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Importance of Auto-Levelling to avoid Glare for Road Users

GTB Field Test

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- Thanks to TU Darmstadt, Dipl. Ing. Bastian Zydek
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- Thanks to GTB / GRE participants
- Thanks to car makers

Project within GTB TF CAVGS

Agenda

Glare and Visibility

Presentation of first results on discomfort glare

Test Set-up

Boundary Conditions

Selection of vehicles

Selection of loading conditions

Selection of subjects

Analysis and next steps

Introduction

- Influencing Paramters for discomfort glare in Night Time Driving * :

- - Initial aiming of the headlamps
- - geometry of the road
- - weather conditions
- - dynamic behaviour of vehicle

* : GTB Lighting ForumTorino 1/2011

Introduction

- **and** loading condition of vehicles

- Report of statistical analysis of cars involved in accidents (France) :
-
  – **Accidental data : EACS + EDA**
  - ✓ **74% of cars involved in an accident have an empty trunk**
  - ✓ **21% of cars involved in an accident contain 0 - 40kg in the trunk**
  - ✓ **4% of cars involved in an accident contain 40 - 100kg in the trunk**
  - ✓ **0,5% of cars contain 100 - 190kg in the trunk**

DEKRA Test Track Klettwitz (Lausitzring)

Test Conditions - Glare Cars

- ## Glare Cars
  - 25 in total: 24 with different loading conditions, 1 calibration car
  - 12 with Halogen (2 projection, 10 reflection), 8 with HID and 4 with LED headlamps

- ## Glare runs
  - 0 % loading: 23 runs by 23 cars
  - 50% loading: 25 runs by 24 cars
  - 100% loading: 4 runs by 4 cars
  - Calibration car: 10 example and 4 check runs
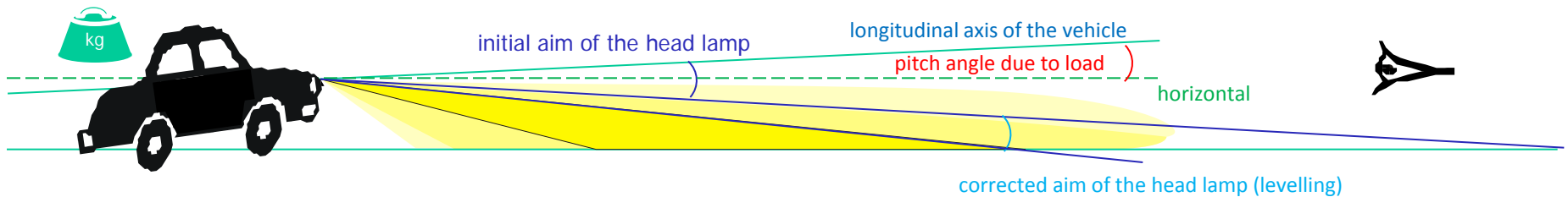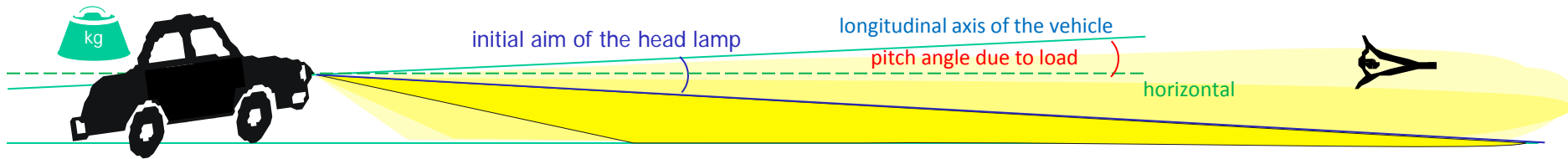 - 66 runs in total

Test Preparation : Vehicles

- All vehicles have been preprared with:
- Initial aiming (1%) on 10m wall

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- Initial aiming (1%) on 10m wall

- Same tire pressure

- Cleaned windshield , headlamp

- 90% gas filling

- Existing automatic levelling devices switched off

- Loading process via: driver, co-driver, rear seats, trunk

- Measurement of the pitch angle

- Constant speed used (80km/h) when passing subjects sitting in cars for evaluation (no acceleration or decellaration effect) , plane road

Pitch due to load
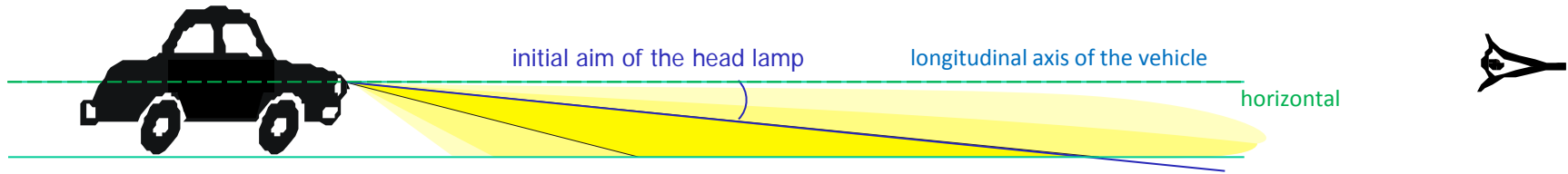
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Questionaire - de Boer Scale

Discomfort Glare Rating – (Please perform rating from top to bottom)

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

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

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List of Participating Vehicles for Discomfort Glare Evaluation

GlareVehicleName / Headlamp / Light SourceType

Mercedes E Klasse (for calibration and check of stability)	HID
Ford Mondeo	HID
Ford Focus Combi	HID
VW Tiguan No. 1	HID
Toyota Yaris	Halogen
VW Touran	HID
Renault Twingo	Halogen
Renault Megane	Halogen

List of Participating Vehicles for Discomfort Glare Evaluation

GlareVehicleName / Headlamp / Light SourceType

Renault Scenic	Halogen
Mercedes CLS	LED
VW Tiguan No. 2	HID
Citroen C4	LED
BMW E60 (5 series)	LED
Opel Astra	Halogen
VW Golf	Halogen
VW Beetle	HID

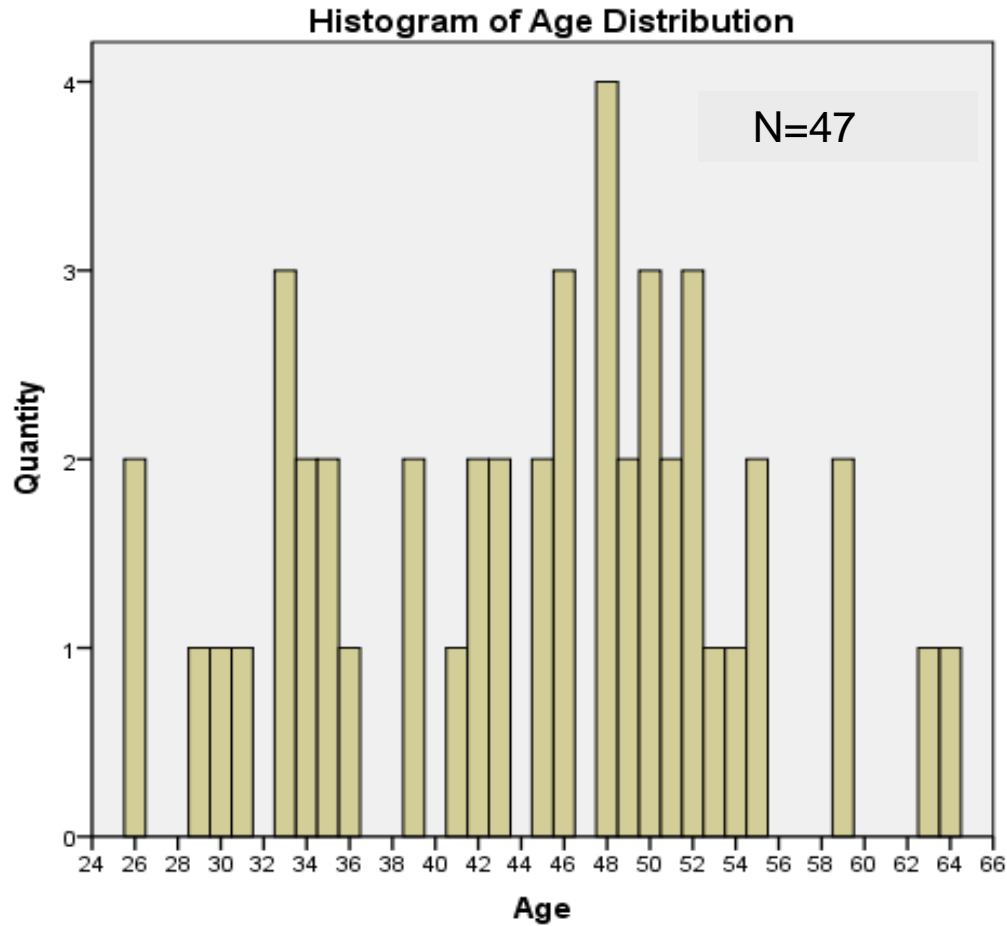# List of Participating Vehicles for Discomfort Glare Evaluation

GlareVehicleName / Headlamp / Light SourceType

Mercedes C-Class Coupé	Halogen
Audi A7	LED
BMW X3	HID
BMW 3-series	HID
VW T5	Halogen
Landrover Freelander	Halogen
Peugeot 508	Halogen
Citroen C5 Break	Halogen
Focus Combi	Halogen

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Test Conditions - Subjects

- 47 subjects in total (majority experienced lighting experts)
- 24 in driver and 23 in co-driver seating position
- 4 female and 43 male subjects
- 19 without and 27 with glasses,
  1 with contact lenses
- Approx. 2800 ratings
  performed
- Age distribution:
  - Mean age is 44,5 years
  - Median age is 46 years
  - Range is 26 – 64 years

Subjects: Age Distribution

Histogram of Age Distribution

N=47

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Results for Halogen, Xenon, LED
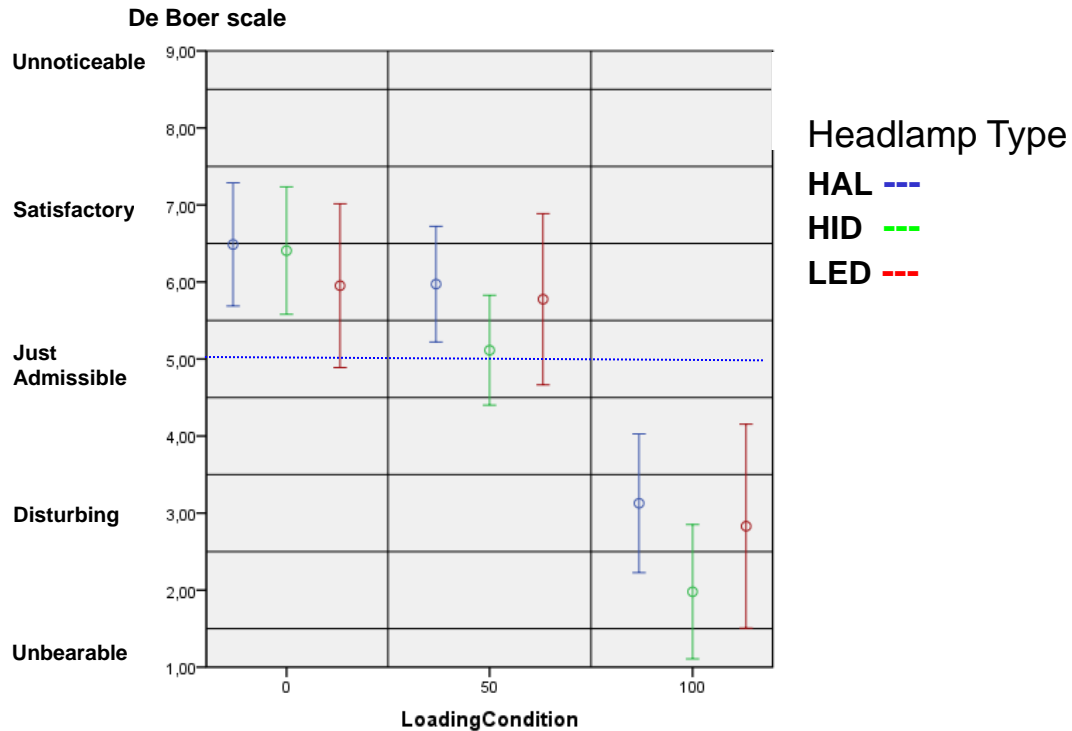
* Width of the bars covers app. 70% of all ratings

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Results for all light sources

Histogram: Pitch with 50% loading

N=25 vehicles tested

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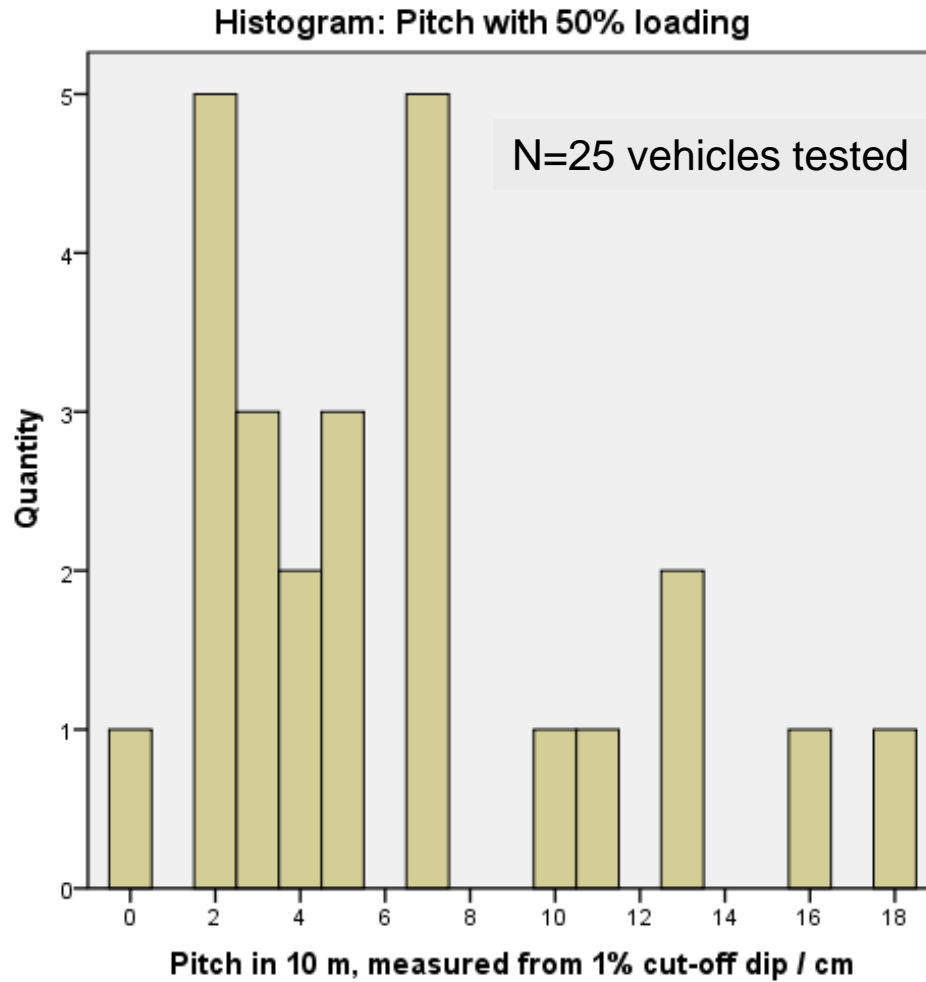
Pitch Angle Results
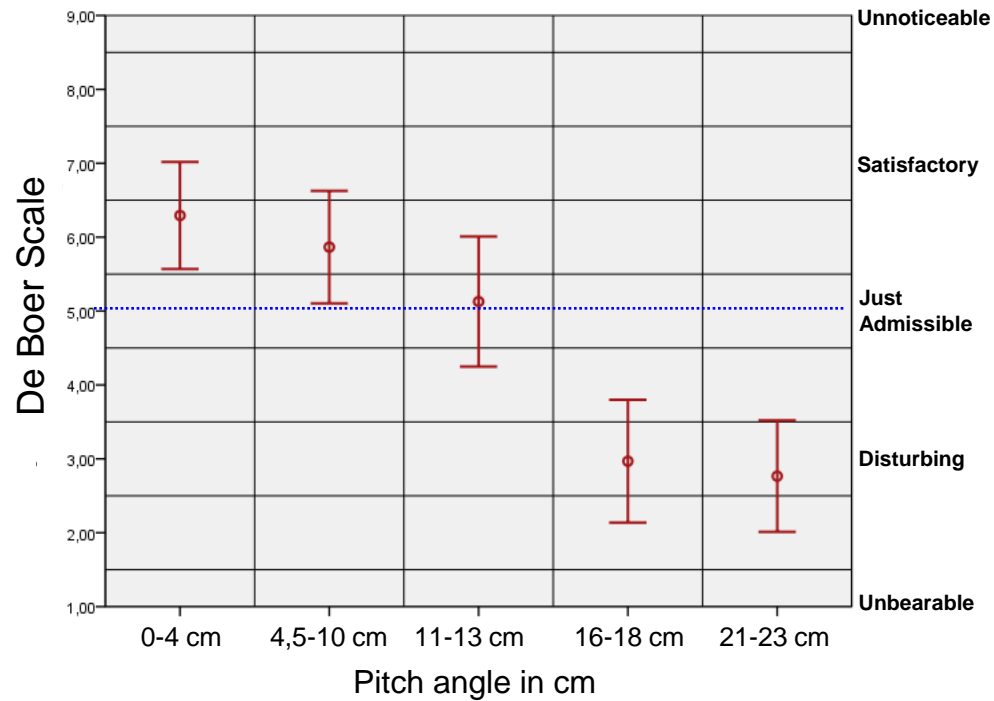
* For all light sources and loading conditions

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Summary and Results

- First field test in this size (66 runs, 47 mainly experienced subjects) for evaluating discomfort glare with various loading conditions

- Consistency in the individual opinions

- Light source is not primary criterium for classifying request of auto-levelling

- Pitch angle is a very robust indication for the need of auto-levelling

- Loading conditions between unloaded and 50% loading do not justify an auto-levelling system

Driver vs. Co-Driver
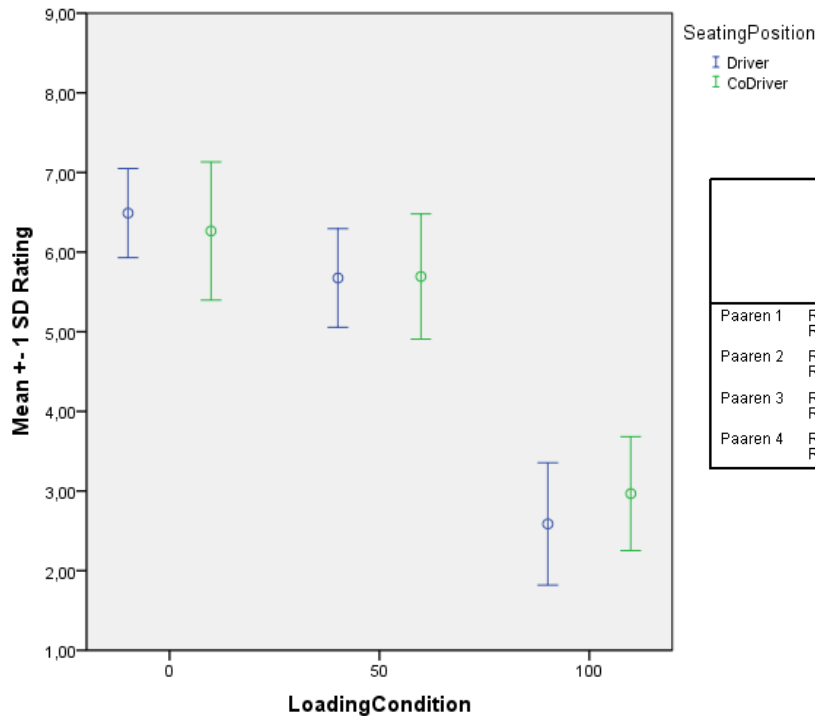
Test bei gepaarten Stichproben

		Gepaarte Differenzen			99% Konfidenzintervall der Differenz				
		Mittelwert	Standardabweichung	Standardfehler des Mittelwertes	Untere	Obere	T	df	Sig. (2-seitig)
Paaren 1	Rating0Driver - Rating0CoDriver	,22448	,85737	,17877	-,27944	,72840	1,256	22	,222
Paaren 2	Rating50Driver - Rating50CoDriver	-,01913	,87227	,18188	-,53181	,49355	-,105	22	,917
Paaren 3	Rating100Driver - Rating100CoDriver	-,38043	1,03866	,21657	-,99091	,23004	-1,757	22	,093
Paaren 4	RatingDriver - RatingCoDriver	,03746	,78019	,16268	-,42110	,49602	,230	22	,820

- No significant difference between ratings of driver and co-driver in all loading clusters
- No significant difference between ratings of driver and co-driver in all ratings independent on clustering

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Subject stability over test

- Stability checked by control car with same loading. The control car drove two times in the first as well as in the second halftime of the test. Subjects did not know (should not know) that a control car was used:

Run	1	2	3	4
De Boer	5,52	4,79	4,77	4,57
St. Deviat.	1,19	1,43	1,25	1,56

  ➢ The values show that the subjects behave stable over the test. The anomaly of the first value can be explained by the fact, that the test supervisor did accidentally announce the first control car over walkie talkie.

- Car number 25 did, by mistake of organization, drive two times with 50% loading. This gives us a second look on stability:

Run	1	2
De Boer	5,94	6,06
St. Deviat.	1,24	1,41

  ➢ Again the values are relatively close which shows that stability is given.

Next Steps

- Discuss necessity to include 100% loading
- Investigate correlations to corresponding light values of the headlamps tested
- Develop classification criteria to replace

  2000 lm definition and general light source categorization

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