

Motorcycle conspicuity in a changing environment



Motorcycle conspicuity in a changing environment

draft version
1.5

Topics

- ACEM policy on conspicuity
- AHO
- Accident research
- Research project
- Conclusions
- **Next steps**

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Developments leading to the Conspicuity project:

- Various publications on poor conspicuity;
- Increasing and future mandatory use of DRL on cars;
- World wide harmonisation of lighting Regulations (ECE/WP29/GRE).

ACEM Policy on Conspicuity

- *short term*

AHO (automatic headlight on)

- *medium term*

Research project

- *long term*

use of ITS / Telematics

AHO (automatic headlight on)

- Motorcycles without headlight are extra vulnerable when all other motorcycles have light on;
- AHO:
 - Motorcycles: improve conspicuity by avoiding rider forget to switch headlight on.
 - Mopeds: introduce riding with light on during daytime.

Note:

- *The use of headlight during daytime by motorcyclists:*
 - *since 1993 in the Vienna Convention on road traffic.*
 - *mandatory in A, B, CZ, D, DK, E, EST, F, G, H, I, L, LT, LV, P, S, SF, SK and SL.*

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AHO (automatic headlight on)

ACEM member manufacturers equip motorcycles and mopeds with AHO since 2003.



(old) manual switch



(new) automatic switch

Previous research: MC accidents

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Previous research: MC accidents (Vis, 1995)

collision avoidance action?

<u>action</u>	<u>MC</u>	<u>car</u>
nothing	26%	72%
braking	51%	17%
steering	12%	5%
accelerating	2%	1%
other	<u>9%</u>	<u>5%</u>
total	100%	100%

see the other party?

	<u>MC</u>	<u>car</u>
yes	70%	25%
yes, but too late	20%	20%
not at all	5%	50%
unknown	<u>5%</u>	<u>5%</u>
total	100%	100%

Previous research: PTW accidents (cont'd)

In depth accident research MAIDS n=921:

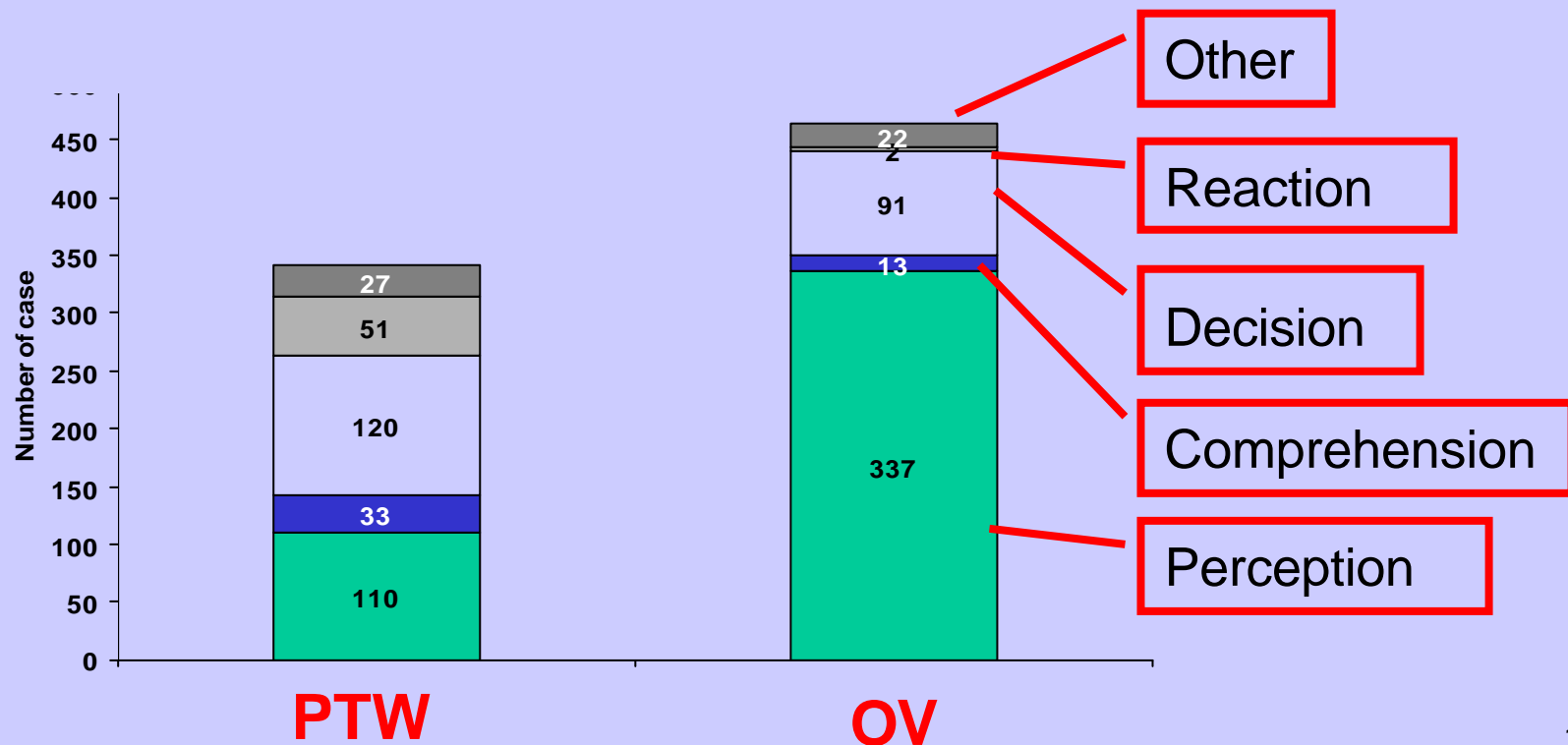
- 73% Daylight,
- 90% Clear weather,
- 86% Light or moderate traffic (no congestion),
- 71% Bearing of OV from PTW between 11-1 o'clock,
- 80% Vehicle to vehicle collision,
- 89% Motorcycles headlamp on,
- 59% Mopeds headlamp on.

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Previous research: PTW accidents (cont'd)

In depth accident research MAIDS n=921:

- 37% perception failure by OV (opposing vehicle);
- 72% of all OV errors is perception failure (n=464).



Previous research: PTW accidents (cont'd)

- **OV driver perception failure is the main consideration for the improvement of PTW safety.**

The research project

- Objectives
- Methodology
- Examples of data
- Conclusion

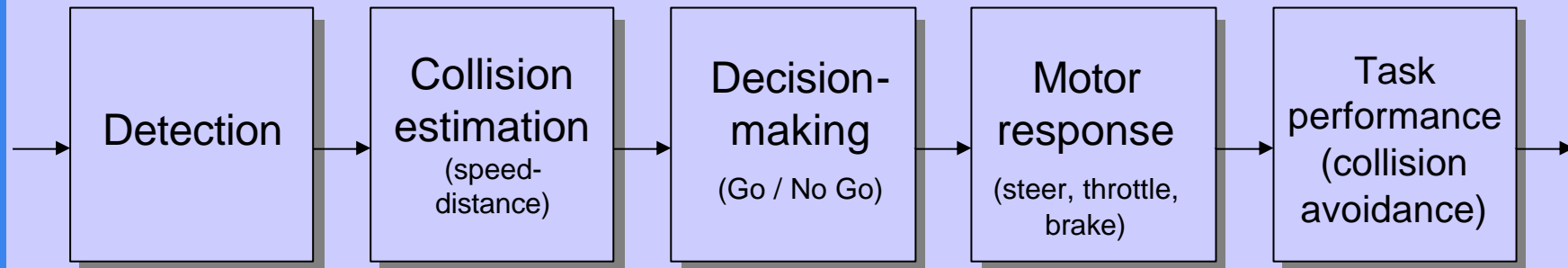
Objectives of the research project

- To reduce accidents between cars and powered two wheelers (PTWs):
 - Which will be operating increasingly in a car daytime running lights (DRL) and PTW automatic headlamp-on (AHO) environment;
 - By means of further increases in the conspicuity of PTW lighting systems (beyond AHO).



Methodology

- Use of a “Human behavior framework”
 - Reference: Hart et al (1997), NASA MIDAS model



- Most past research focused on “Detection” only, self-reported by subjects
- Ideally, one should measure the output of each functional block, especially “Task performance” ➡ Behavioral conspicuity”

Methodology

- The methodology used a Driving Simulator involving:
 - Naturalistic driving
 - Full-task driving
 - “Blind” experiments
 - **Exactly repeatable traffic and lighting conditions**
 - **Use of real accident scenarios, possibility of collision or near-collision**
 - Photometrically calibrated lighting treatments
 - Full-scale validation using driver “glimpse detection” tests

Methodology: Driving Simulator

- All Tests are run in a Driving Simulator
 - 180 deg view
 - 11 DOF motion base
 - Interactive steering, braking, throttle controls
 - Graphics
 - High speed
 - Textured surfaces
 - Calibrated lighting model
 - Complex road scenes
 - Motions of other vehicles
 - Can measure all motion and control states



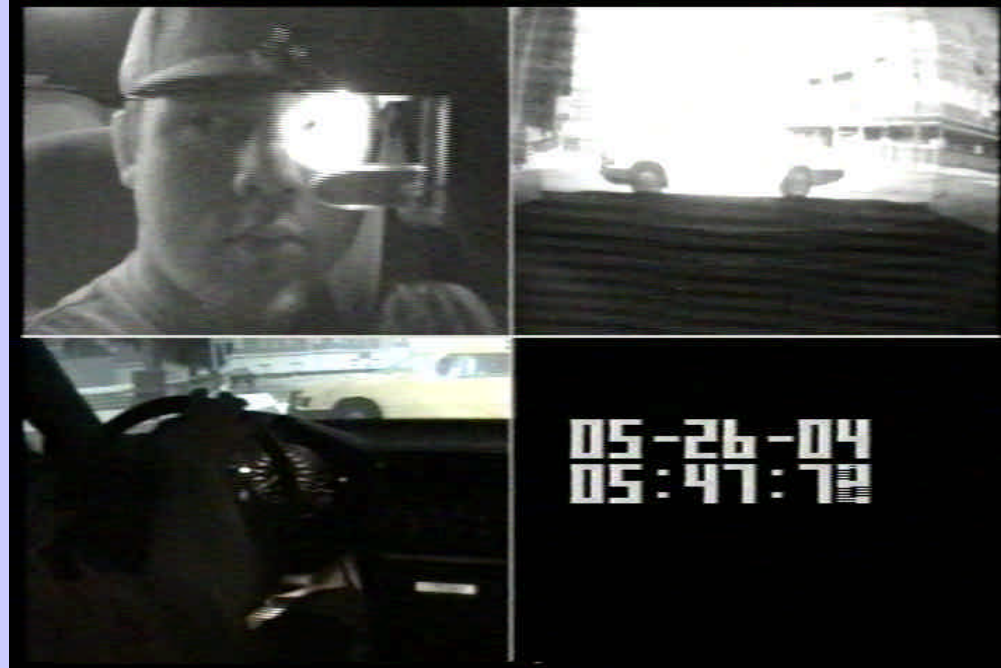
Methodology: Subject protocols

- All driver subjects are given the same specific instructions for consistency
 - **“Drive as quickly and safely as possible through the road course”**
 - **Speed limits** imposed on various portions of the road circuit
 - Driver subjects performed **secondary tasks** between intersections
 - **Reward/penalty** instructions so as to maintain proper speeds
 - Systematic **verbal feedback** was provided to drivers so as to achieve a **“Moderate GO” rate**, since no information would be gained from “Always GO” (e.g., long gap) conditions or “Never GO” (e.g., short gap) conditions

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Measurements (cont'd)

- 2 video recordings are taken:
 - Split image of driver face, forward road scene, and cab interior
 - Head-mounted camera view, associated with infrared eye tracker, with eye fixation crosshair superimposed on road scene (see next slide)



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Measurements (cont'd)

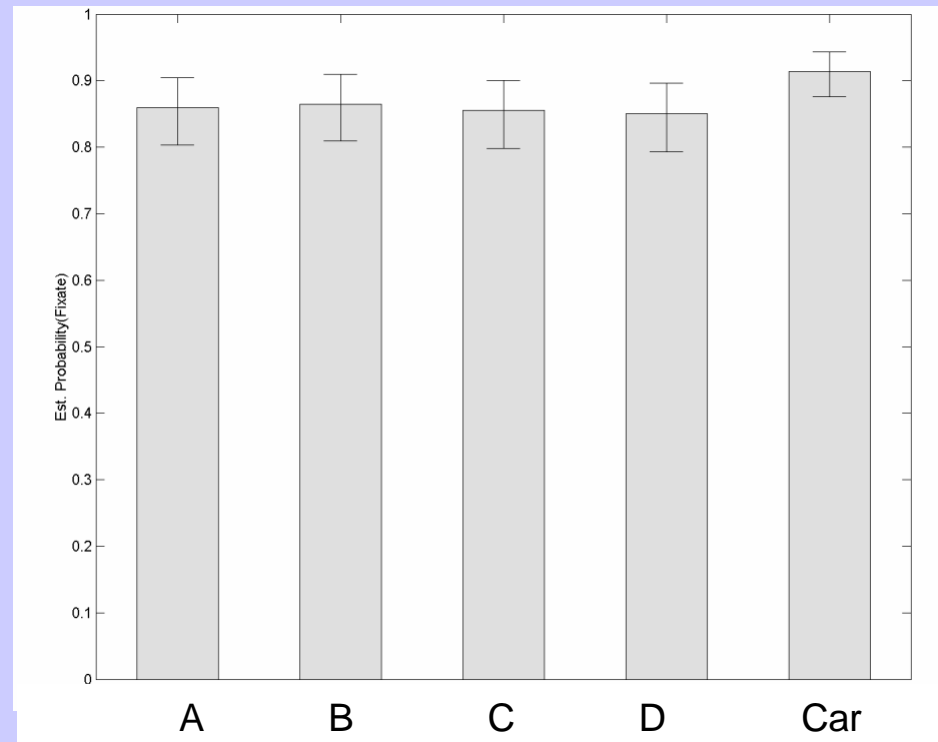
- View from head-mounted camera, through side window, driver fixating on PTW



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Example data: eye fixations

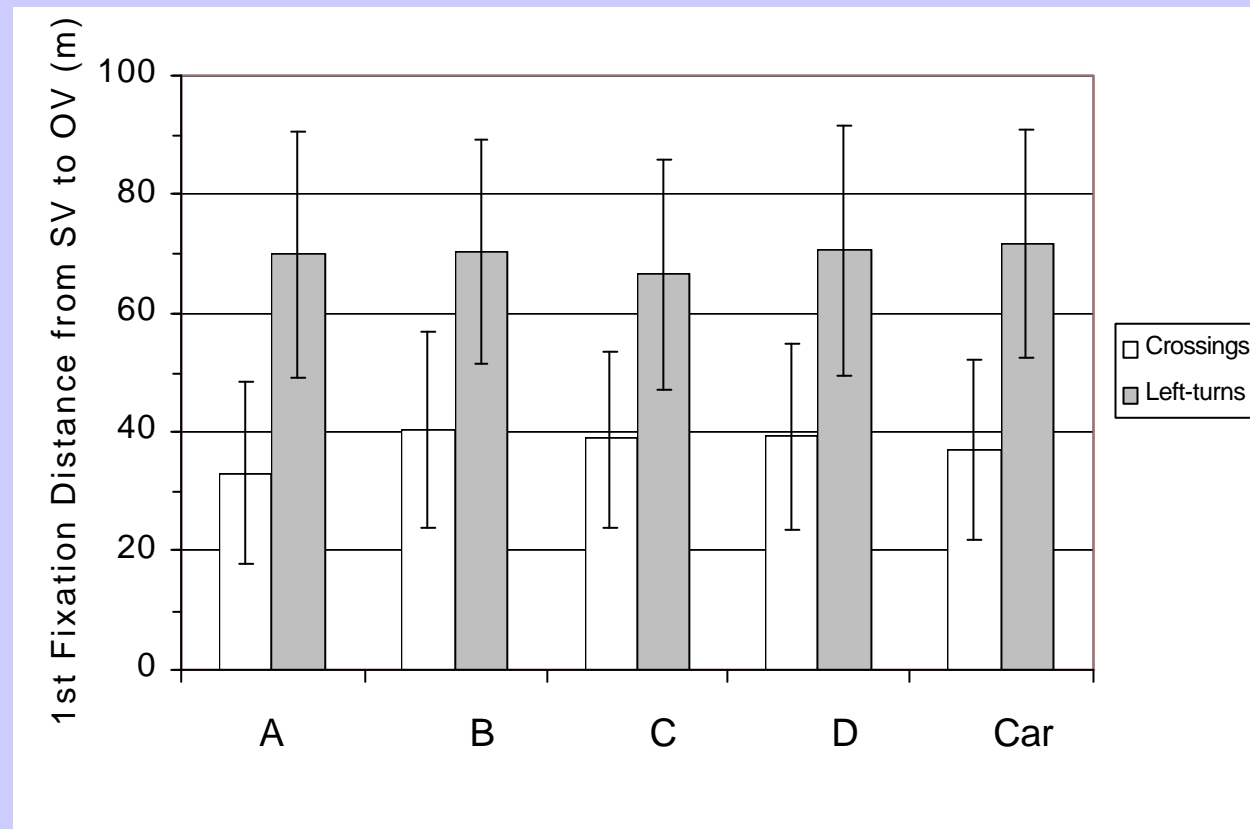
- Probability of Eye Fixation on Opposing Vehicle
 - Small differences in probability of fixation for example treatments
 - Probability of eye fixation is significantly lower than car for Trts. C ($p=0.04$) and D ($p=0.03$)



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Example data: eye fixations

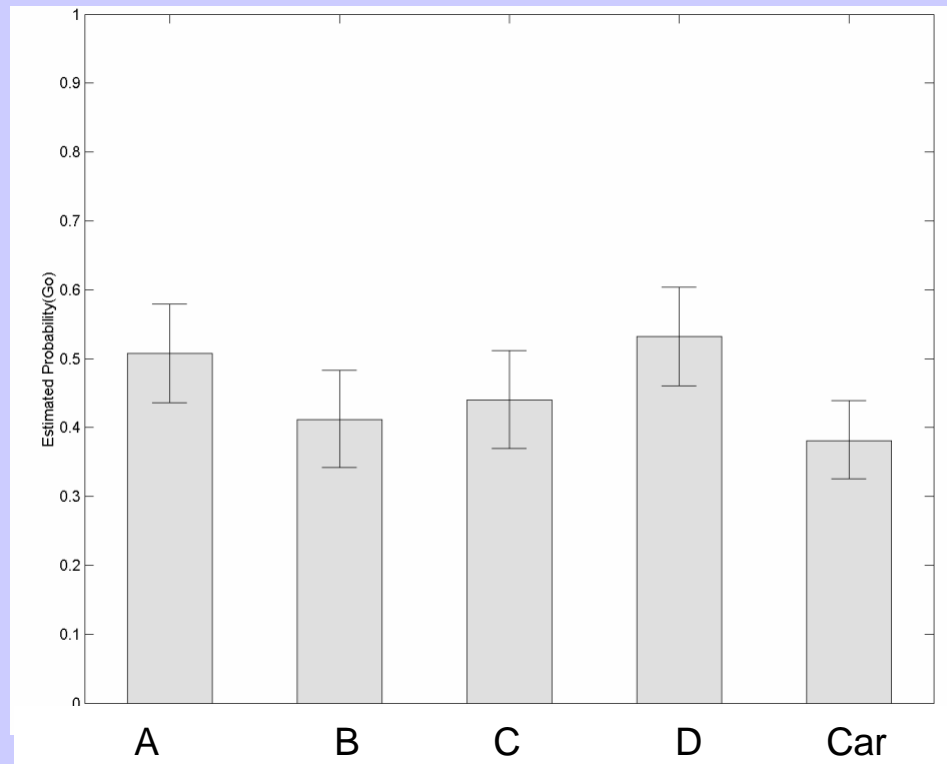
- Distance at 1st Fixation on Opposing Vehicle
 - At crossing intersections, Trt. A was fixated at a slightly shorter distance than other PTW treatments



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Example data: probability of "GO"

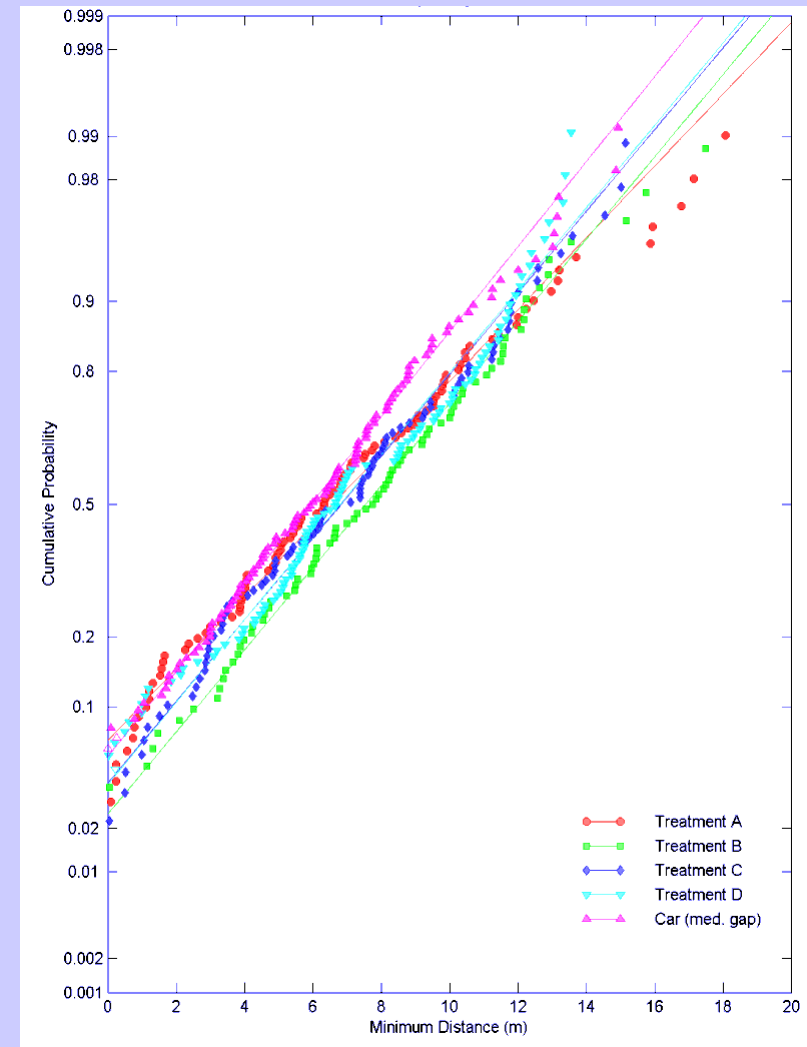
- Effect of Treatment on P(GO)
 - Cars had a significantly lower probability of “GO” than Trt. A ($p=0.005$) and Trt. D ($p=0.001$)
 - Trt. B had a significantly lower P(GO) than Trt. D ($p=0.016$)



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Example data: minimum distance

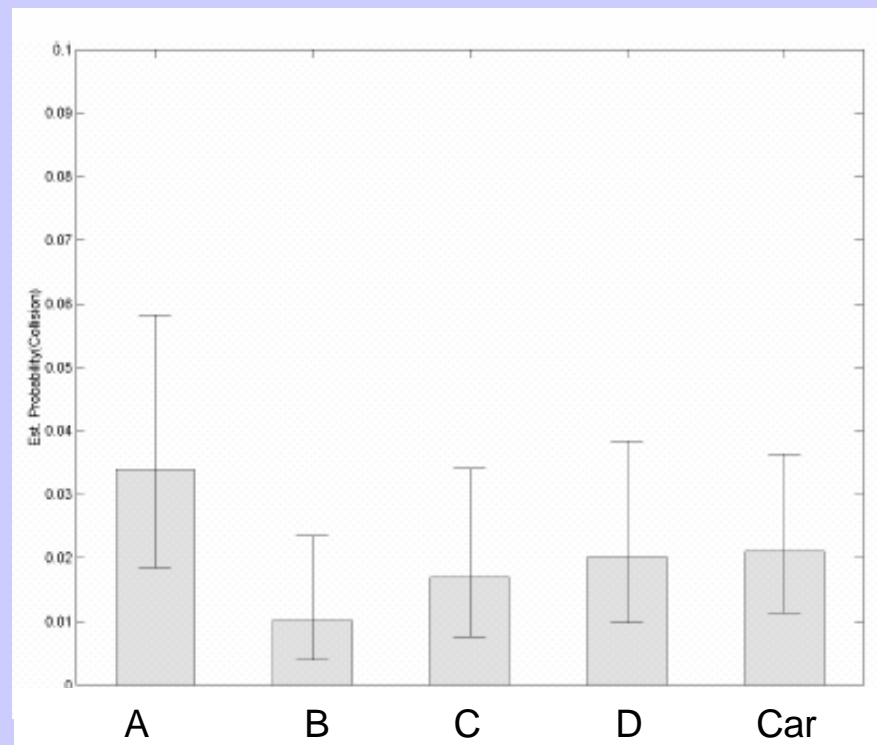
- **Distribution of minimum distances to Opposing Vehicle, "GO" conditions only (all intersection types)**
 - Linear trend indicates “normal distribution,” can accurately estimate zero intercept (=collision probability)
 - Trt. A had greatest probability of probability of collision and “near misses”
 - Trt. B had least probability of collision and near misses



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Example data: probability of collision

- Overall probability of collision for each treatment
 - Trt. A had the greatest probability of collision (significantly greater than Trt. B and Car)
 - Trt. B had the least probability of collision (significantly different from Trt. A)



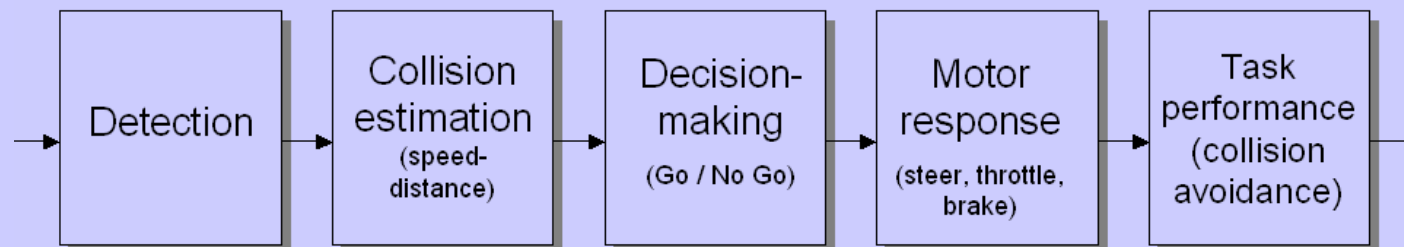
Conclusions

- The Driving Simulator methodology used provides a powerful tool for researching differences:
 - In driver behaviour due to PTW lighting treatments
 - In a sample of real-world accident scenarios and visual environments
 - In terms of driver probabilities of detection, “GO” and collision
- The Driving Simulator methodology might also be useful for the evaluation of other safety technologies, such as Telematics and E-safety

Conclusions (cont'd)

- For some lighting treatments:
 - Probability and distance eye fixation: no significant differences
 - Probability of collision: significant differences
- It is important to consider not only the detection, but the...

← **complete task** →



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Next steps

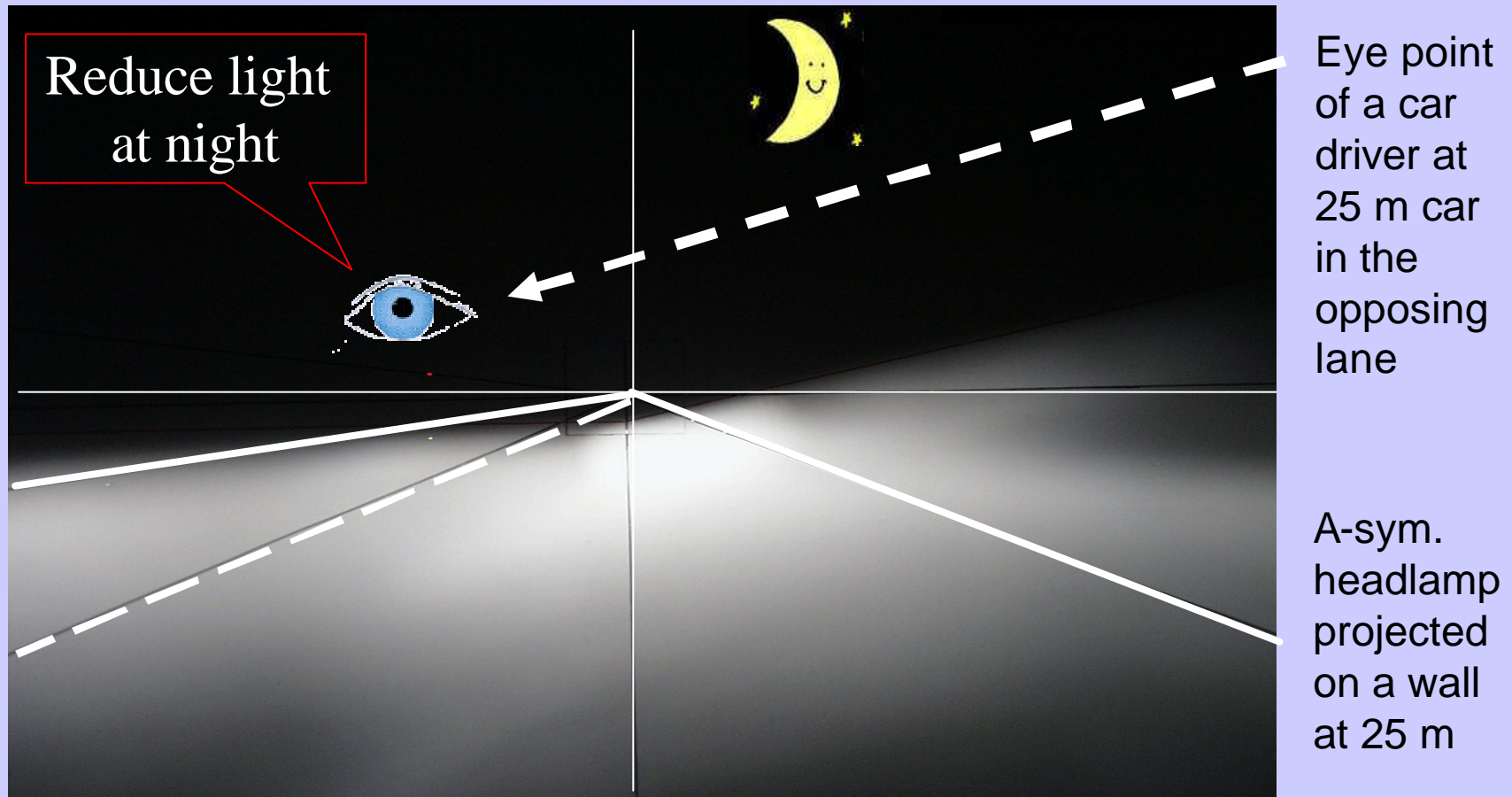
Reminder

PTWs have distinct technical regulatory frameworks from other vehicles:

the current regulation does not allow to install any daytime lighting enhancement other than low beam (see next slide).

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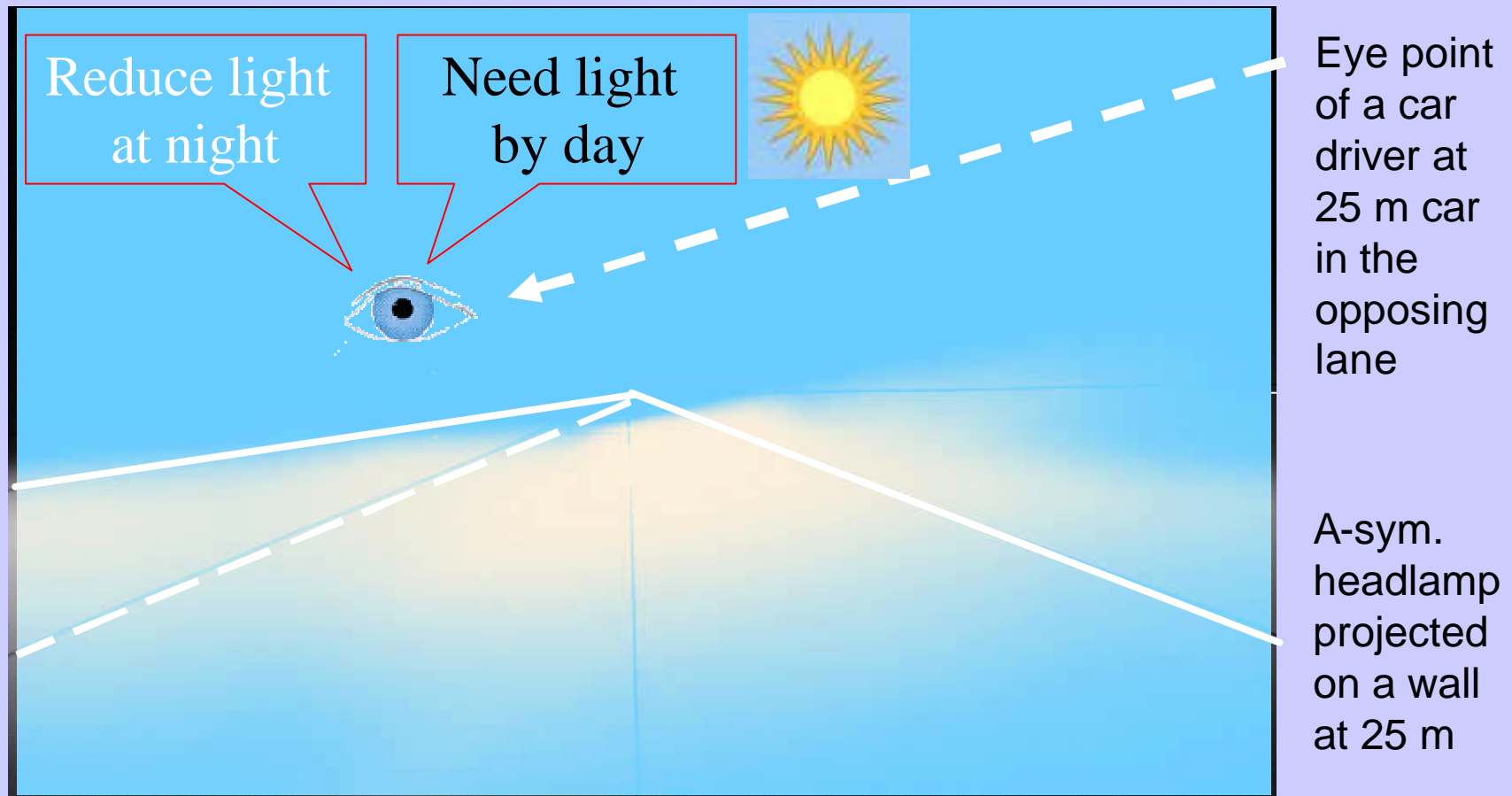
Regulations allow only Dipped beam at daytime



But.....dipped beam is made for nighttime and limits the light, where we need it: the opposing drivers eye.

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Regulations allow only Dipped beam at daytime



But.....dipped beam is made for nighttime and limits the light, where we need it: the opposing drivers eye.

Next steps

1. Short term:

- Industry will look for technical solutions to mitigate perception problem, by using the methodology:
 - Taking into account a scenario with dedicated DRL on all future cars;
 - Results expected second half of 2007;
 - Industry will make proposals to UN/ECE/WP29/GRE.

Next steps

2. Requests to the Commission:

- To freeze any decision until the results of Industry's research
- To support a quick adaptation of the regulatory framework at worldwide level.
- Then to create a uniform car lighting background

Next steps

3. Further:

- PTW conspicuity is not only making PTW's better perceived,
- it is also educating other vehicle drivers to look and see motorcyclists.
- Repeated awareness campaigns aimed at both the car driver and PTW riders will mitigate the problem

MAIDS: OV drivers who also have a PTW licence are much less likely to commit a perception failure

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After all, PTW riders:

- **Can't eat, drink, telephone, change a CD,**
- **Have learned to anticipate,**
- **Have a free field of vision without an A pillar.**



Thank you

For more information:

See: ESV 2005 paper O5-0259

<http://www-nrd.nhtsa.dot.gov/pdf/nrd-01/esv/esv19/Other/Print%2012.pdf>

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