Intraindividual variability within and across conditions in driving simulator measures of healthy drivers of different ages

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BACKGROUND & AIMS

Intraindividual variability is a signal in its own right rather than error and is systematically associated with age and changes in cognitive functioning (Hultsch et al., 2008). Intraindividual variability in cognitive and psychomotor performance is important for understanding aging and cognition and is associated with cognitive load and task complexity (e.g., Bielak et al., 2014). It has been investigated to a very limited extent in driving performance, however.

The present study investigates intraindividual variability in healthy drivers of different ages on driving simulator measures in different driving environments and conditions.

METHODS

Participants

Healthy active drivers 22-78 years of age

- 72 drivers who participated in all 4 rural conditions (*M*=43.75, *SD*=15.97 years)
- 60 drivers who participated in all 4 urban conditions (*M*=42.03, *SD*=15.69 years)

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: 1920x1080pixels - 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

moderate traffic (R1, R3)
without & with distraction

high traffic (R2, R4)
without & with distraction

moderate traffic (U1, U3)
without & with distraction

high traffic (U2, U4)
without & with distraction (shown)

Distraction condition: conversation with passenger (R3, R4, U3, U4)

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* for Speed, Headway distance, Lateral position

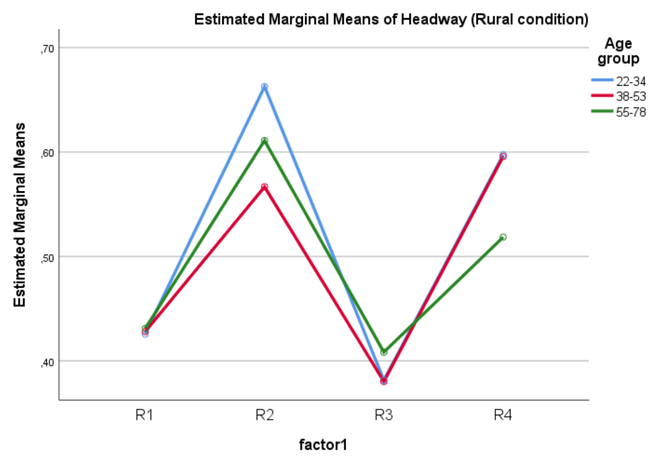
RESULTS

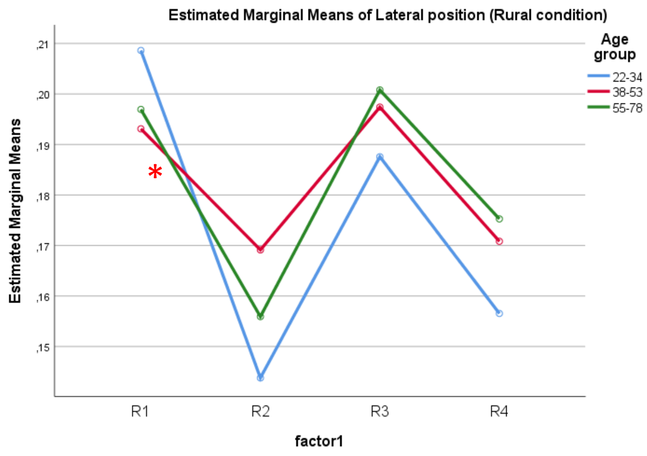
Repeated measure analyses were conducted with condition as within-subject variable and age group as between-subject variable.

Rural environment

No effect of age group for any of the measures
22-34 years of age (N=28); 38-53 (N=27); 55-78 (N=17)

Effect of condition: Greater CV for Headway in R2, R4
Smaller CV for Lateral position in R2, R4 (*p*s <0.001)



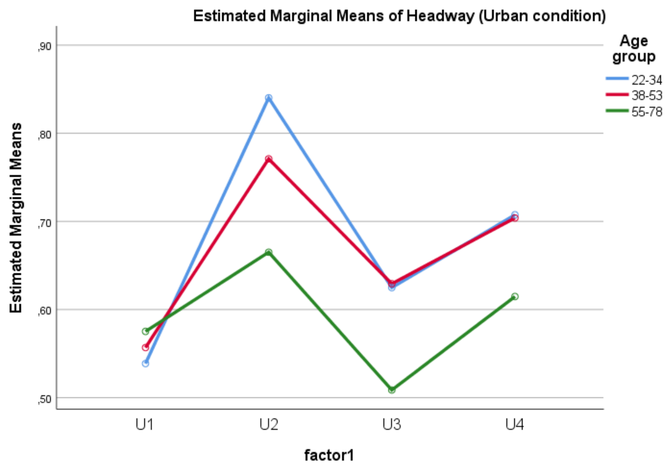


* Interaction (*p* <0.05)

Urban environment

No effect of age group for any of the measures
22-34 years of age (N=26); 38-53 (N=22); 55-78 (N=12)

Effect of condition: Greater CV for Headway in U2, U4 (*p* <0.001)



CONCLUSION

- Intraindividual variability is stable across different age groups and driving environments in healthy regular drivers, once corrected for performance level.
- High traffic results in higher intraindividual variability in Headway (Rural and Urban) and lower intraindividual variability in Lateral position (Rural).
- Task complexity associated with high traffic leads to greater variability across age groups but cognitive load associated with distraction does not.

References

Bielak, A. A., Cherbuin, N., Bunce, D., & Anstey, K. J. (2014). Intraindividual variability is a fundamental phenomenon of aging: Evidence from an 8-year longitudinal study across young, middle, and older adulthood. *Developmental Psychology*, *50*, 143-151.
Hultsch, D. F., Hunter, M. A., MacDonald, S. W. S., & Strauss, E. 2005. Inconsistency in response time as an indicator of cognitive aging. In Duncan J., Phillips L., Mc Leod P., eds. *Measuring the mind: speed, control, and age*. NY: Oxford University Press, pp 33-58.