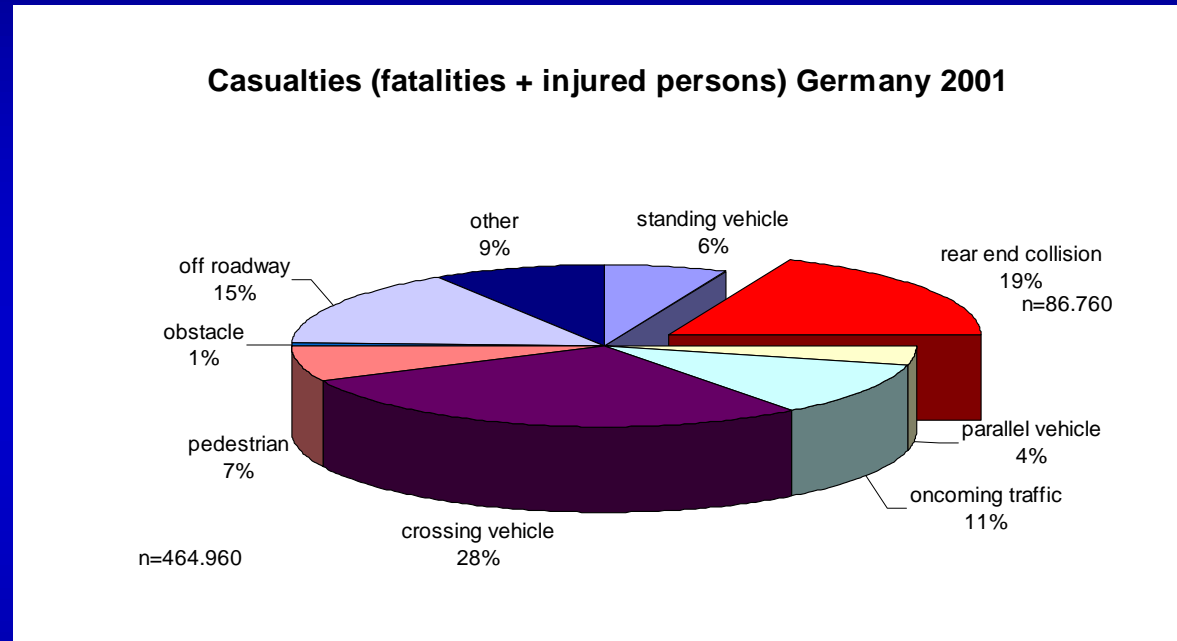


DAIMLERCHRYSLER

Safety Benefits of Flashing Brake Lights

Dr. Joerg Breuer

Accident Data



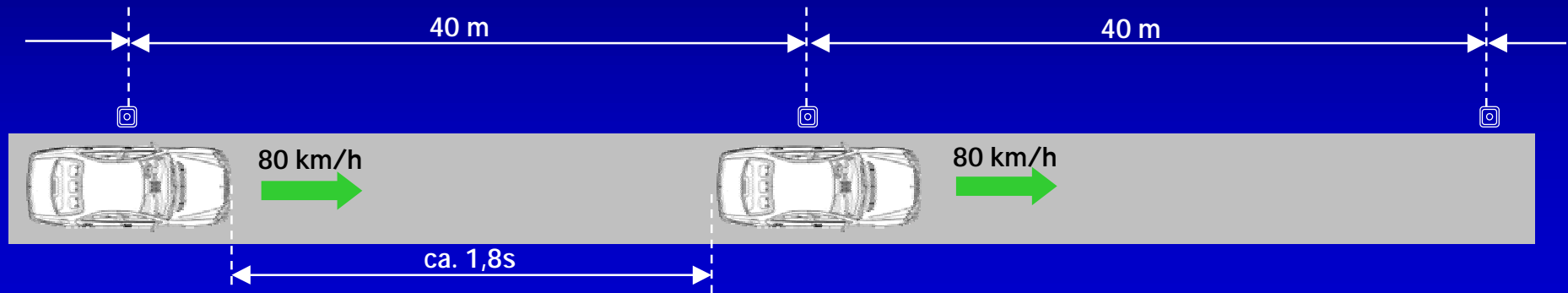
- USA: 5 % of all fatal crashes occur in rear end collisions, economic cost \$ 18.3 Billion per year (NHTSA)
- Japan: 34.2% of all accidents are rear end collisions (1999), numbers increased 1995-1999 by 4.2%

Goals

- ⚡ Comparison of Reaction Times in emergency braking situations
 - ⚡ conventional brake lights
 - ⚡ conventional brake lights + hazard warning lights
 - ⚡ flashing brake lights
 - flashing frequency 4 Hz
 - flashing frequency 7 Hz
- ⚡ Experiments on test track and in laboratory (08/2002)



Test Track Experiment



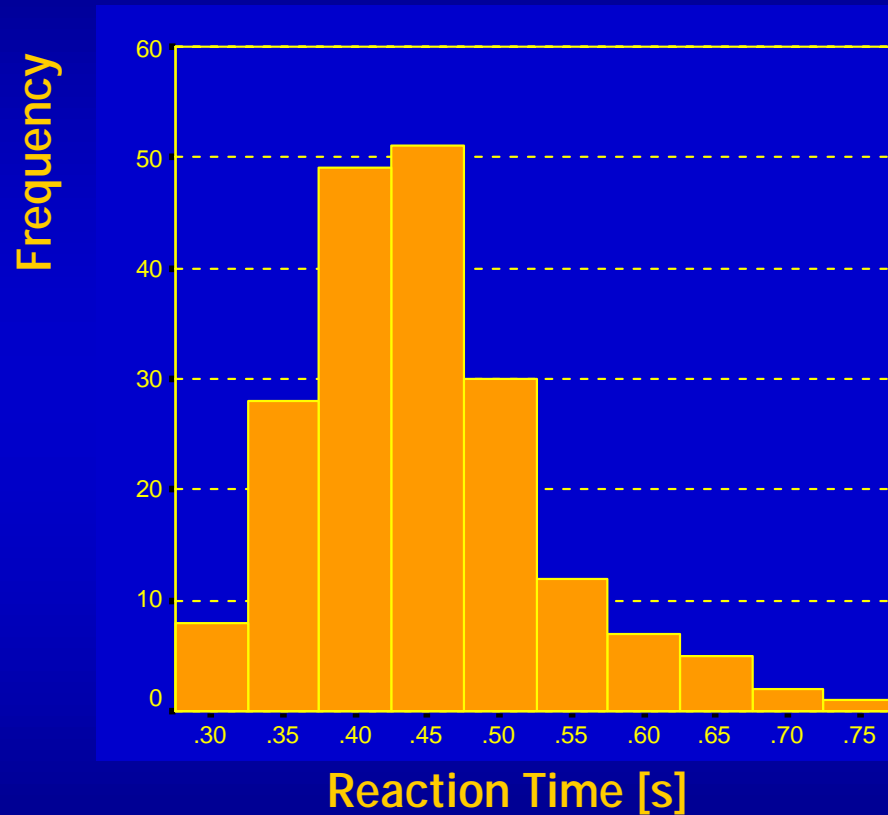
- 39 subjects aged 18 - 63 ($\bar{\Delta}36$) years, 39% female
- car following task, different driving maneuvers
- preceding vehicle performed sudden emergency braking maneuvers (brake assist activation)
- measurement of reaction times and acceptance



Test Track Experiment



Reaction Times: Baseline Values

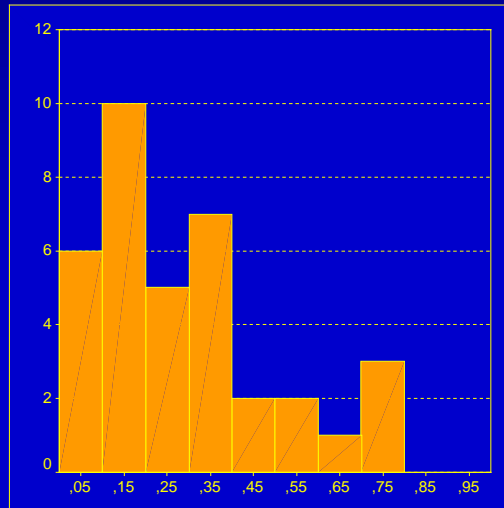


- ⌘ measured after driving tests in stationary vehicles (distance = 40m)
- ⌘ reaction time = time between activation of brake lights in lead vehicle and first activation of brake pedal in subject vehicle

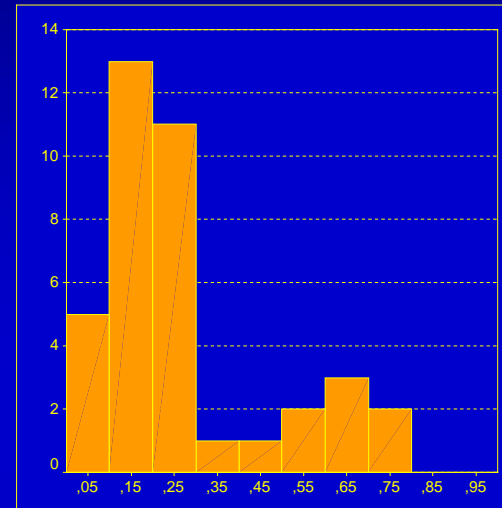
Frequency Distribution of Reaction Times*

conventional
brake lights

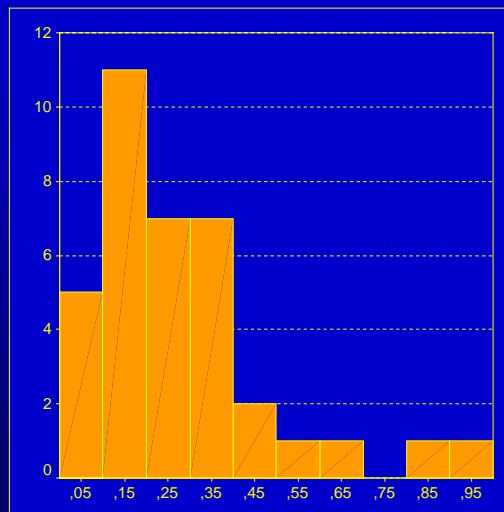
Frequency



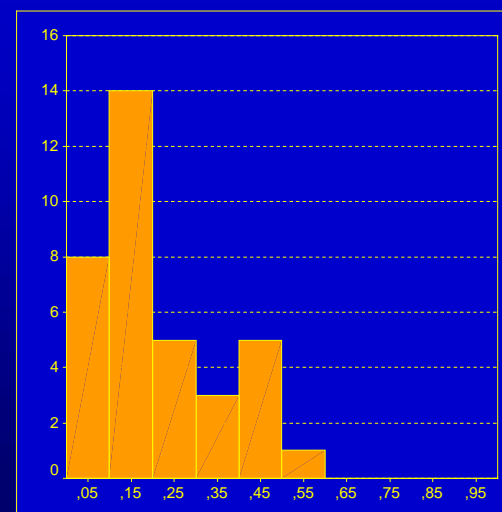
hazard warning
lights



flashing
brake lights
(4 Hz)

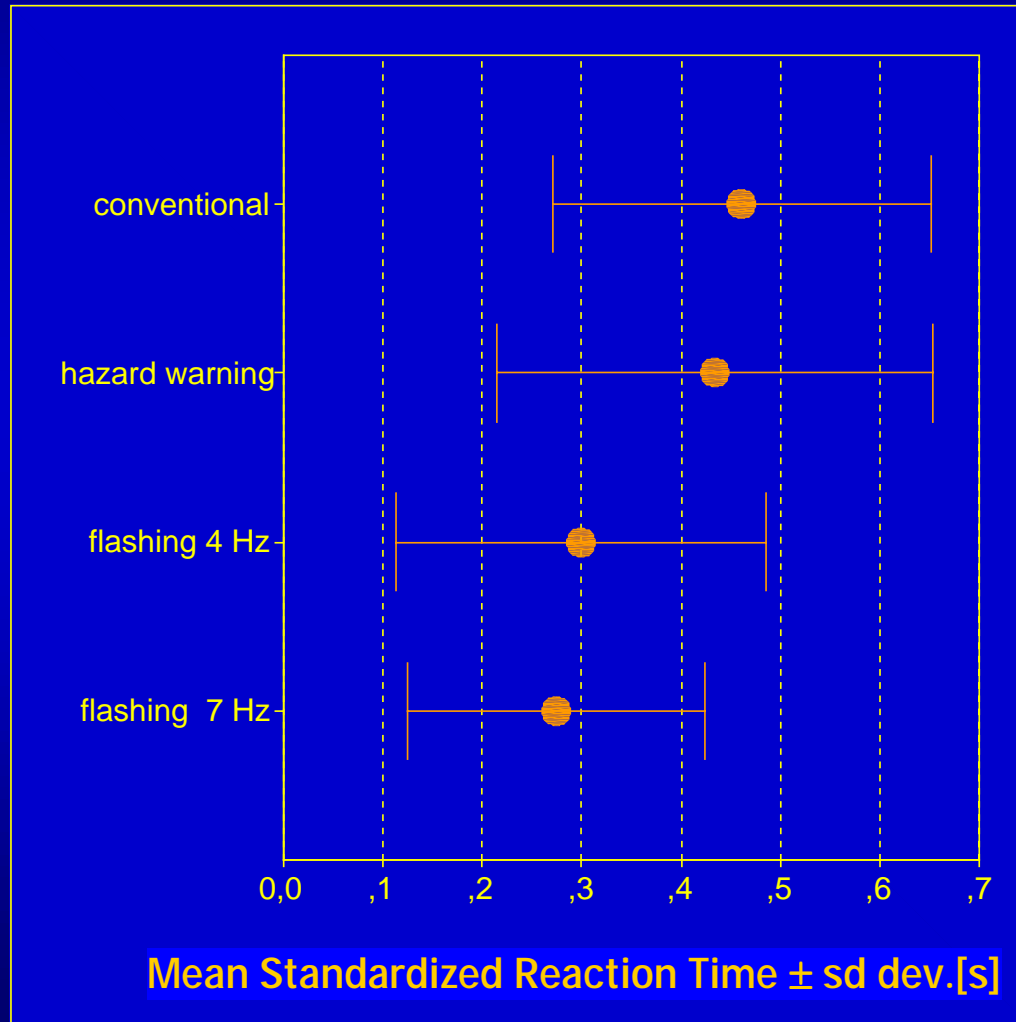


flashing
brake lights
(7 Hz)



* standardized by subtraction of baseline value of reaction time to brake lights (stationary vehicles)

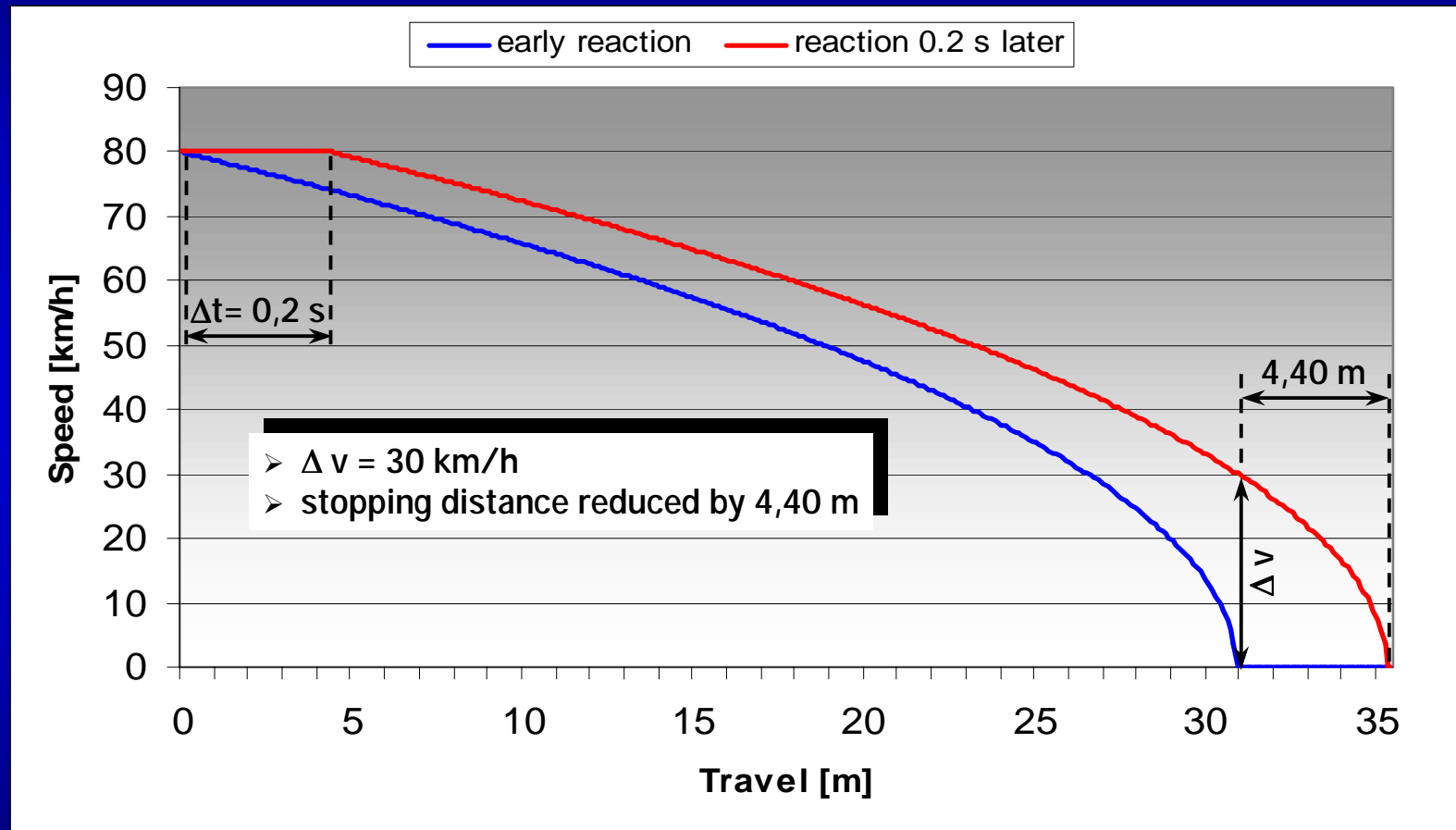
Reaction Times* (first emergency braking)



Flashing brake lights significantly reduce mean reaction times by up to 0.2 s

* standardized by subtraction of baseline value of reaction time to brake lights (stationary vehicles)

Safety Benefit of Earlier Brake Reaction*



* estimation based on deceleration of 8 m/s²

Other Factors

- /// Weather effect (test track):
 - /// longer reaction times in rainy conditions
 - /// biggest increase for hazard warning lights (mean: 0.12 s)
 - /// lowest increase for flashing brake lights (mean < 0.06)

- /// Distraction (secondary task, laboratory):
 - /// longer reaction times when performing secondary task (ca. 0.1 s)
 - /// significantly shorter reaction times for flashing brake lights (7 Hz)

- /// Acceptance
 - /// flashing brake lights are most preferred

Summary

- /// Flashing Brake Lights
 - /// indicate emergency situation (flashing red)
 - /// non-ambiguous, intuitive
 - /// reduce reaction times by up to 0.2 s compared with conventional brake lights
- /// Hazard warning lights
 - /// serve as attention getter but
 - /// do not significantly reduce reaction times in emergency braking situations