Mercedes-Benz

# Quiet Cars

## Recent Findings from Research conducted by Mercedes Benz and the Technical University of Dresden (TUD)

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# Outline

- Focus on „sound at idle“ vs „commencing motion sound“ / Research performed by Daimler and Technical University of Dresden (TUD)
  - Test Procedure
  - Test Results
- Conclusions

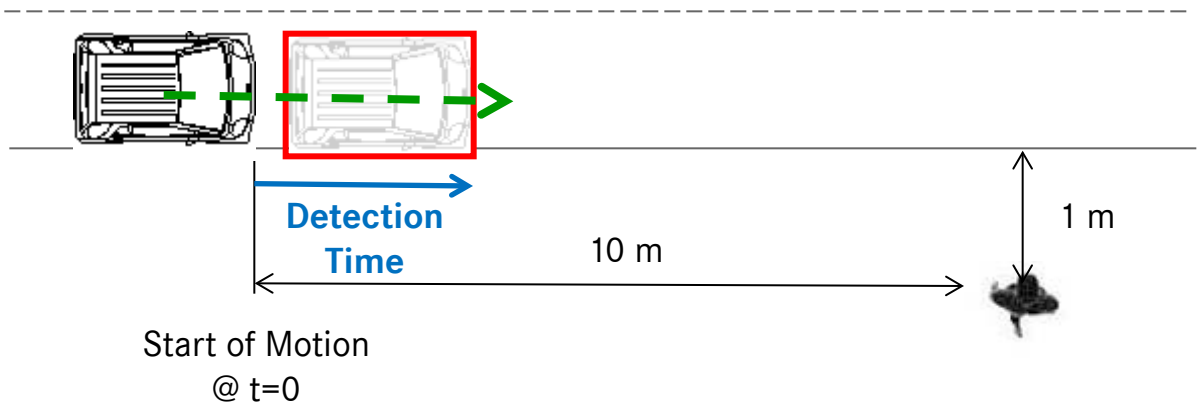
# Sound at idle vs. commencing motion sound
# Objective of the study

- Determine the effect of different sound characteristics in a situation where a stopped vehicle near a pedestrian resumes motion.
- This a situation that frequently occurs at intersections.
- The most important safety objective for a visually impaired pedestrian would appear to quickly recognize that now a vehicle is moving.

- The following basic variances in sound of the quiet vehicle were compared:
  - Vehicle with sound at idle
  - Vehicle without sound at idle
  - Vehicle without sound at idle but with commencing motion sound

  In all cases the sound of vehicles when driving complied to the NPRM

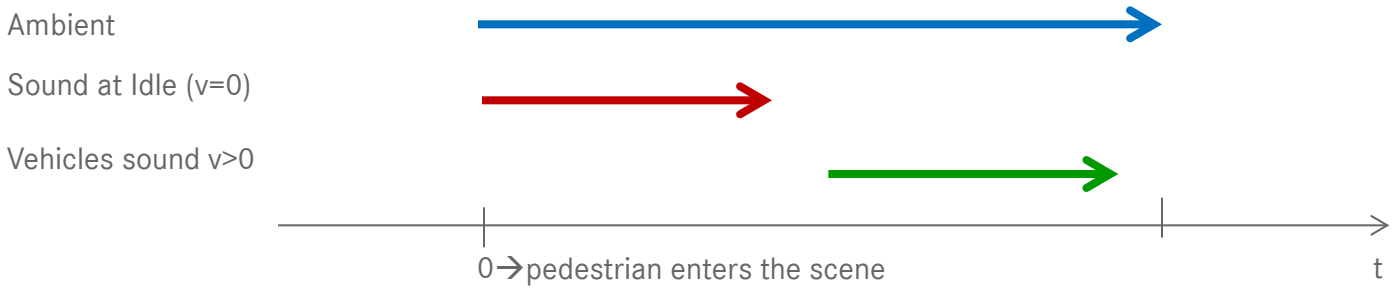
# Sound at idle vs. commencing motion sound
# Test Procedure



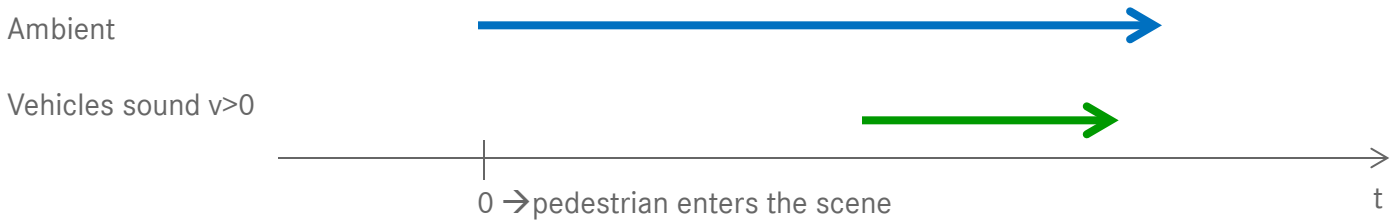

- Vehicle stopped/parked by the roadside a) with vs. b) w/o sound at idle c) with commencing motion sound (2 different levels were tested)
- Distance to the pedestrian: 10 m.
- Ambient noise was overlaid: Pederson (NHTSA NPRM) and TUD
- Vehicle sounds when moving: smart electric drive with different artificial sounds that comply with NHTSA requirement
- **Detection time is measured for an approaching vehicle**

# Sound at idle vs. commencing motion sound - Test Procedure

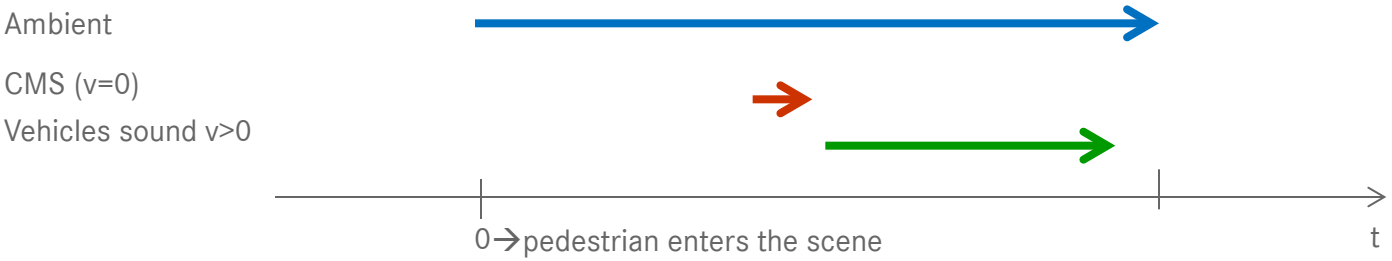
a) Vehicle with Sound at Idle:




b) Vehicle without Sound at Idle




c) Vehicle with Commencing Motion Sound



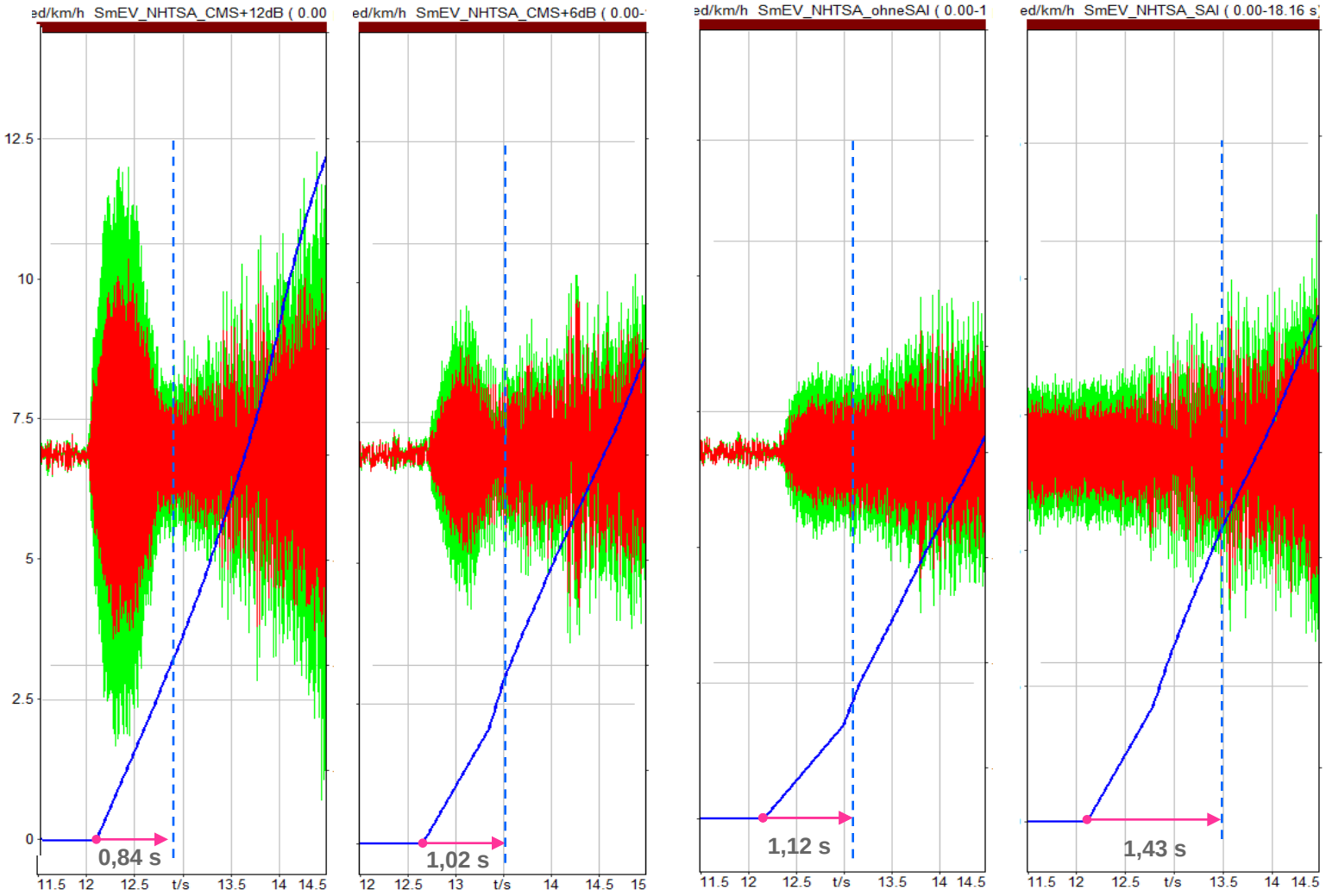
# Sound at idle vs. commencing motion sound
# Test Procedure

- Sound recordings were generated at Mercedes Benz's indoor test track with dummy head microphone.
- These soundfiles were mixed with simulated ambient noise (Pederson and TUD) and played back for subjects in the TUD Multi-Modal Measurement Laboratory.
- Each subject was exposed to repeated measures of each test condition for a total of 36 trials per sound mode with randomized start times between 2-4 seconds.
- Total number of test objects: **30** (sighted: 25, visually impaired, blind: 5)
- Sighted:
  - women: 10 (age 20 … 50, mean 33)
  - men: 15 (age 23 … 62, mean 37)
- Visually impaired, blind
  - women: 1 (age 24)
  - men: 4 (age 22 … 52, mean 31)
- Question: When do you hear an approaching vehicle?

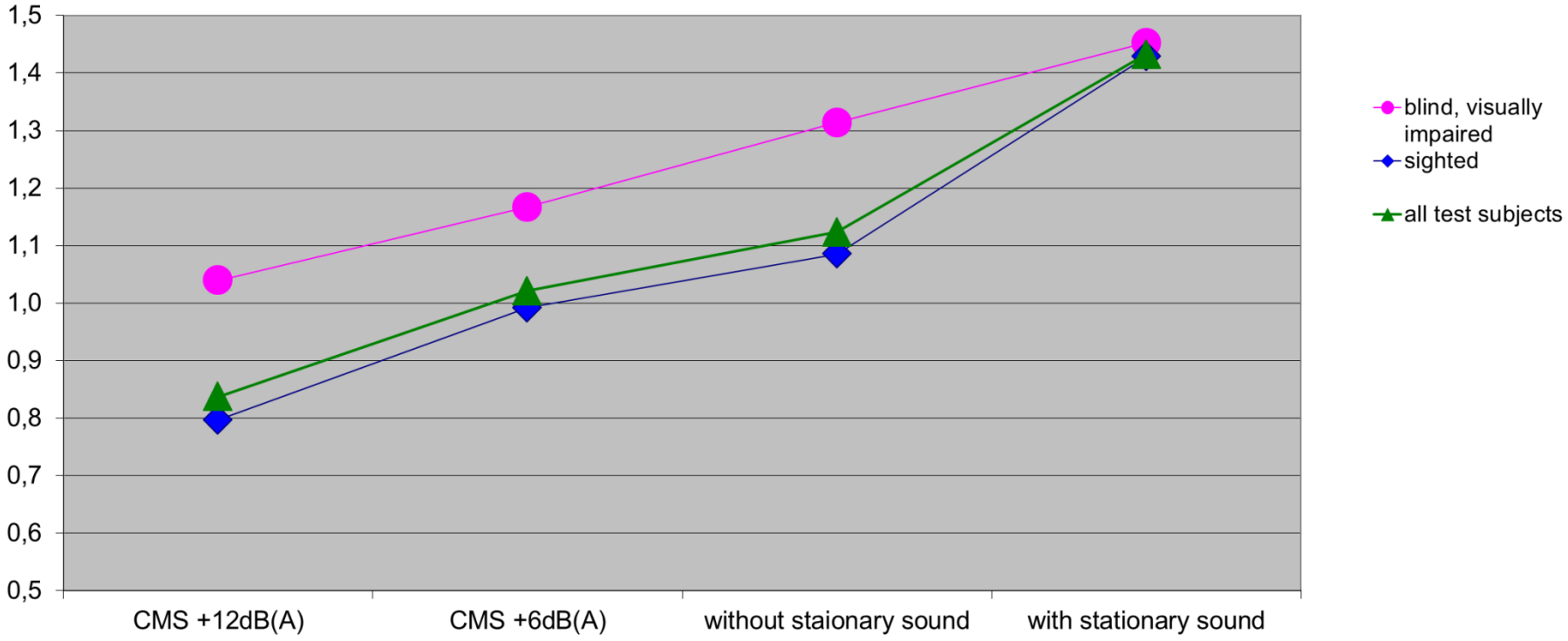
→ Next slide: Results measured detection time

MultiModal Measurement Laboratory with 464 loudspeakers
Source: TUD, GTR presentation

| Sound Mode | CMS +12 dB(A) | CMS +6 dB(A) | no stationary sound | with stationary sound |
|---|---|---|---|---|
| Mean Detection Time (all subjects) | 0,84 s | 1,02 s | 1,12 s | 1,43 s |



# Sound at idle vs. commencing motion sound
# Test results: mean detection time in s



# Conclusions

- Detection, that a vehicle starts to move is quicker without stationary sound (1,12 s) as compared to stationary sound (1,43 s).
- Applying a commencing motion sound accelerates detection even further (0,84 s - 1,02 s).
- The attention is adequately caught by an increase of 6 dB(A) in the commencing motion sound.
- No significant differences between the different ambient noises.
- These test results suggest that the sound change (contrast) transitioning from no sound while stationary to alert sound active in motion has a measurable effect on detectability.
- Results are in line with the joint demonstration conducted by Nissan, Toyota, Honda and Mitsubishi which showed that sound level of sound at idle as proposed by NHTSA can mask the sound of an approaching vehicle.

- **A vehicle poses a danger to a visually impaired person only as it starts to move. Therefore, quick detection of a vehicle approaching is paramount to the detection of a stationary vehicle. For this situation the study shows that commencing motion sound is more effective than sound at idle.**
- **Daimler therefore proposes to allow commencing motion sound as an alternative to stationary sound.**