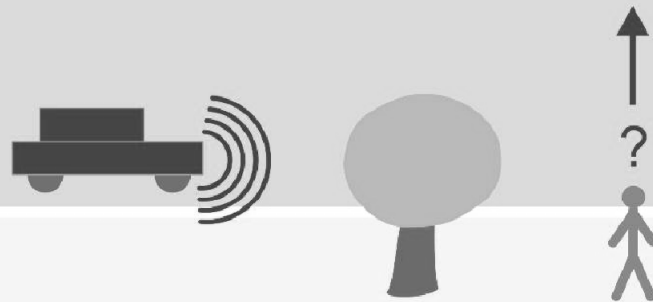


„Investigations on the Detectability
of Vehicle Sounds by Sighted, Visually
Impaired and Blind Pedestrians “



Dr. Ercan Altinsoy

Dresden University of Technology
Chair of Communication Acoustics

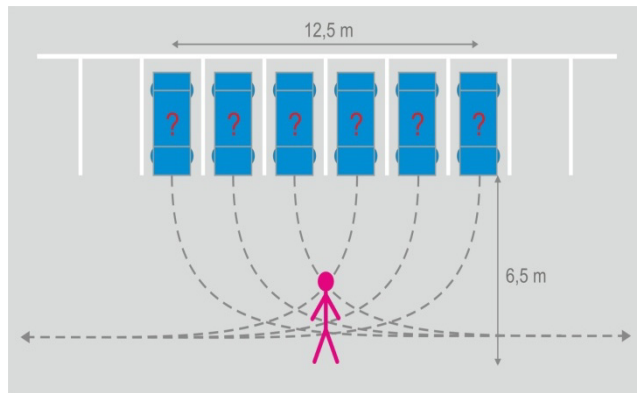
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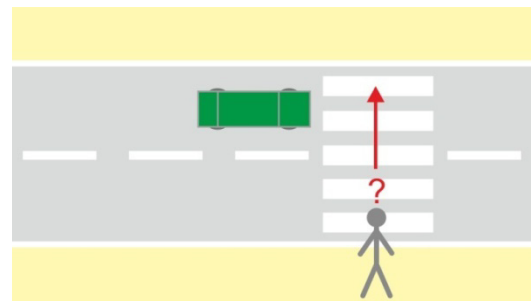
Interview with visually impaired and blind pedestrians

The traffic conditions, which were investigated in this study, were described by visually impaired and blind pedestrians as dangerous situations

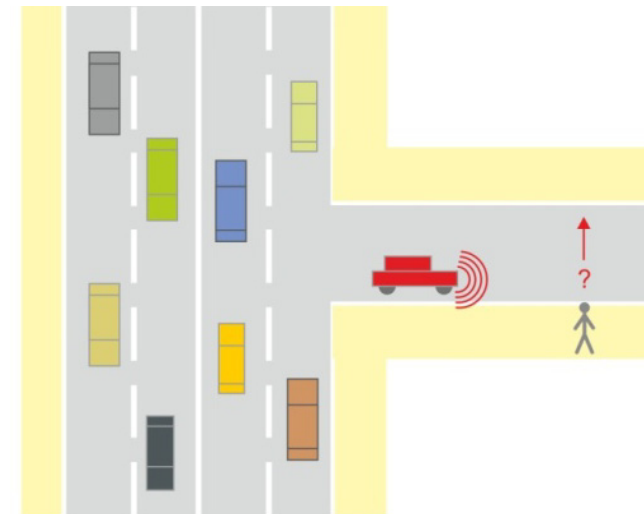
Sit.1: Park slot



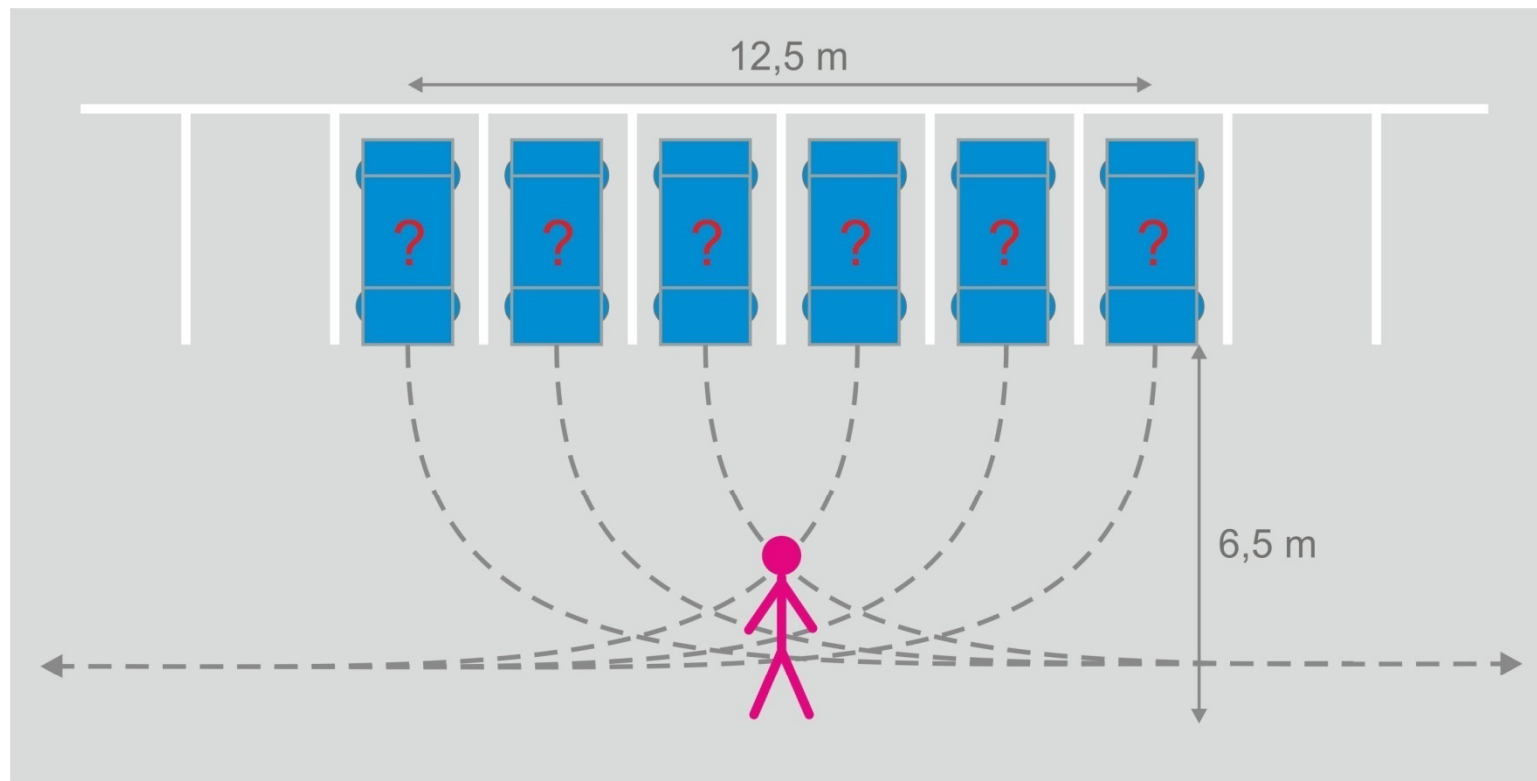
Sit.2: Crosswalk



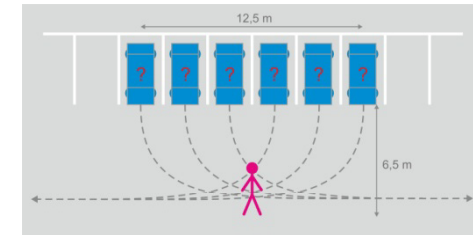
Sit.3: Crossing Street



Park slot - Vehicle leaving a parking space



Stimuli



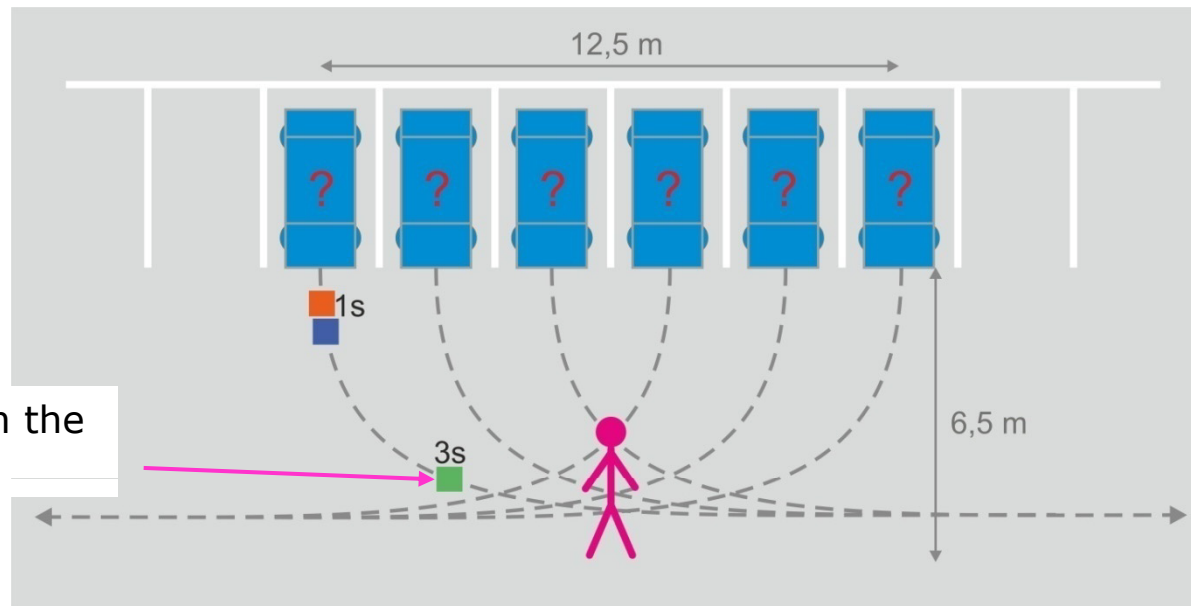
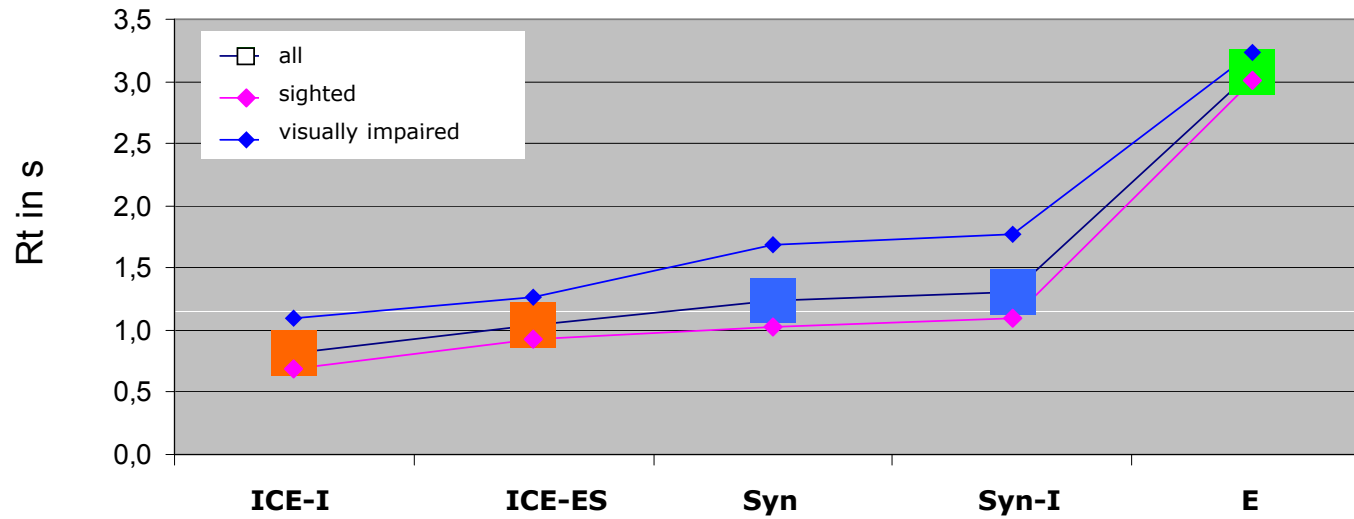
Sounds:

- Vehicle with ICE from the idle (ICE-I)
- Vehicle with ICE with engine start (ICE-ES)
- Synthesized sound from the synthesized idle (S-I)
- Synthesized sound (S)
- Vehicle with the actuator powered electrically (Mitsubishi Imiev) (E)

Participants

Number: 54 Participants (37 sighted, 18 visually impaired)



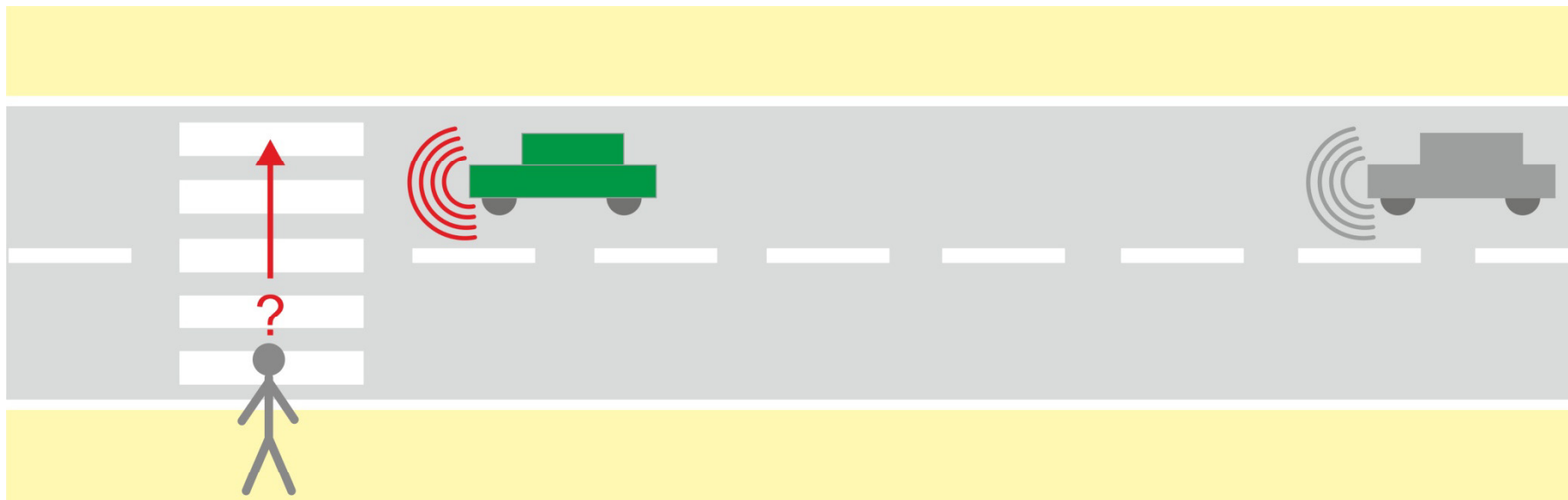


Detection based on the tyre/road noise

Conclusions Parkslot

- A vehicle with the actuator powered electrically (without sound generator) will be very late (3 sec.) detected
- A vehicle with ICE will be detected already in 1 sec.
- A synthesized sound will be detected in 1.3 sec

Situation: Crosswalk - Stopping Vehicle



Listening test:

A vehicle is approaching the crosswalk – Slowing/Stopping situation

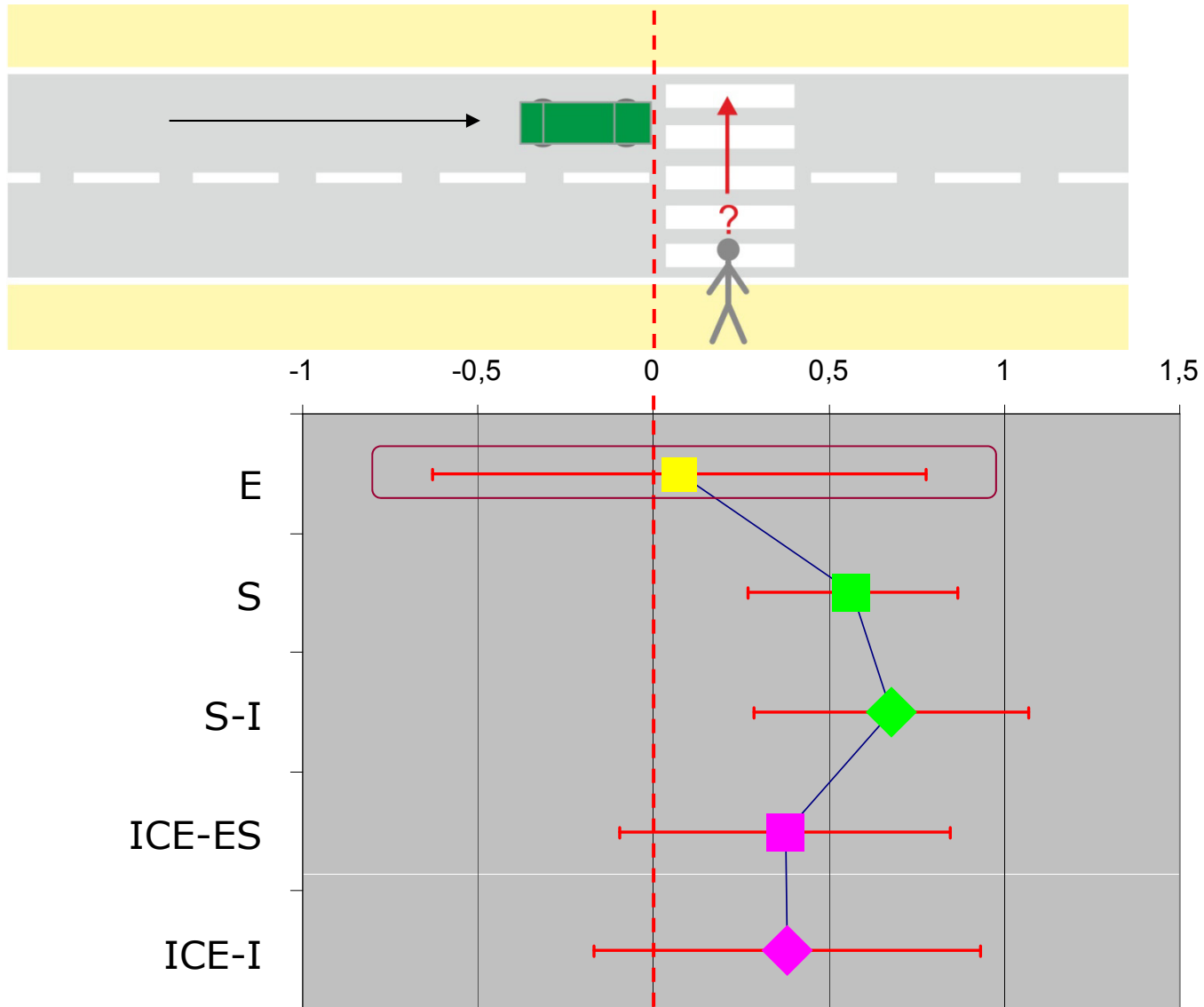
Subject should press the button, if she/he thinks that the vehicle is stationary.

Stimuli

Sounds:

- Vehicle with ICE slowing and idling (ICE-I)
- Vehicle with ICE with engine stop (ICE-ES)
- Synthesized sound slowing and idling (S-I)
- Synthesized sound (S)
- Vehicle with the actuator powered electrically (Mitsubishi Imiev) (E)

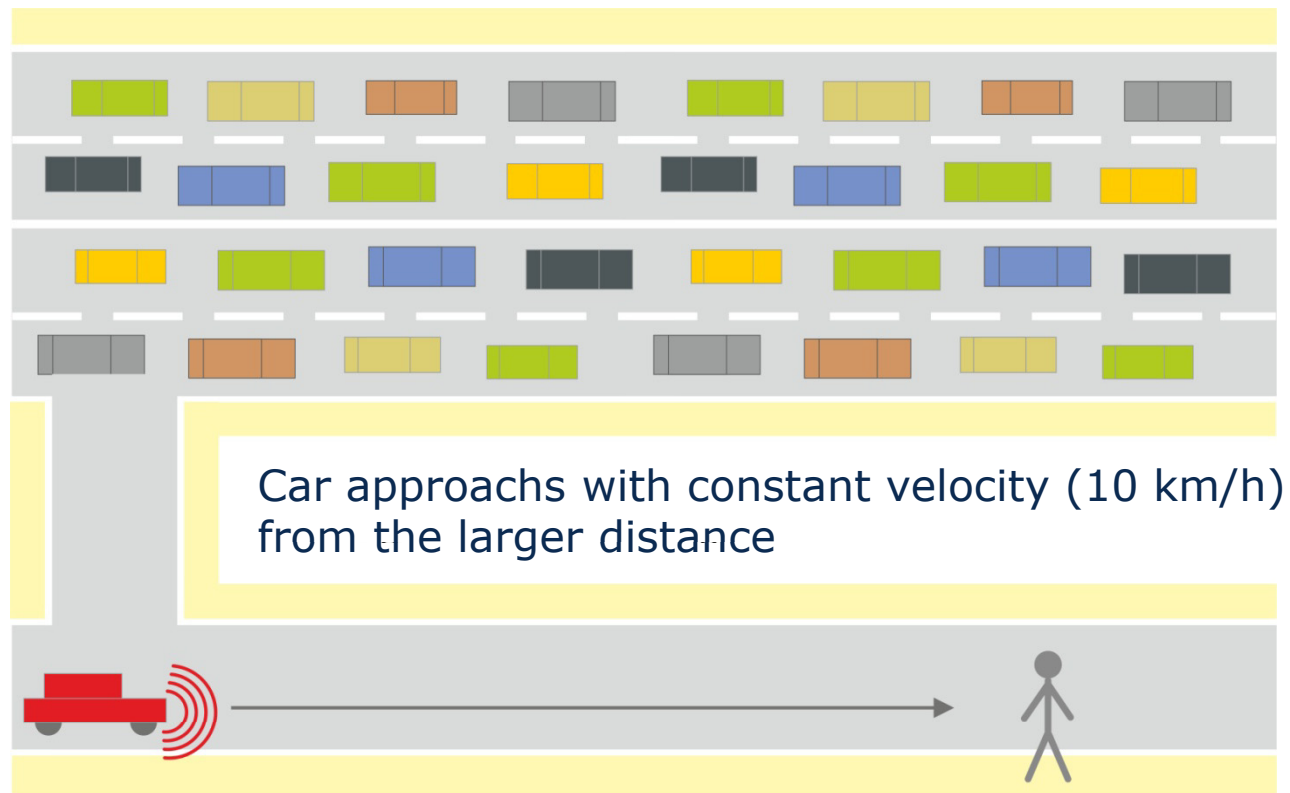
Crosswalk – Reaction time measurement



Conclusions - Crosswalk

- The stopping time of the electric vehicle is not estimable using its sound
- The stopping time of the vehicle with synthesized sound is clearly perceptible

Situation 3: Crossing street



Reaction time measurement

In this study, we examined the detection of vehicle sounds measuring the reaction time in presence of the ambient (Pedersen, 55 dB(A)).

Subjects were asked to imagine that they are standing on the curb waiting to cross a one-way street when there may be vehicle approaching from the left.

They should to respond as quickly as possible by pressing a button, if they hear an approaching car. Presentations of the vehicle sounds followed each response with a random delay between 2 and 4s. Each sound was presented six times.

Participants

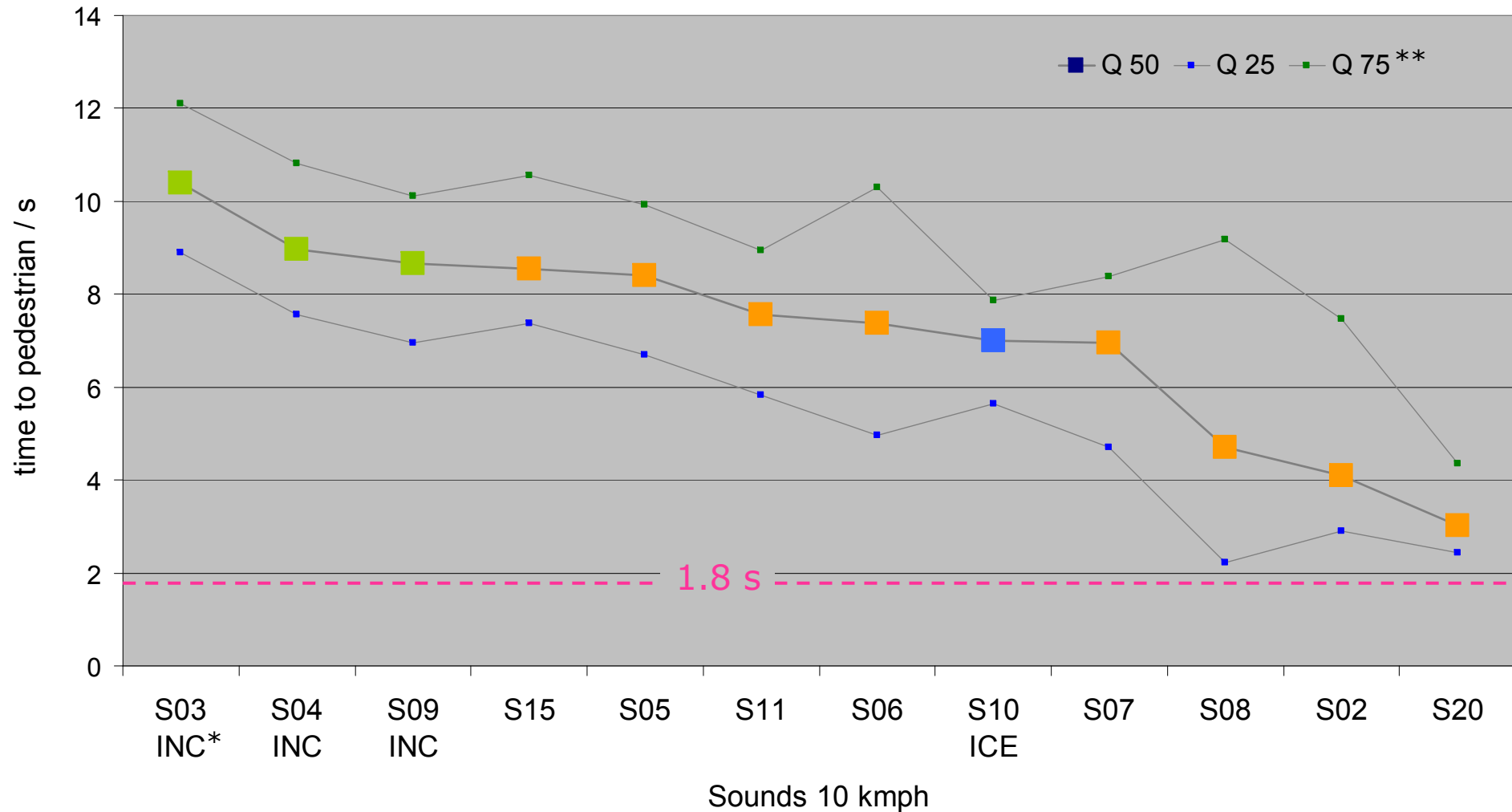
Number: 35 Participants (29 sighted, 6 visually impaired)
Average age: 31.5 years



Objective of the study

Comparison of the detection distances with the desired detection distance for pass-by operation as proposed in the NPRM by NHTSA.

- 5 m in front of the vehicle for 10 km/hr → 1.8 sec.



*INC = Intended NHTSA compliant, all others = Manufacturer's preferred sounds

**Q50 = Median, Q25 = 25th percentile, Q75 = 75th percentile

Conclusions - Crossing street – Constant velocity (10 km/h)

➤ Both sound types

- sounds that comply with the NPRM requirement
- sounds that don't comply with the NPRM requirement

fulfill the NHTSA requirement.

- Sounds which are detected a long time before the safety detection distance will be proven to loud and impact the environment unnecessarily