Intraindividual variability within and across conditions in driving simulator measures of neurology patients and healthy drivers

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Intraindividual variability in cognitive measures and reaction time is associated with cognitive impairment or dementia (e.g., Christensen et al., 2005; Thaler et al., 2015). The continuous nature of driving simulator measures lends itself to the study of intraindividual variability but has been investigated to a very limited extent.

The present study examines intraindividual variability in healthy drivers and drivers with neurological disorders in different driving environments and conditions.

**Participants**

Rural environment:
- 43 healthy drivers over 38 years (age of youngest patient) (M=54.63, SD=10.95)
- 37 mild cognitive impairment (MCI) drivers (M=68.43, SD=9.15)
- 16 mild Alzheimer’s disease (AD) drivers (M=75.38, SD=4.86)
- 15 Parkinson’s disease (PD) drivers (M=62.13, SD=10.24)

Urban environment:
- 33 healthy drivers over the age of 38 (M=56.06, SD=10.51)
- 28 MCI drivers (M=69.68, SD=9.84)
- 8 mild AD drivers (M=76.38, SD=3.89)
- 10 PD drivers (M=62.60, SD=9.18)

**Driving simulator experiment**

- Data from Distract and DriverBrain research projects
- All participants underwent neurological, neuropsychological and ophthalmological assessment
- **Driving simulator assessment:** all drivers drove a quarter-cab FOERST driving simulator (3 LCD wide screens 42", full HD: 1920x1080 pixels - total field of view 170 degrees, validated against a real world environment) in 4 rural (R) conditions, and 4 urban (U) conditions counterbalanced across participants.
- Rural conditions occurred before urban conditions.
- A practice drive (10-15 minutes) preceded the driving assessment

**Measures**

- Average speed (in km)
- Headway average (distance from the vehicle ahead in m)
- Lateral position (distance from the right road border in m)
- Average speed variability (SD of average speed)
- Headway variability (SD of headway average)
- Lateral position variability (SD of lateral position)
- Coefficient of Variation (CV) = Intraindividual SD / Intraindividual M

**RESULTS**

Repeated measure analyses were conducted with condition as within-subject variable and driver group as between-subject variable.

**Rural environment**

- No effect of driver group for any of the measures
- **Effect of condition:** Greater CV for Headway in R2, R4
- Smaller CV for Lateral position in R2, R4 (ps <0.001)

**Urban environment**

- Effect of driver group for Headway (MCI, AD < controls), and Lateral position (MCI > controls), (ps <0.01)
- **Effect of condition:** Greater CV for Headway in U2, U4 (ps <0.001)

**CONCLUSION**

- Intraindividual variability is stable across patient groups in Rural but not in Urban environments once corrected for performance level.
- High traffic conditions result in higher intraindividual variability in Headway (Rural, Urban) and lower intraindividual variability in Lateral position (Rural).
- MCI and mild AD drivers are more variable in Lateral position and less variable in Headway than controls in Urban environments.
- The Urban environment affects variability measures in MCI, mild AD drivers more than the Rural environment.

**References**