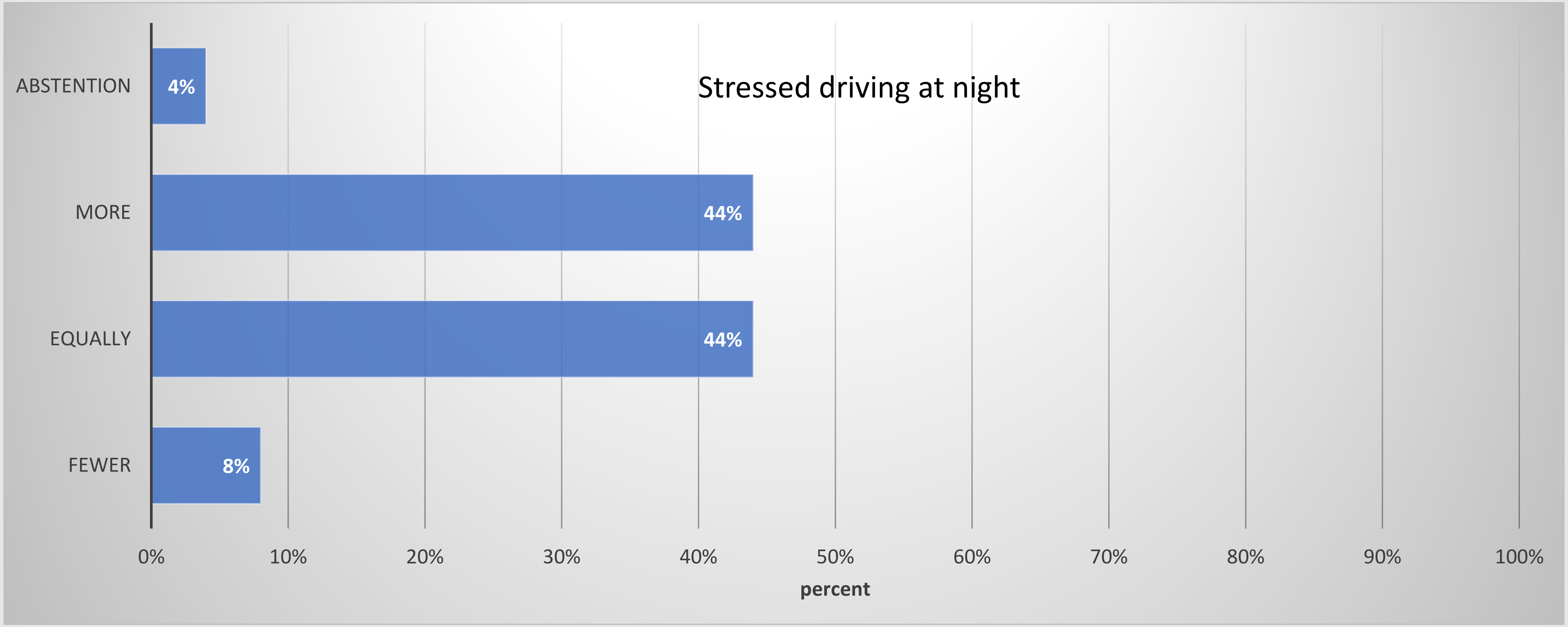
Mainly used street type



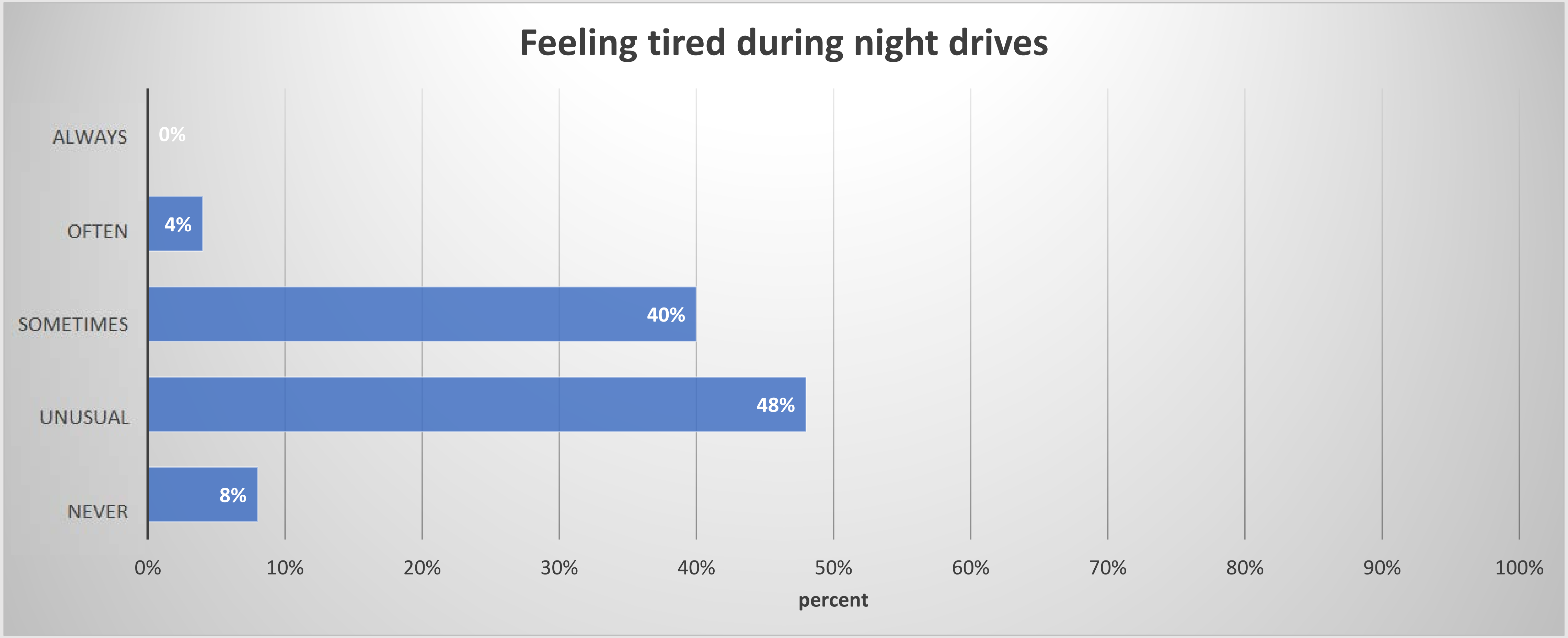
Enjoying driving at night



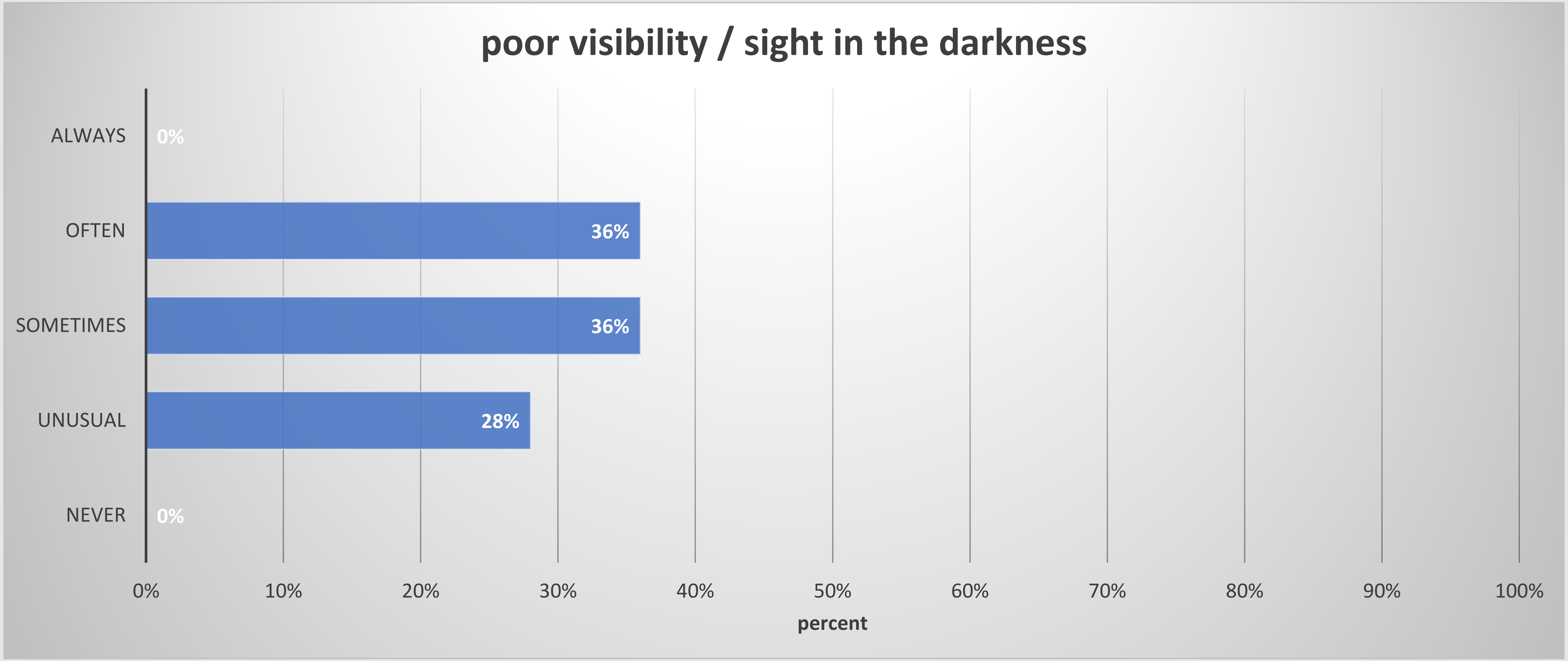
Stressed driving at night



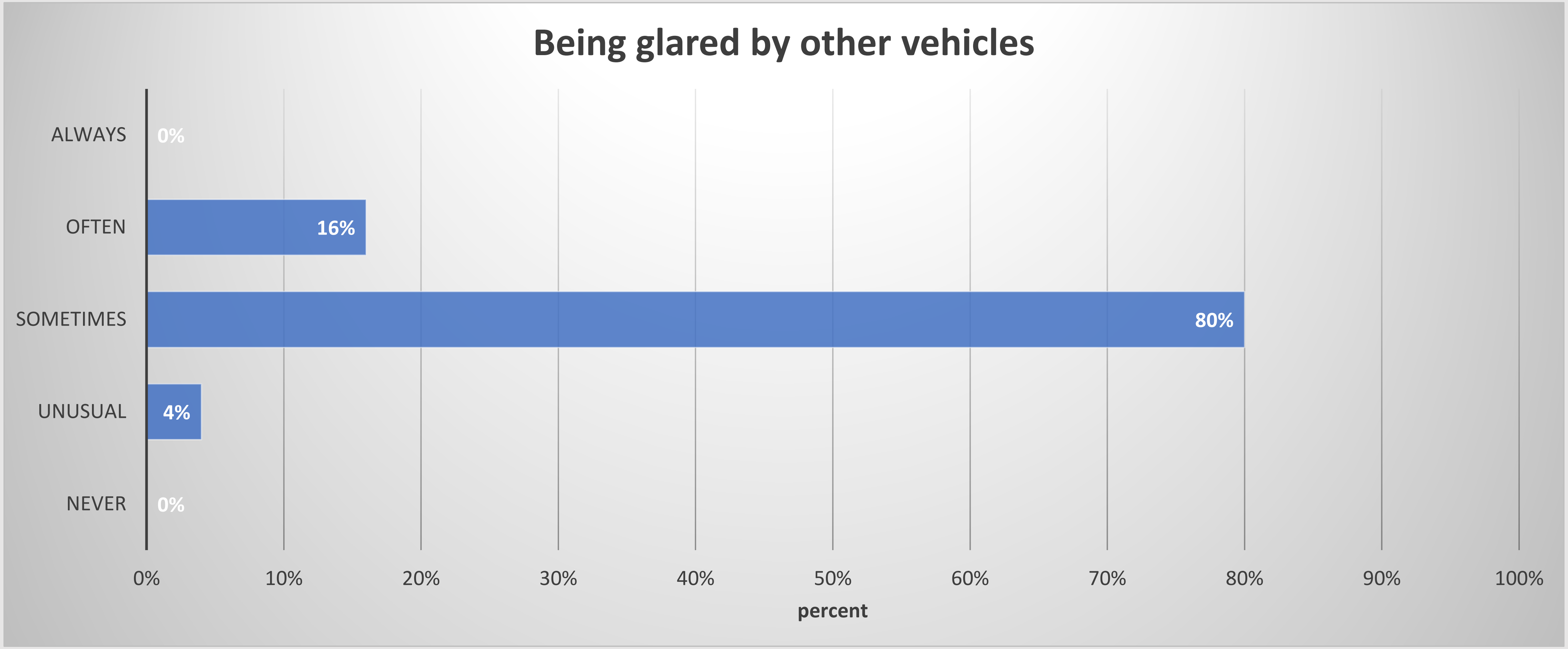
Feeling / being tired while driving at night



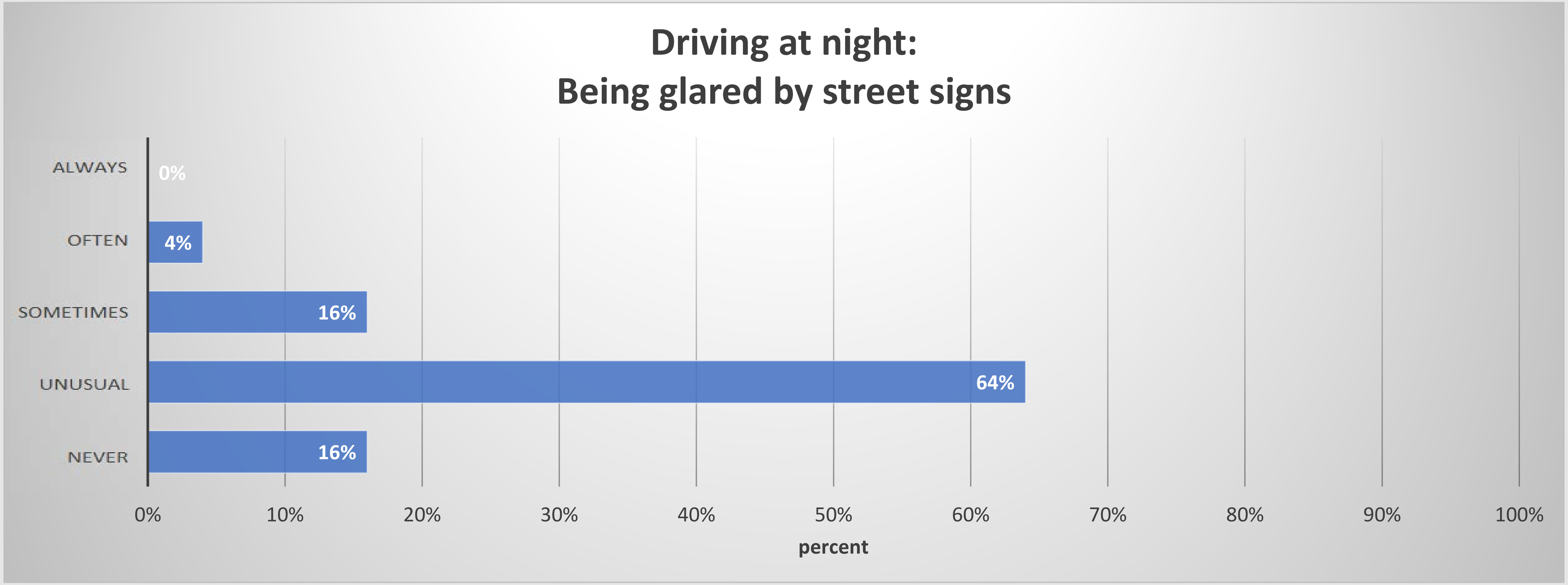
Poor visibility / sight in the darkness



Being glared by other vehicles



Being glared by street signs while driving at night



Summary

- Mainly used head lamp type → 48% Halogen
- Satisfaction with current HL system → 64% mainly
- Desire for better view → 96% yes!
- Mostly used street type (at night) → 59% Country roads
- Feeling stressed driving at night → 44% more than during the day
- Poor visibility driving at night → 36% often
- Feeling being glared by other vehicles → 76% often
- Feeling being glared by street signs → 64% rare

Prof. Dr. Dirk Meyer

Emiljano Bibleka, Marvin Dietermann

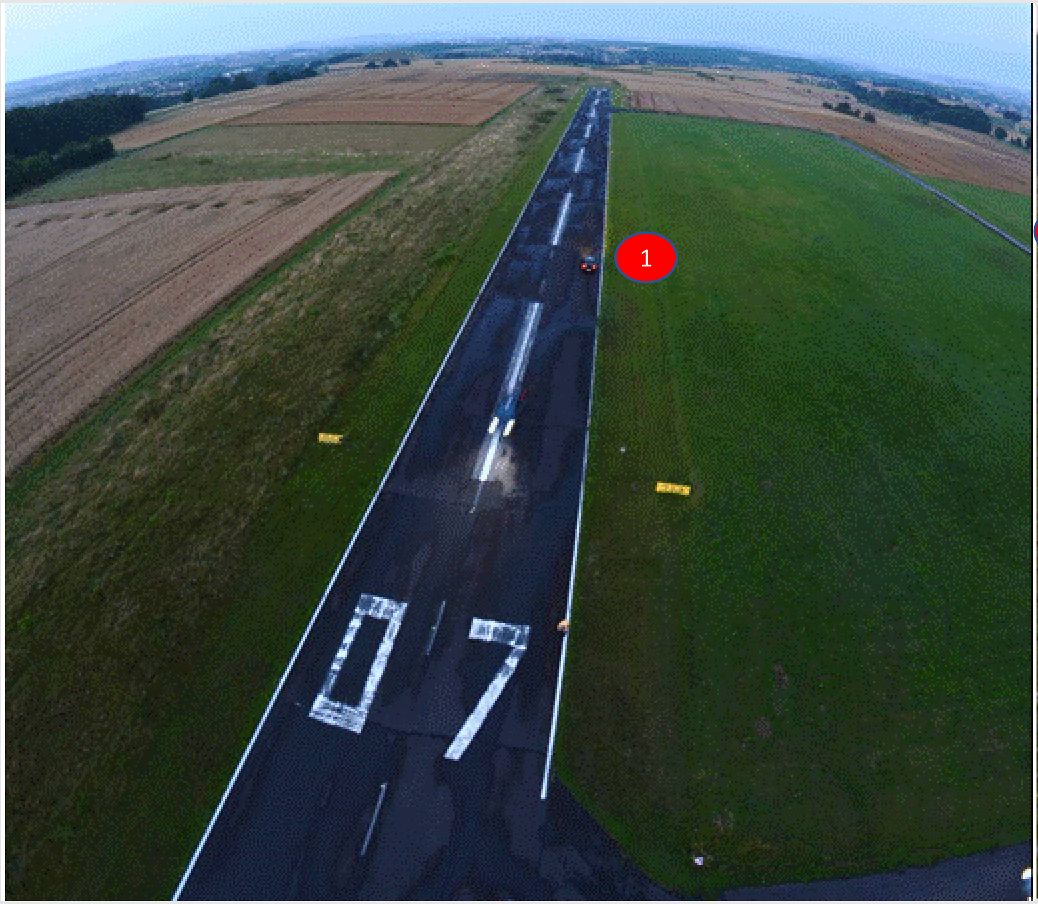
UAS-Gießen & Light Sight Safety

1. Volvo XC 60 (Xenon)
2. BMW 7er (LED)
3. BMW 5er (LED)
4. Opel Insignia (LED)
5. Volvo V90 (LED)
6. VW Touran (LED)
7. Mini Countryman (Xenon)
8. Seat Ibiza (Halogen)

- Red test cars lined up, representing the to be evaluated Head Lamp Syst
- Red cars to drive two times along track according to red flashes
- 2 x 8 and 1 x 5 (= 21) Test persons placed in white cars along runway (POS.1 – POS. 4)
- Test persons to evaluate "de Boer" amount of psychologic glare for the 8 test cars passing by twice at 70km/h, (seq1 and seq 2)
- After 2nd sequence, next 8 Test persons to enter white cars

Quelle: Google Maps

Vehicle POS. 1



Vehicle POS. 2, 3 & 4

- **2 Test runs**:

  a) each performed with for the test persons unknown, different switched on Head Lamp conditions:

  Low Beam (AL), High Beam (FL) or GFHB (IL)

- Test run 1:

  2 sequences on **dry runway**, repeated 3 times for in total 21 Test persons

- Test run 2:

  2 sequences on **wet runway**, repeated 3 times for in total 21 Test persons

- One Test person in Car 1 was wearing **Tobii Pro Eye Tracking** Glasses

Sequence of Vehicles and Headlamp system used

Nr.	Vehicle	Head Lamp System	1.Sequence	2. Sequence
1	Renault Twingo	Halogen	AL: Low Beam	FL: High Beam
2	Mini Countryman	HID AFS	FL: High Beam	AL: Low Beam
3	Opel Insignia	LED (IntelliLux MatrixLight)	IL: GFHB	AL: Low Beam
4	Volvo V90	LED ()	AL: Low Beam	IL: GFHB
5	Volvo XC60	HID (GFHB)	IL: GFHB	AL: Low Beam
6	BMW 5	LED (Selective Beam)	AL: Low Beam	IL: GFHB
7	BMW 7	Laser-Spot (Selective Beam)	IL: GFHB	AL: Low Beam
8	VW Touran	LED (Dynamic Light Assist)	IL: GFHB	AL: Low Beam

De boer skala „inverted

De Boer Scale „inverted“

- de Boer Scale from 1 to 9
- Smallest value >>> little to no glare

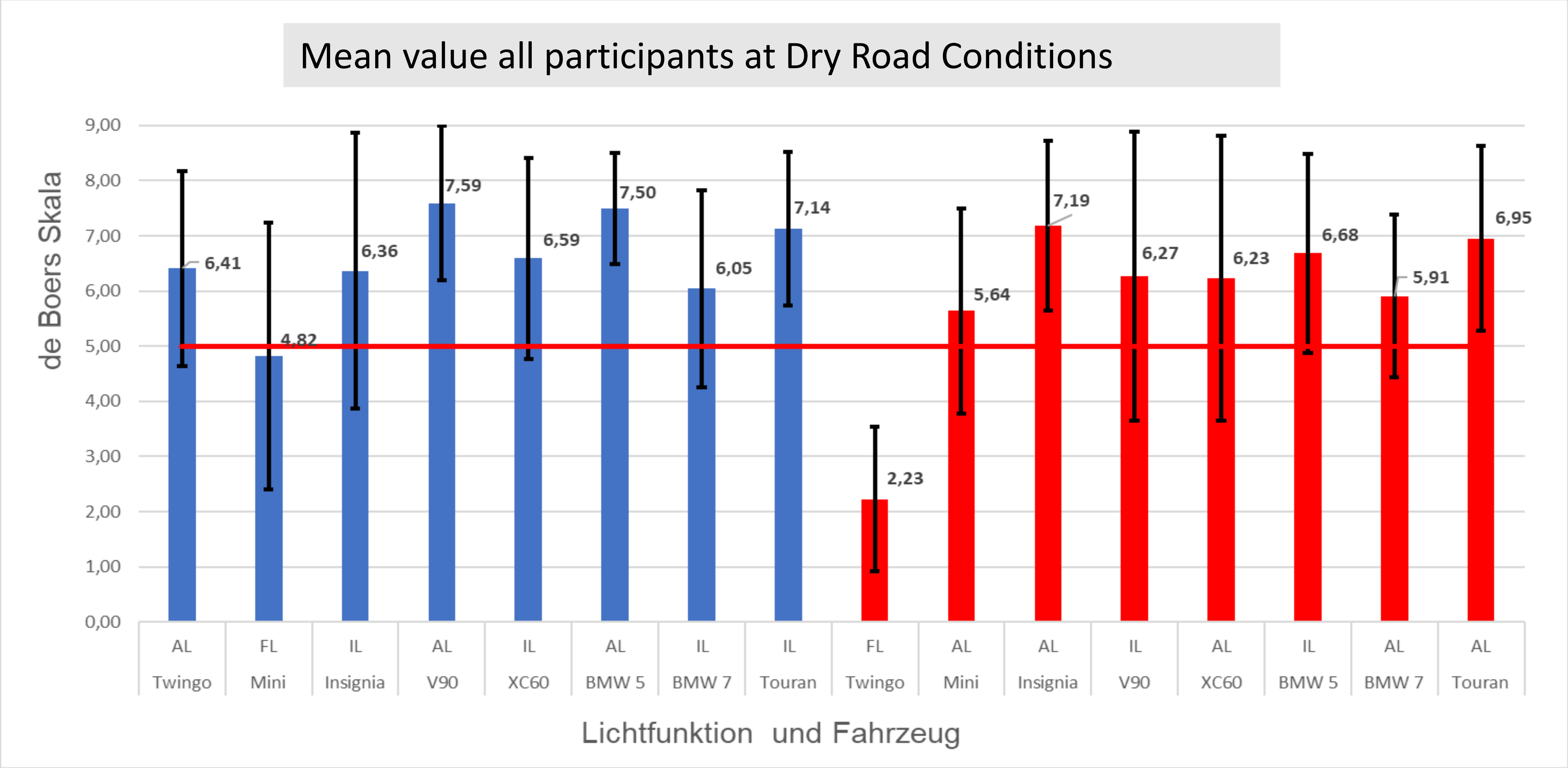
  Biggest Value >>> extreme glare
- Up to level 5 : acceptable
- Test person to give evaluation on form

1	Hardly noticeable
2	
3	acceptable
4	
5	Limit of being acceptable
6	
7	distracting
8	
9	Unbearable

9	Unnoticeable
8	
7	Satisfactory
6	
5	Just Acceptable
4	
3	Disturbing
2	
1	Unbearable

9	**Unnoticeable**
8	
7	**Satisfactory**
6	
5	**Just Acceptable**
4	
3	**Disturbing**
2	
1	**Unbearable**

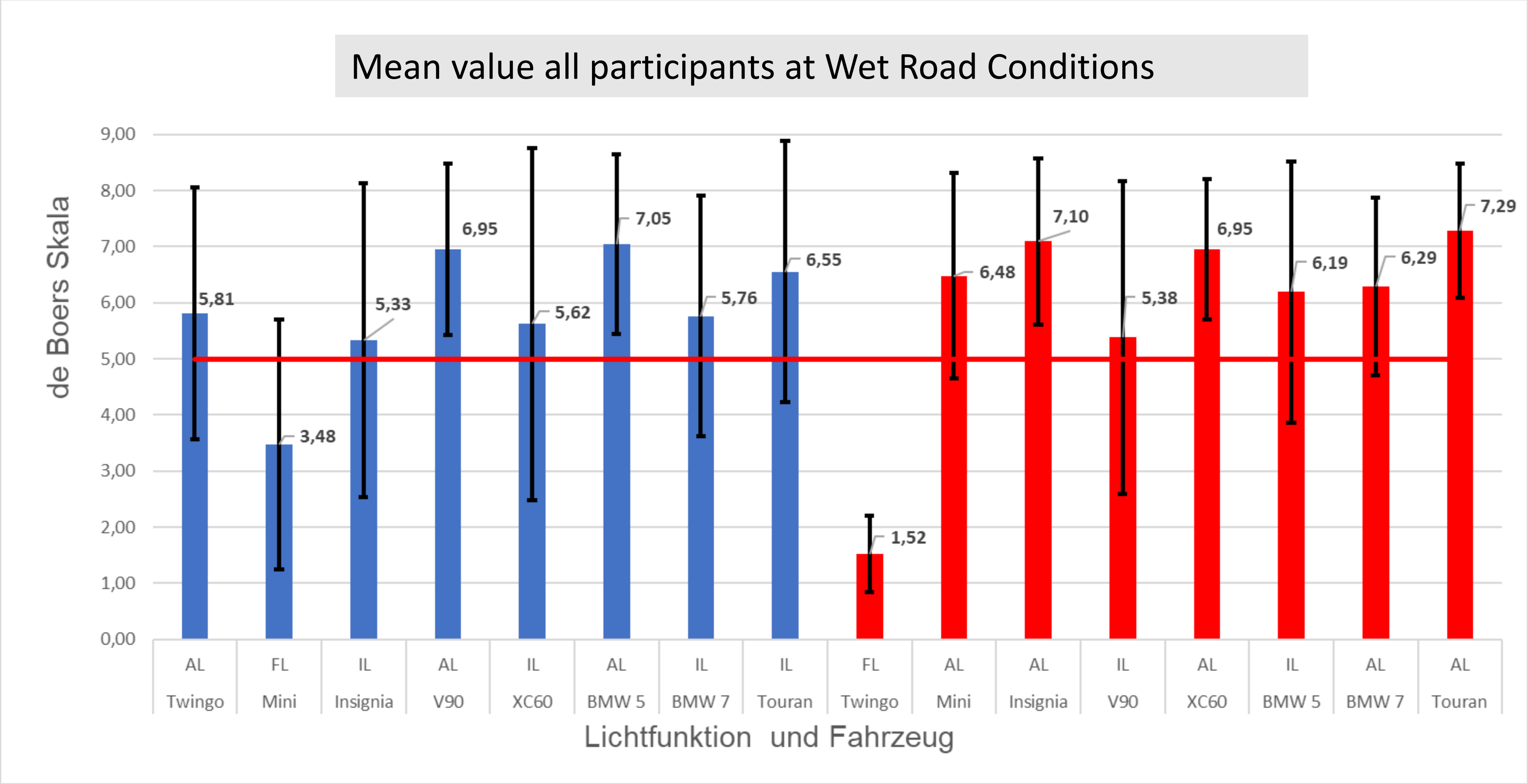
Average = 6,22 indicating high level of satisfaction in terms of perceived glare



Psychologic Glare at Wet Road Conditions

9	**Unnoticeable**
8	
7	**Satisfactory**
6	
5	**Just Acceptable**
4	
3	**Disturbing**
2	
1	**Unbearable**

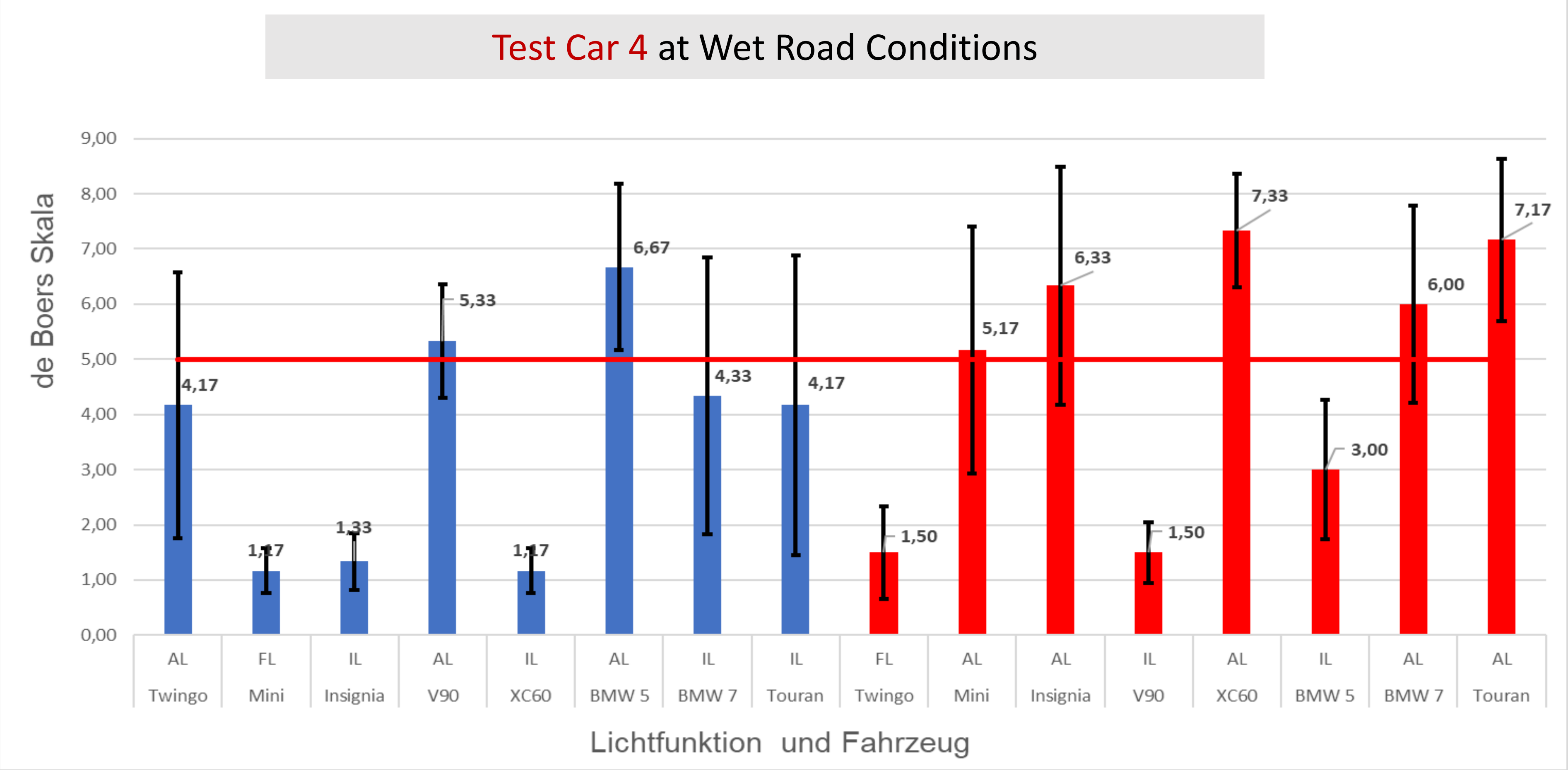
Average= 5,86 → 5,8 % lower than on dry runway, indicating more perceived glare



Car 4: Highest Values of psychologic Glare

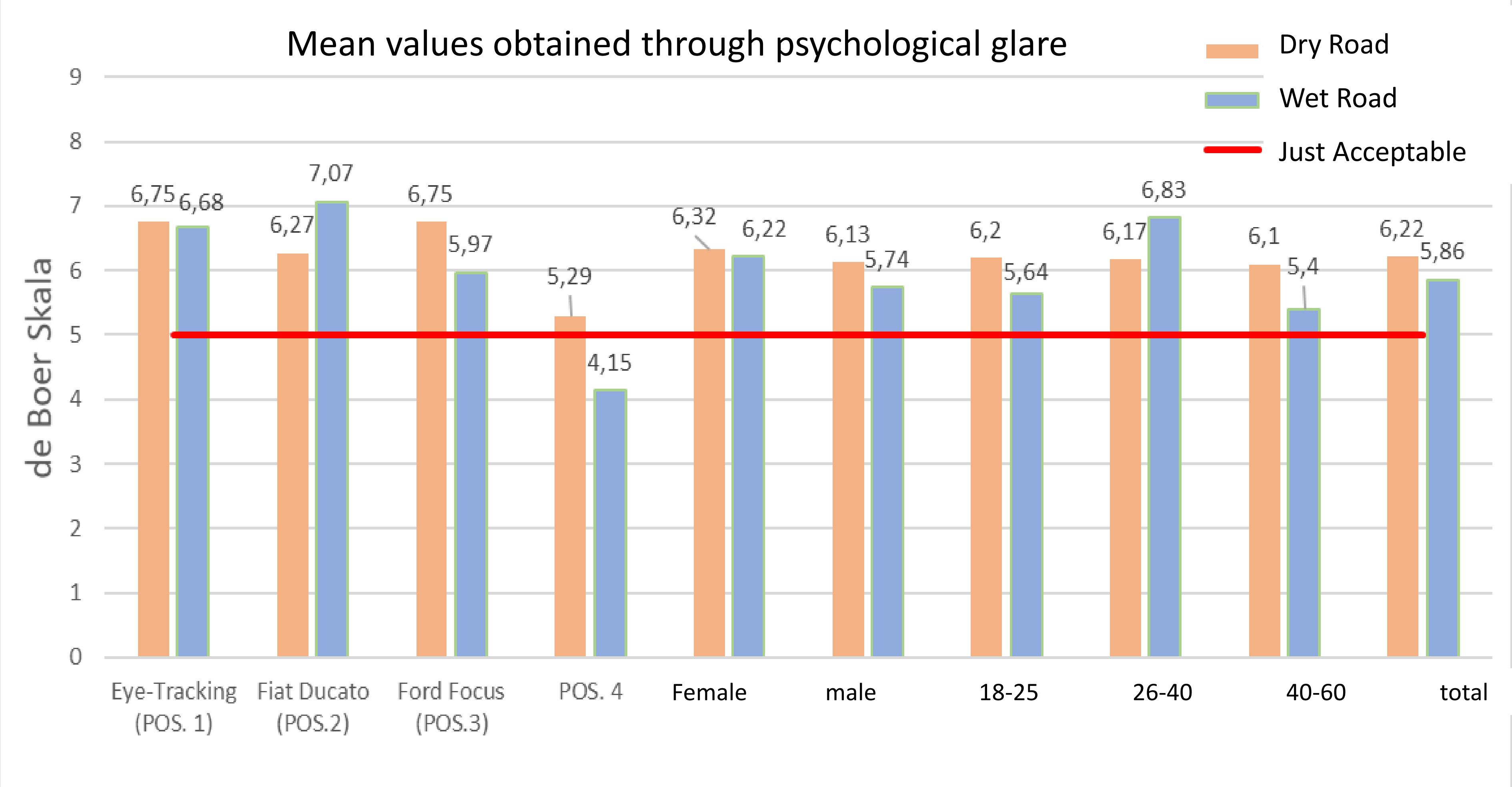
9	**Unnoticeable**
8	
7	**Satisfactory**
6	
5	**Just Acceptable**
4	
3	**Disturbing**
2	
1	**Unbearable**

Average = 4,15 → 33,3% lower evaluated by respondents placed in car 4



Summary of average values

9	Unnoticeable
8	
7	Satisfactory
6	
5	Just Acceptable
4	
3	Disturbing
2	
1	Unbearable

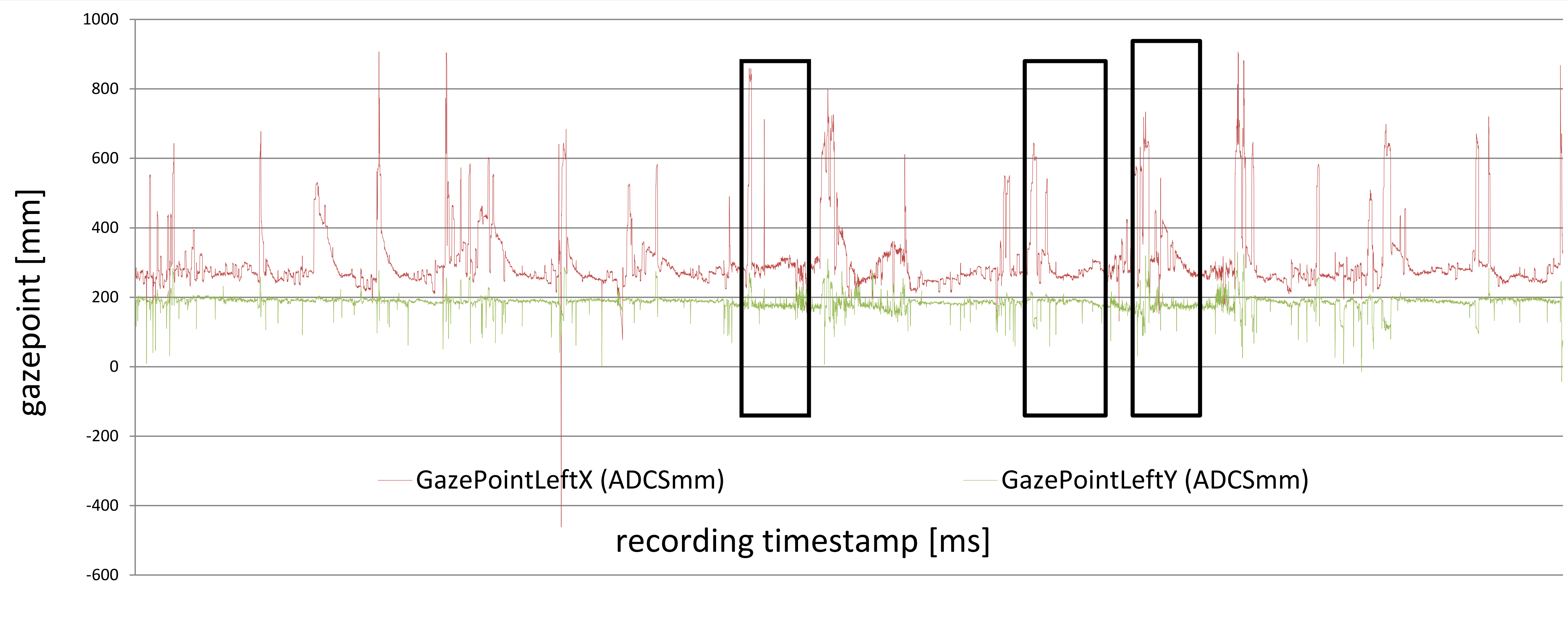


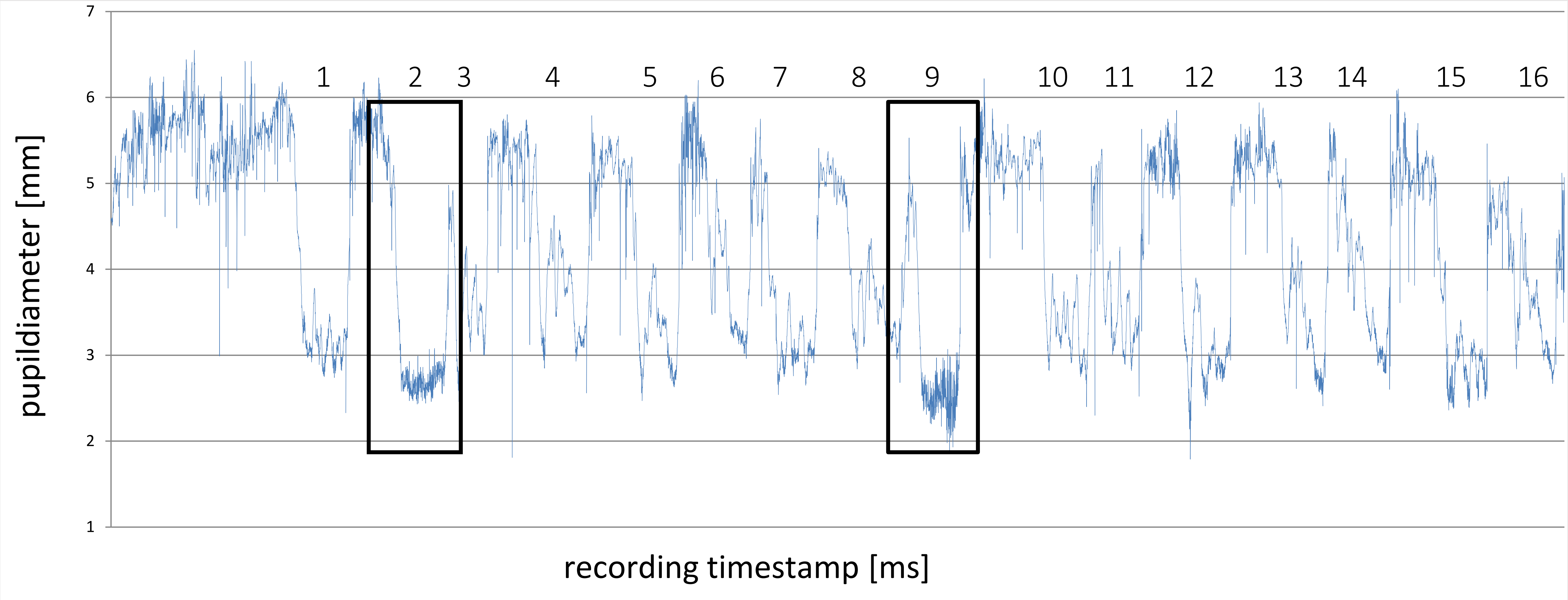
Summary of findings on Glare Analysis

1. No signs of perceived glare on **Dry Road Conditions** for **GFHB** Head Lamp systems
2. Very little perceived glare on **Wet Road Conditions** Only 10% more perceived glare recorded, but still at acceptable level
3. Perpendicular to oncoming traffic positioned cars (e.g. car 4) to experience **high** amount of glare (55% more) since **GFHB system cannot detect the car**. Advantages or Dis-advantages need to be investigated!
4. No effects on perceived glare in terms of gender or age

- Tobii Pro X2-30 eye tracker
  - used with Tobii Pro Studio software

source: https://www.tobiipro.com/imagevault/publishedmedia/cafs3ff3rsy0of3jdz44/TobiiPro_X2_Eye_Tracker_3_1.jpg


1000
800
600
400
200
0
-200
-400
-600
gazepoint [mm]
GazePointLeftX (ADCSmm)
GazePointLeftY (ADCSmm)
recording timestamp [ms]


pupildiameter [mm]
recording timestamp [ms]
7
6
5
4
3
2
1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

- **gaze points going downwards and to the right**:
  Test Person experiences GLARE
- Test Cars 2 (Mini Countryman HID high beam) & Test Car 8 (VW Touran LED high beam) caused **biggest change in pupil diameter**
- **pupil diameter** remains small over a longer period of time after cars 2 & 8 had passed

3) Dynamic Sign Detection

Prof. Dr. Dirk Meyer

Emiljano Bibleka, Marvin Dietermann

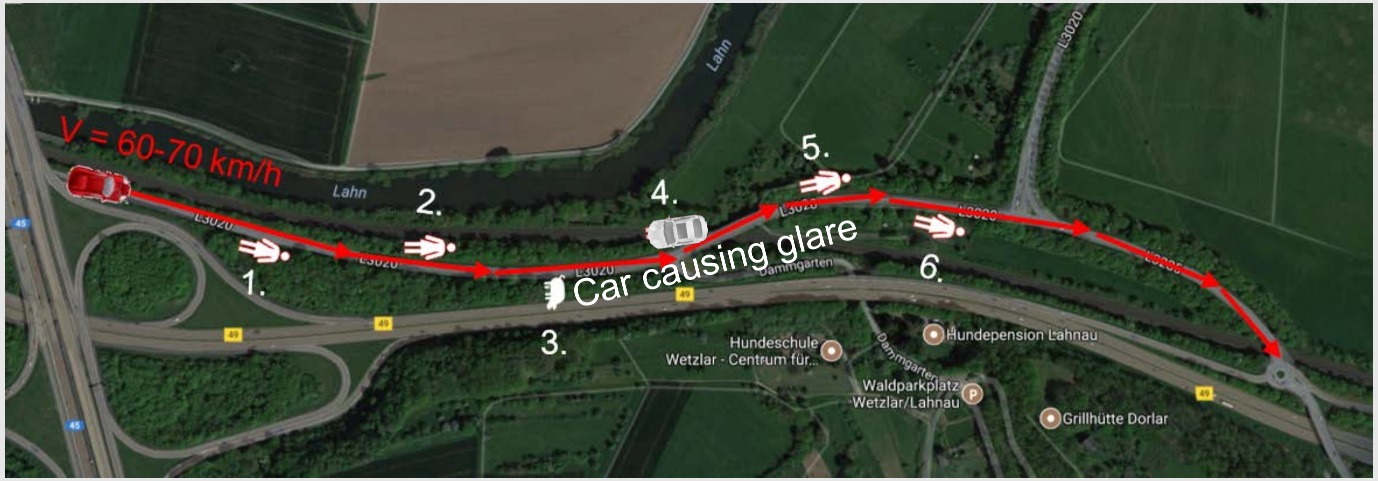
UAS-Gießen & Light Sight Safety

Dynamic Sign Detection

- Country road trip with detection of various objects placed left and right along the road (wild boar, doll and grey colored figures made out of wood)
- Test persons to drive with GLHB Systems
- Simulation of oncoming vehicles
- In Addition test persons to wear Eye Tracking systems

Dynamic Test: Setup

FIRST RUN:



SECOND RUN:

Quelle: Google Maps

- 9 Test persons to drive with:
  1. Insignia Low Beam
  2. Insignia GFHB
  3. XC60 GFHB
  4. BMW 7er GFHB
- In total 12 dummies to detect
- Detection distance to each dummy to be determined

Dummy 1 (Doll, to compare with grey plywood dummies)

Dummy 2 (grey plywood)

Dummie 3 (dark brown Wild Boar)

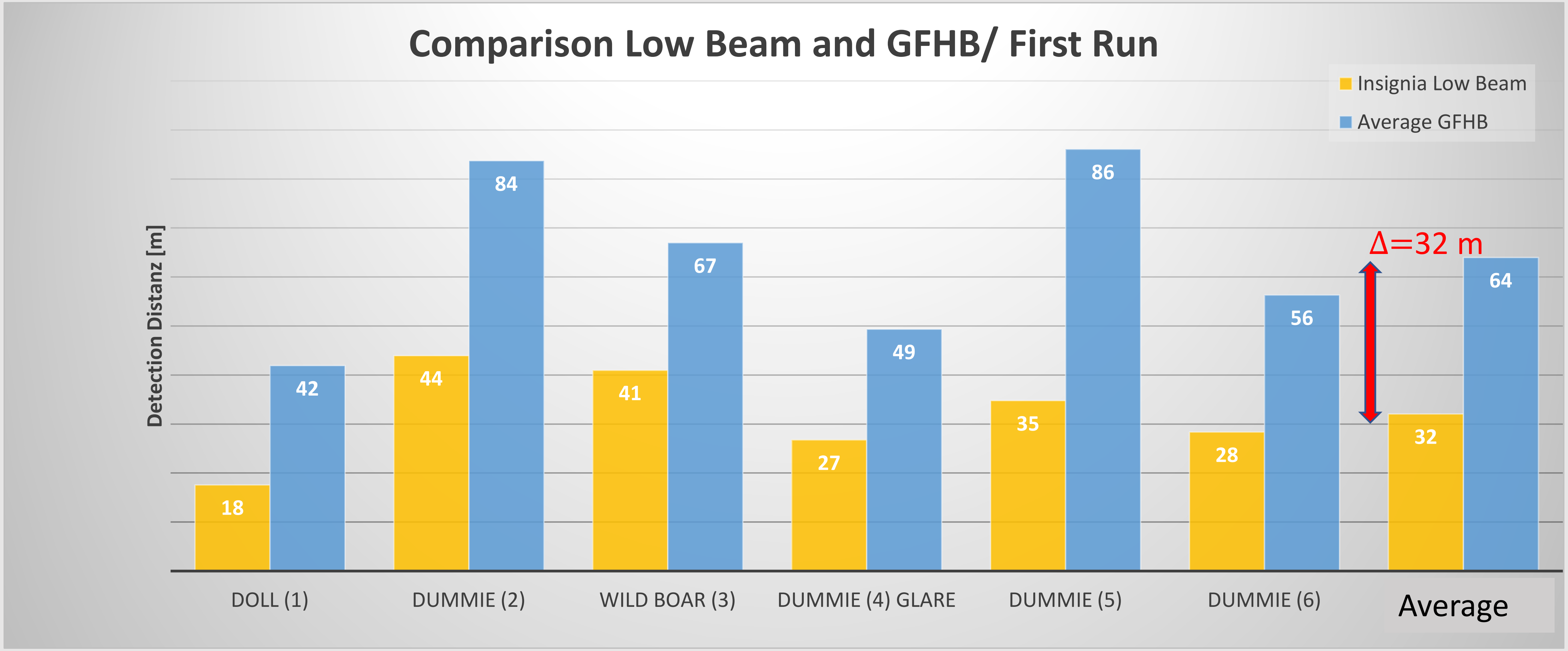
Dummie 4 (with Glare caused by car at rest)

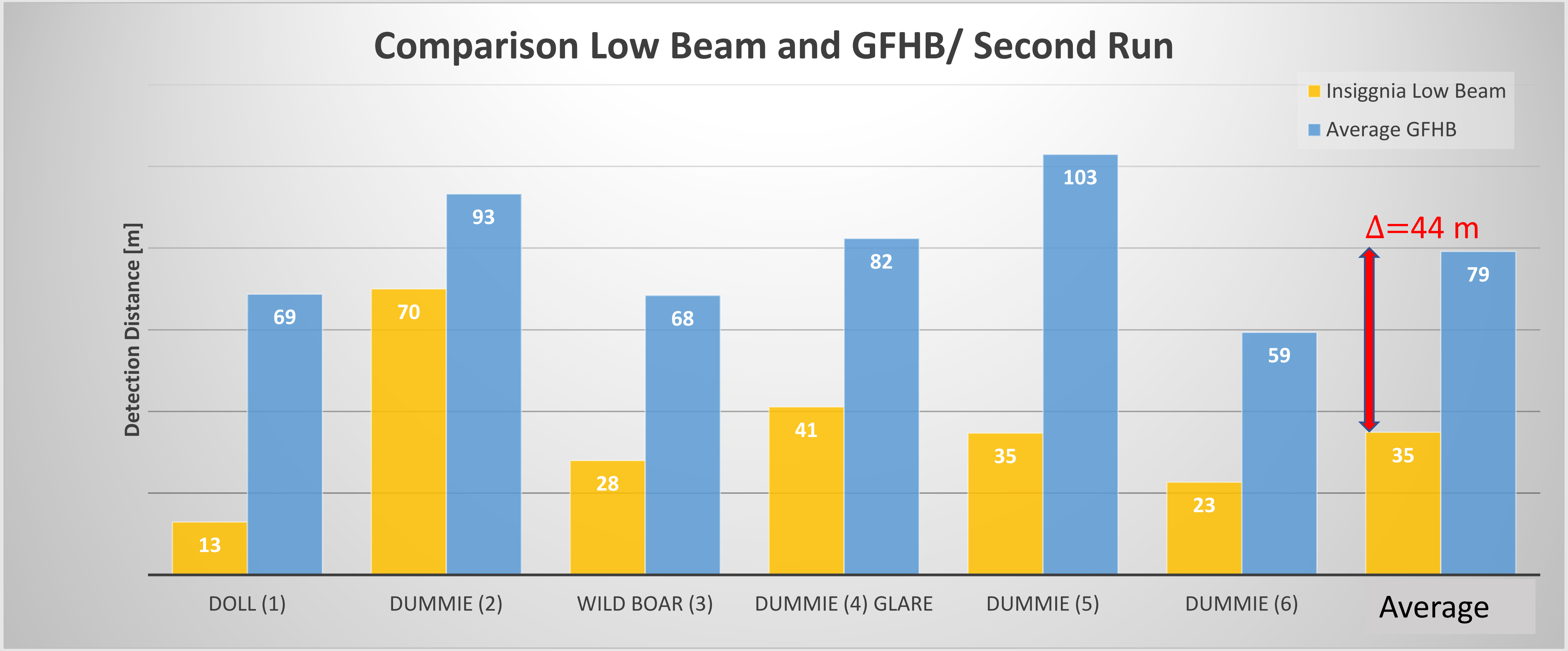
To be detected dummies

Dummy 5

Dummy 6

Comparison low beam and GFHB/ First Run




Comparison Low Beam and GFHB/ Second Run
Insiggnia Low Beam
Average GFHB
Detection Distance [m]
13
69
70
93
28
68
41
82
35
103
23
59
35
79
Δ=44 m
DOLL (1)
DUMMIE (2)
WILD BOAR (3)
DUMMIE (4) GLARE
DUMMIE (5)
DUMMIE (6)
Average

Conclusion

- Low Beam only is not enough to allow for necessary visibility at >70km/h

  → Too many accidents occur at night due to poor visibility

- Glare-free high beam does significantly increase ride comfort and safety

  →Oncoming traffic does not experience noticeable higher amount of glare

  →**On average visibility is twice as high using GFHighB**

- Potential customers need to be better informed about new headlamp technologies

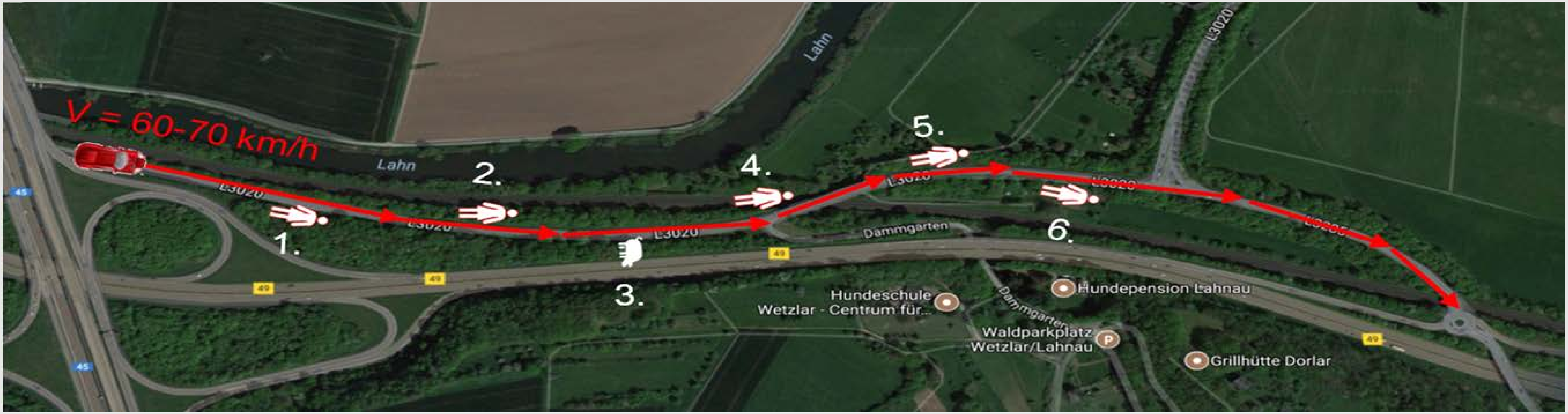
  → For example, test drive cars at night, dealers to start using Virtual Reality Tools!

Prof. Dr. Dirk Meyer

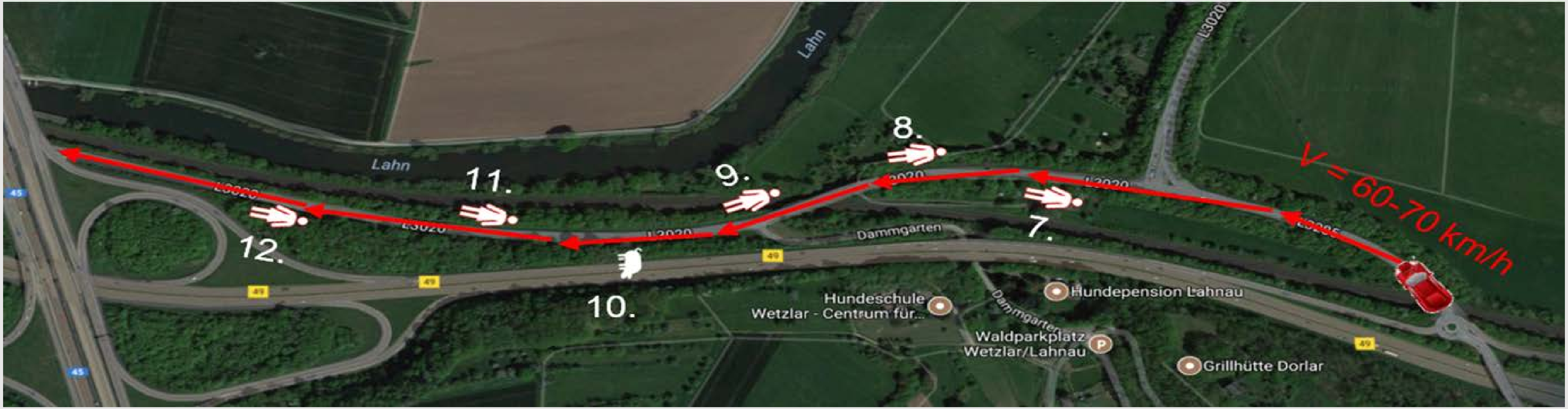
Lars Weck

UAS-Gießen & Light Sight Safety

test track 1 „way up“



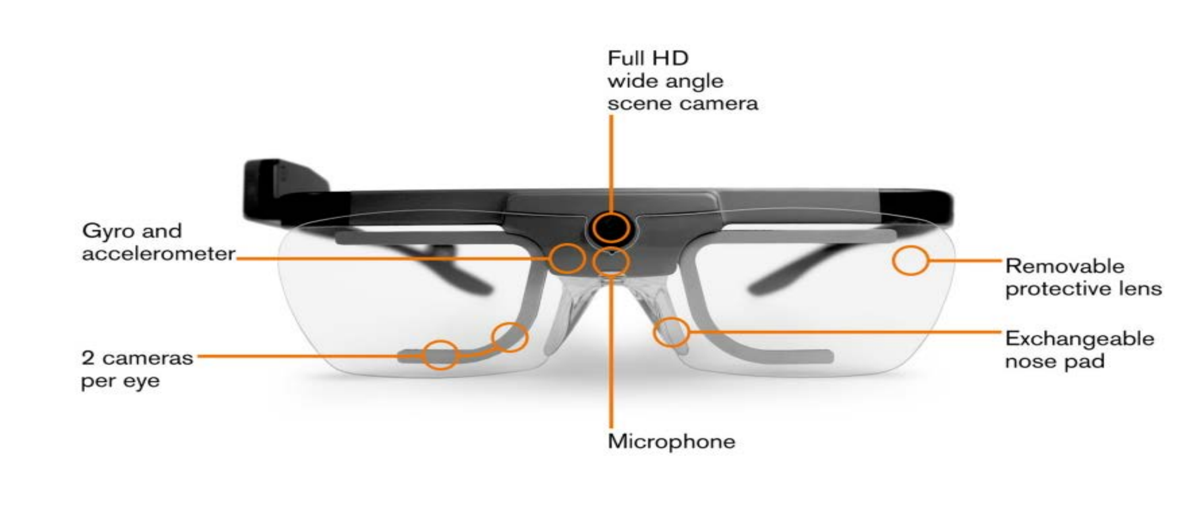
test track 2: „way back“



Experiment 3

- task:
  - 12 objects have to be detected by the driver, wearing the eye tracking glasses
  - velocity of the test vehicle has to be 60-80 km/h

- Tobii Pro Glasses 2
  - used with Tobii Pro Studio software



source:
https://www.tobiipro.com/imagevault/publishedmedia/i9of1ntsqe84c0p4f2qn/TobiiPro_Glasses_2_Eye_Tracker_side_3_1.jpg

- Tobii Pro X2-30 eye tracker
  - used with Tobii Pro Studio software

source: https://www.tobiipro.com/imagevault/publishedmedia/cafs3ff3rsy0of3jdz44/TobiiPro_X2_Eye_Tracker_3_1.jpg

Eyetracking Video Volvo XC60 HID Low Beam

Eyetracking Video Volvo XC60 HID Low Beam

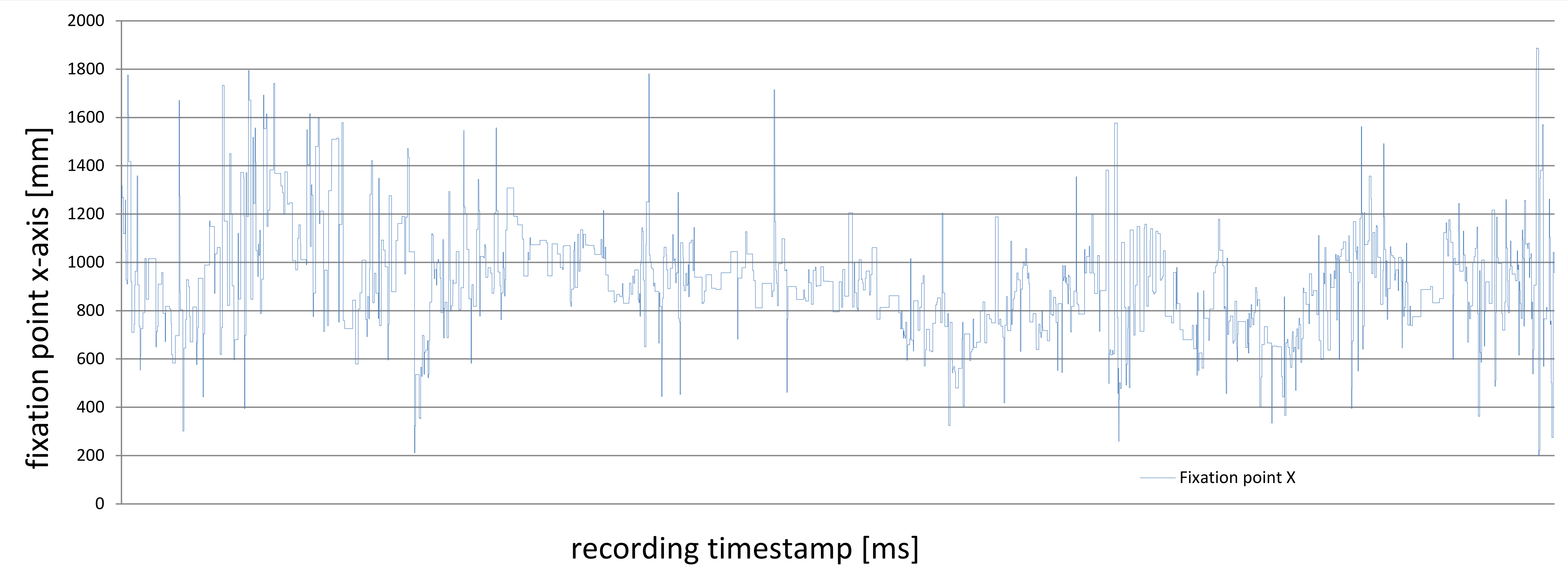

Start
1.
2.
3.
4.
5.
6.
Blendfahrzeug
Ziel
Hinfahrt

Light Sight Safety a CLEPA initiative

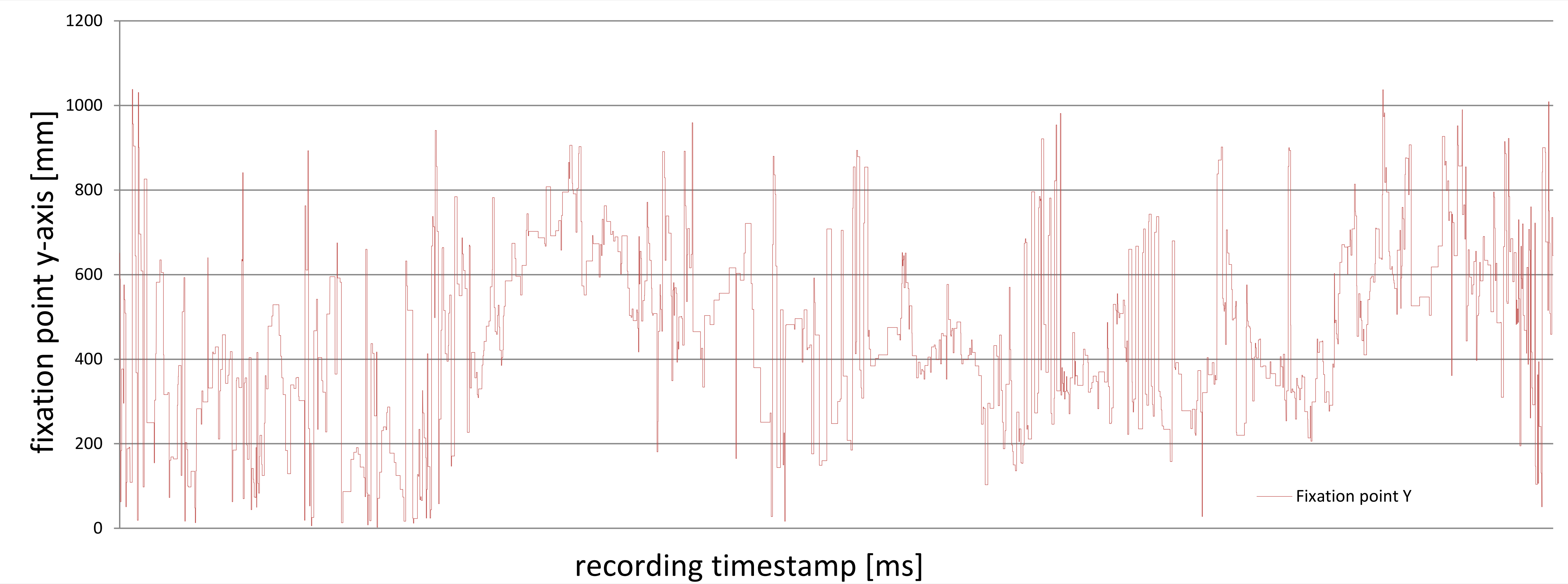
THM TECHNISCHE HOCHSCHULE MITTELHESSEN

Eyetracking Video Volvo XC60 HID GFHB

Fixation point X-axis



Fixation point y-axis



Findings of the experiment

- using GFHB systems the visibility of objects beyond the road limits is significantly improved
- drivers do look over the side limits of the road while using GFHB systems
- With GFHB systems being switched off, drivers focus only within the limits of the road or the limits of the Low Beam beam pattern respectively
- Psychological signs of glare noticed with Eye Tracking System (oncoming traffic using Low Beam)
- More detailed Analysis on Psychological Glare possible with Eye-Tracking System

Question and Answers

Thank you

Q & A…?