

Speed Recommendations During Traffic Light Approach.

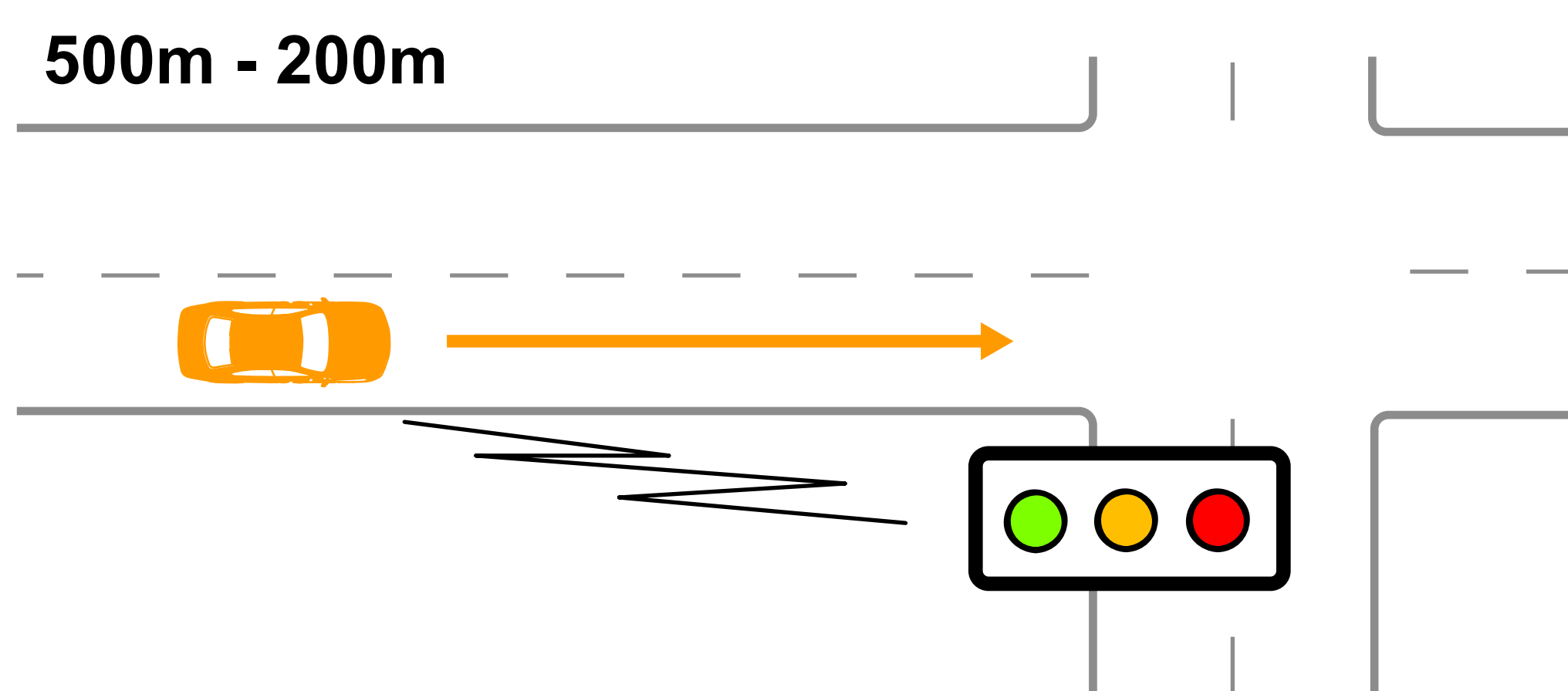
A Comparison of Different Display Concepts.

Stephan Thoma, Thomas Lindberg
BMW Group Research and Technology
stephan.thoma@bmw.de

Prof. Gudrun Klinker, Ph.D.
Munich University of Technology

Challenge

In order to increase comfort and potentially reduce CO₂-emissions, drivers approaching an intersection are given a recommendation at which speed they need to travel to avoid unnecessary stops at traffic lights. This could be achieved by Car2Infrastructure-communication.

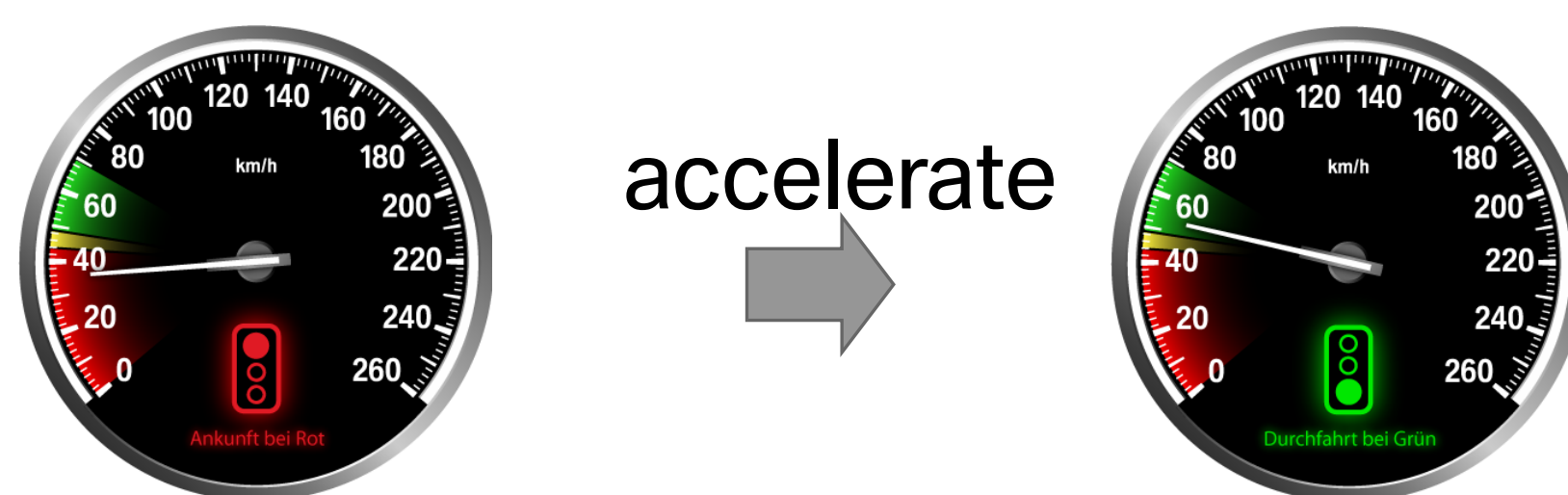


As the vehicle will not effect any speed changes autonomously, an intuitive and easy-to-read human machine interface is needed to present the speed recommendations to the driver:

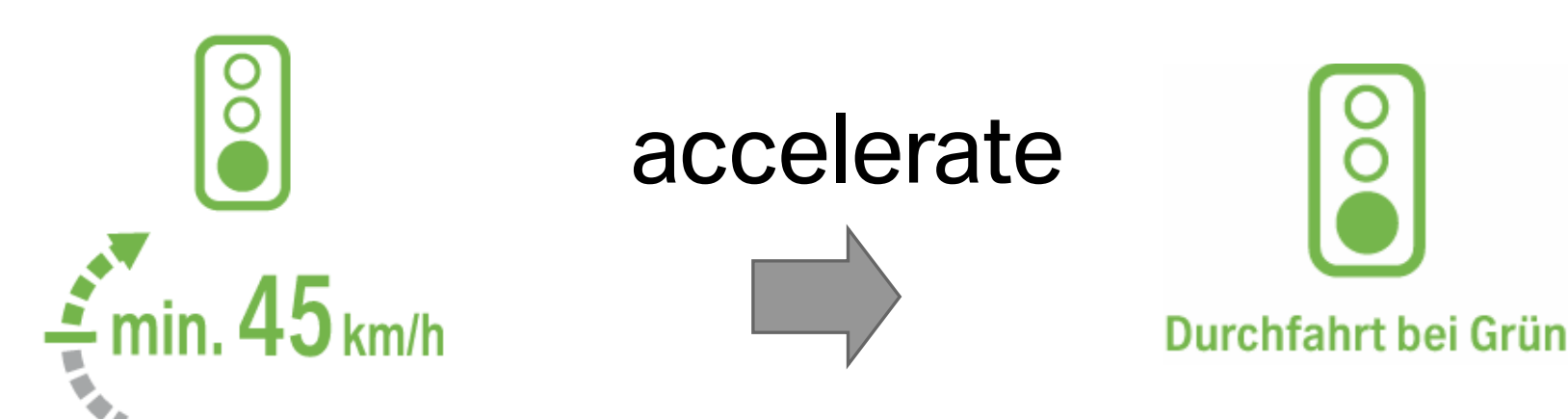
Countdown for green/red phase (seconds)



Coloured areas in speed indicator

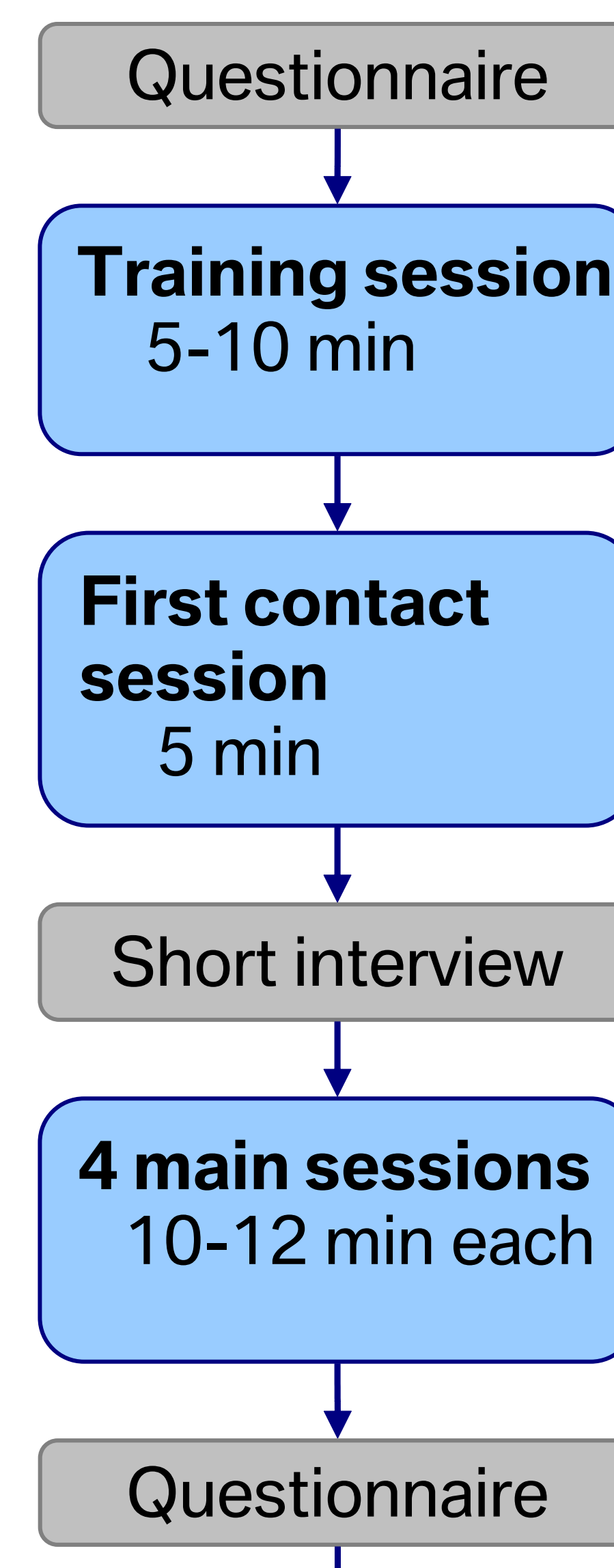


Min/Max speed in textual representation



Methodology

27 subjects were asked to participate in a driving experiment in a static driving simulator. Effectiveness, intuitivity, distraction and acceptance were tested.



Participant becomes familiar with the driving simulator (No HMI shown).

Participant passes four traffic lights with one of the three HMI displays without previous explanations.

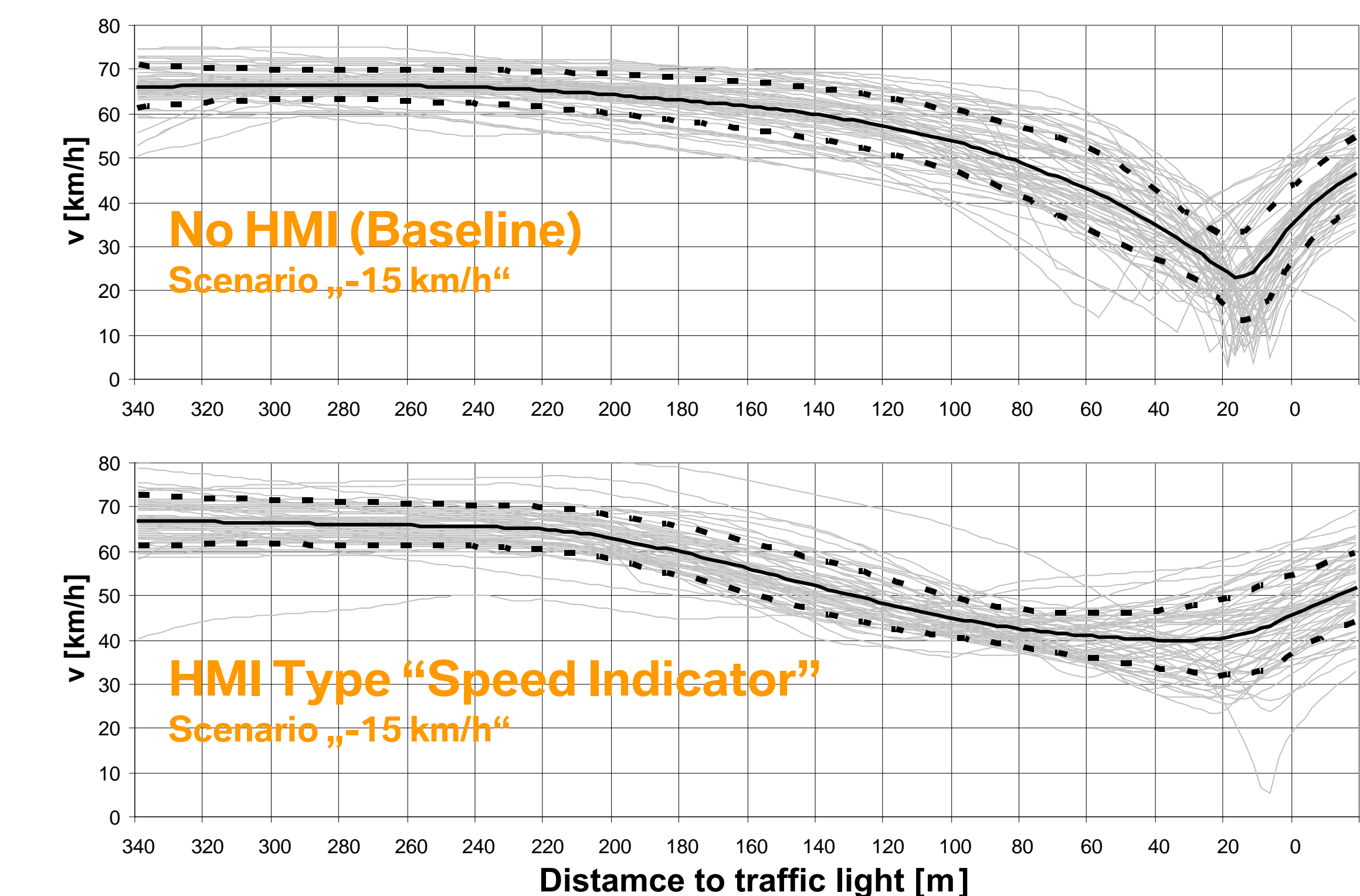
For each HMI type and a baseline, participant passes approx. 12 traffic lights. Visual behaviour and driving data is recorded.

6 different scenarios where evaluated:

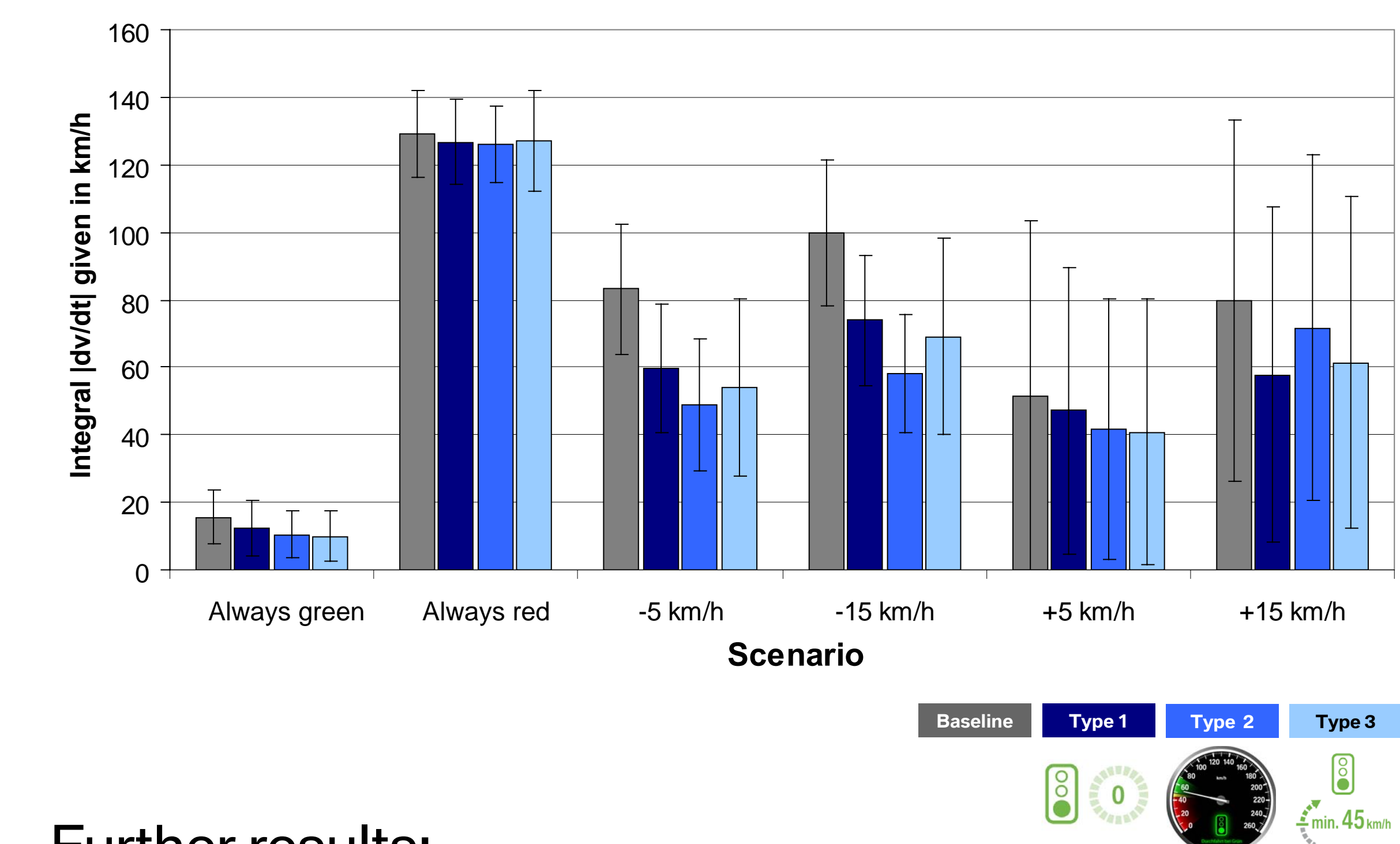
| Scenario | Δv [km/h] |
|-----------------------------------|-------------------|
| No speed change necessary | 0 |
| Stopping at red light unavoidable | -60 |
| Pass by slight deceleration | -5 |
| Pass by stronger deceleration | -15 |
| Pass by slight acceleration | +5 |
| Pass by stronger acceleration | +15 |

Results

Speed profiles were analyzed to evaluate the effectiveness of the HMI. The following two profiles show the baseline and the same scenario with the speed indicator HMI:



To get an objective measure for the effectiveness, the integral over the absolute value of dv/dt was calculated for each traffic light pass. Lower values indicate better performance:



Further results:

- The instrument cluster display has the highest acceptance.
- The countdown has a slight advantage concerning visual behaviour (visual demand).