Cerebral diseases and distractibility while driving

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OBJECTIVES

The objective of this research is to assess the degree to which cerebral diseases affect the distractibility of drivers through a driving simulator task. The driving performance of drivers with cognitive impairments (MCI, AD or PD) is examined under three driving conditions: **undistracted driving, driving while conversing with a passenger, and driving while conversing on a handheld mobile phone**.

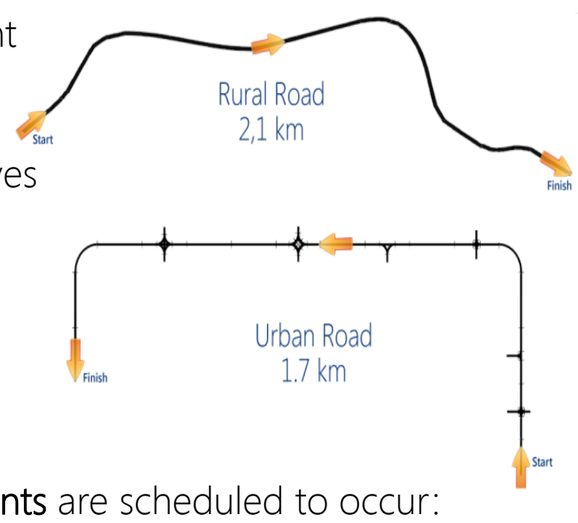
For each driver, the following driving performance measures are calculated: speed, lateral position variability, time headway variability, steering angle variability, reaction time at incidents and number of driving errors per trial for the three conditions.

DRIVING SIMULATOR EXPERIMENT

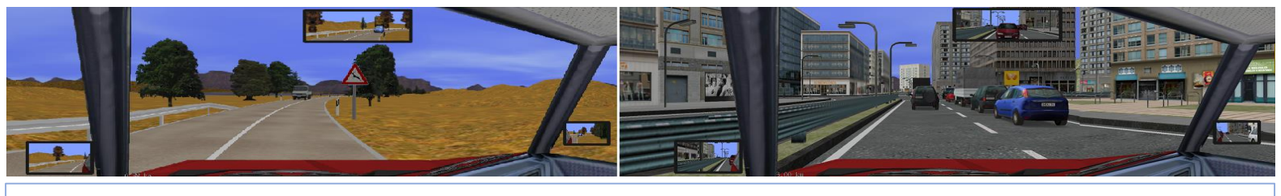
- **Distract** research project distrACT
- **Neurologists -** Medical/neurological assessment: a full clinical medical, ophthalmological and neurological evaluation
- **Neuropsychologists** - Neuropsychological assessment: a series of neuropsychological tests and psychological - behavioural questionnaires to the participants which cover a large spectrum of Cognitive Functions
- **Transportation Engineers -** Driving at the simulator: assessing the driving behaviour of participants by means of programming of a set of driving tasks into a driving simulator for different driving scenarios

"DRIVING AT THE SIMULATOR" ASSESSMENT

- **quarter-cab driving simulator** manufactured by the FOERST Company (3 LCD wide screens 42", full HD: 1920x1080pixels - total field of view 170 degrees, validated against a real world environment)
- At first, **one practice drive** (usually 10-15 minutes)
- Afterwards, the participant drives **two sessions** (approximately 15 minutes each)
- Each session corresponds to a different road environment:
  - **a rural route**, single carriageway, zero gradient, mild horizontal curves
  - **an urban route**, at its bigger part dual carriageway, separated by guardrails. Two traffic controlled junctions, one stop-controlled junction and one roundabout are placed along the route.



- During each trial, **2 unexpected incidents** are scheduled to occur:
  - sudden appearance of an animal (deer or donkey) on the roadway
  - sudden appearance of a child chasing a ball on the roadway or of a car suddenly getting out of a parking position.
- **Three distraction conditions**: undistracted driving, driving while conversing with a passenger, and driving while conversing on a handheld mobile phone.



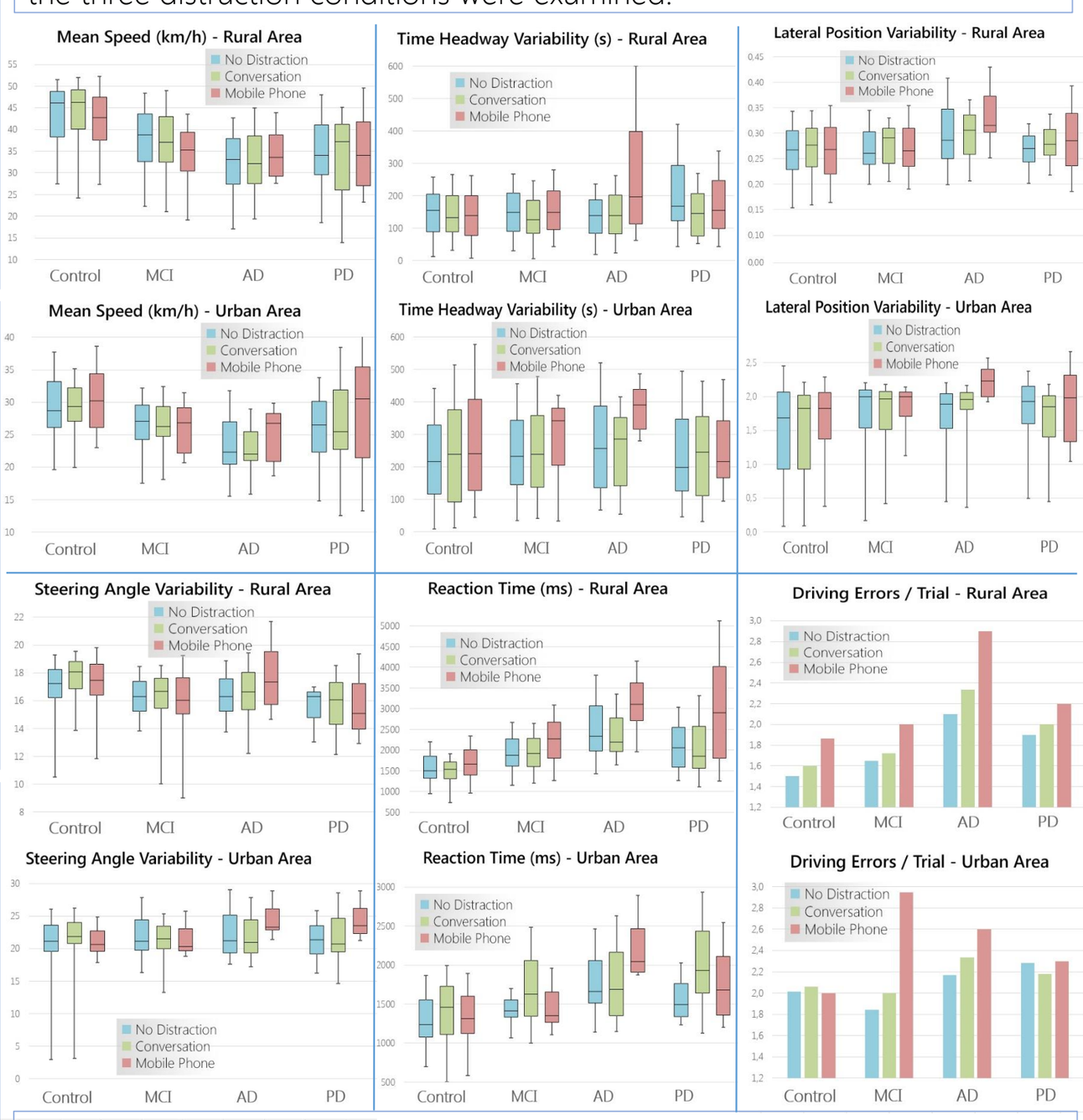
SAMPLE SCHEME

140 participants* (all more than 55 years of age and of similar demographic characteristics): **31 Healthy Controls** (aver. 64.5 y.o., 20 males) and **109 Patients** (aver. 69.0 y.o., 80 males): **25 AD patients** (aver. 75.4 y.o.), **59 MCI patients** (aver. 70.1 y.o.), **25 PD patients** (aver. 66.1 y.o.)

*all 140 participants completed the "no distraction" and "conversation with passenger" scenarios. **28 Controls, 9 AD, 35 MCI and 10 PD patients completed the "mobile phone use" scenario**, because this scenario was completed only by those who claimed they do so in their real-life driving too.

ANALYSIS

Box-and-whisker charts were extracted from the data:
Speed, lateral position variability, time headway variability, steering angle variability, reaction time and number of driving errors per trial (speed limit violations, hit of sidebars, outside road lines, and traffic sign violations), for the three distraction conditions were examined.



RESULTS AND CONCLUSION

- Conversing with passenger appears to have **no significant effect** on speed in all examined groups
- Mobile phone use leads to **increased speed for the AD group** in urban area
- AD and PD drivers have **higher vehicle lateral position variability** when using the mobile phone while driving.
- AD drivers when using the mobile phone have **a large variability in time headways** in both rural and urban environments
- AD and PD drivers have **higher steering angle variability** during the mobile phone conversation
- Mobile phone use while driving **significantly worsens reaction times** at unexpected incidents for AD and PD groups by **at least 30%** in both driving environments
- Regarding the driving errors (speed limit violations, hit of sidebars, outside road lines, and traffic sign violations), mobile phone use leads to **more than 50% increase in errors** than the undistracted condition, for the groups with brain pathologies (especially the MCI group in urban area)
- Conversation with passenger doesn't seem to significantly affect driving behavior in any examined group. Mobile phone use, though, deteriorate driving performance, especially for AD and PD patients, in several ways

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