Self-assessment of change in driving in relation to current driving performance on a driving simulator in patients with various neurological conditions

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Background & Aims

Perception of change in driving ability with age and cognitive decline is important for the self-monitoring of driving and the realistic adaptation to challenging driving situations. Such situations are difficult to investigate during on-road driving.

The aim of the study is to examine self-assessment of driving in relation to objective driving measures derived from a driving simulation experiment in different neurology patients and controls.

Materials & Methods

Participants

In these analyses, 157 drivers participated: 65 controls (>43 years, 61.62±8.55), 50 Mild Cognitive Impairment (MCI) patients (67.66±9.35 years), 23 mild Alzheimer's disease (AD) patients (72.61±6.46 years), and 19 Parkinson's disease (PD) patients (64.16±9.14 years). Different numbers of patients entered different analyses, depending on driving conditions completed.

Measures

Questionnaire measures:

Selected questions from a driving behavior questionnaire asking the driver to rate his/her driving in a variety of driving environments and conditions in relation to five years prior.

Driving measures:

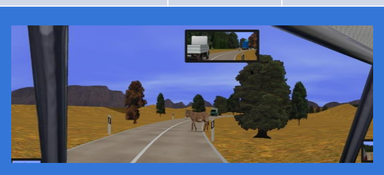
Average speed (in km); **average lateral position** (distance of the vehicle from the right road border in m), **headway average** (distance from the vehicle ahead in m), **number of speed limit violations**, **number of crashes at unexpected incidents**.

Average speed, average lateral position and headway average were z-transformed based on the entire sample of 102 controls (range: 22-80 years, 48.42±16.33 years).

Procedure

A FOERST quarter-cab driving simulator with three 42" LCD wide screens, full HD: 1920x1080 pixel 170° total field of view validated against a real world environment. After a 10-15 min. practice session, two driving sessions followed (about 15 min. each) on **urban** streets with multiple lanes, and on a two-lane **rural** road. Two unexpected incidents occurred during each trial: the sudden appearance of a child chasing a ball on the roadway or a car pulling out of a parking position (urban session); the sudden appearance of an animal (deer or donkey) on the road (rural session).

SESSION	AREA TYPE	TRIAL	TRAFFIC	DISTRACTOR	LENGTH (Km)	DURATION (min)
1	URBAN	U1	MODERATE	NONE	1.7	3:30
		U2	HIGH	NONE	1.7	3:30
		U3	MODERATE	CELL PHONE	1.7	3:30
		U4	HIGH	CELL PHONE	1.7	3:30
		U5	MODERATE	CONVERSATION	1.7	3:30
		U6	HIGH	CONVERSATION	1.7	3:30
2	RURAL	R1	MODERATE	NONE	2.1	3:30
		R2	HIGH	NONE	2.1	3:30
		R3	MODERATE	CELL PHONE	2.1	3:30
		R4	HIGH	CELL PHONE	2.1	3:30
		R5	MODERATE	CONVERSATION	2.1	3:30
		R6	HIGH	CONVERSATION	2.1	3:30
				TOTAL	22.8	42:00



Results

Figures 1-9: Association of driving measures with self-assessment Qs . *Compared to 5 years prior, how would you evaluate your driving in the following conditions?* **1=sign. worse 2=slightly worse 3=no difference**

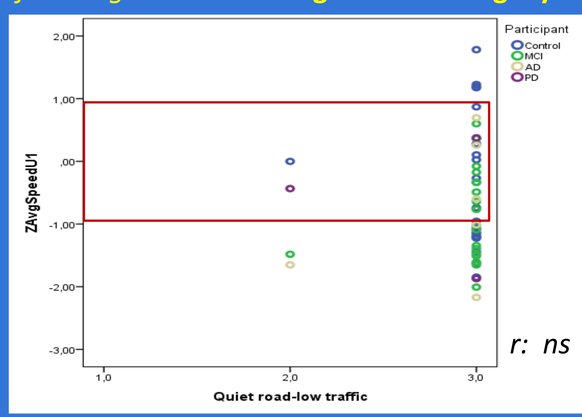


Fig. 1. Avg. speed- Urban mod. traffic

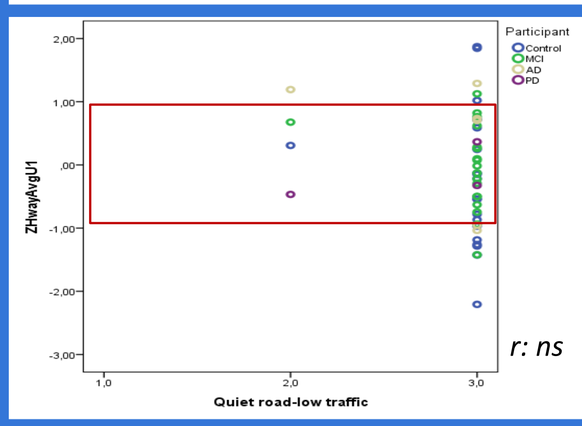


Fig. 2. Hway avg .- Urban mod. traffic

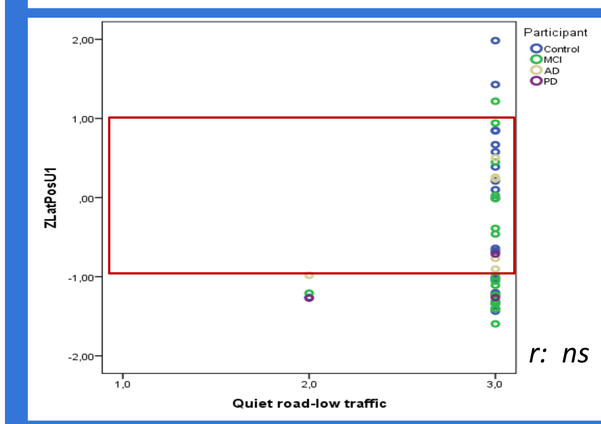


Fig. 3. Lat. position- Urban mod. traffic

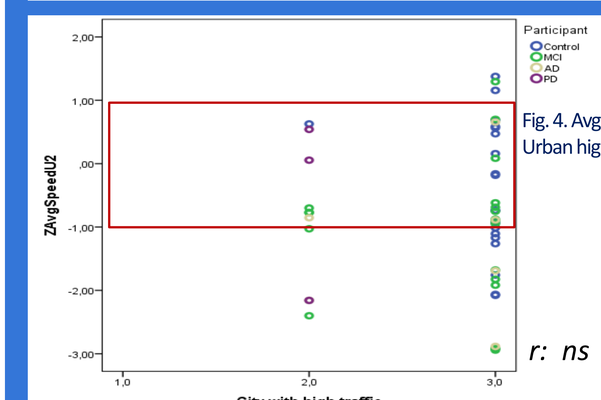


Fig. 4. Avg. speed - Urban high traffic

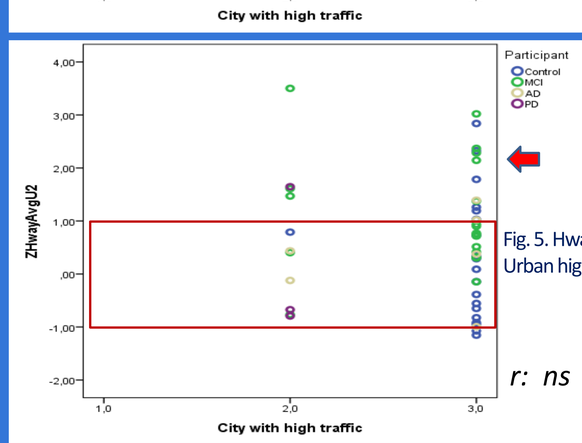


Fig. 5. Hway avg. - Urban high traffic

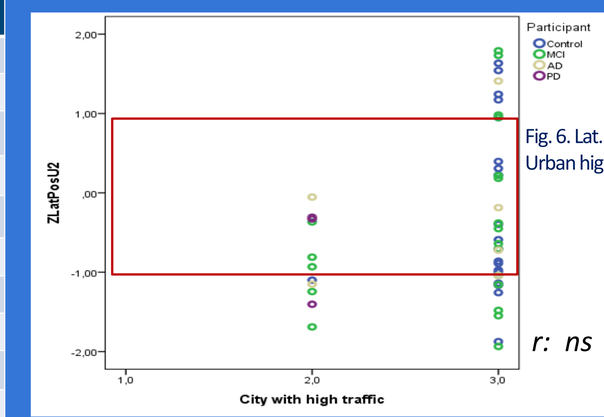


Fig. 6. Lat. Position - Urban high traffic

No significant differences were found in the 3 **Urban** driving measures among the groups, controlling for age.

Results (cont'd)

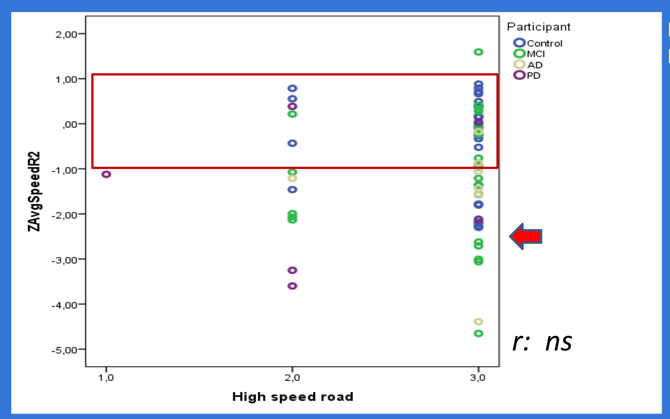


Fig. 7. Avg. speed- Rural high traffic

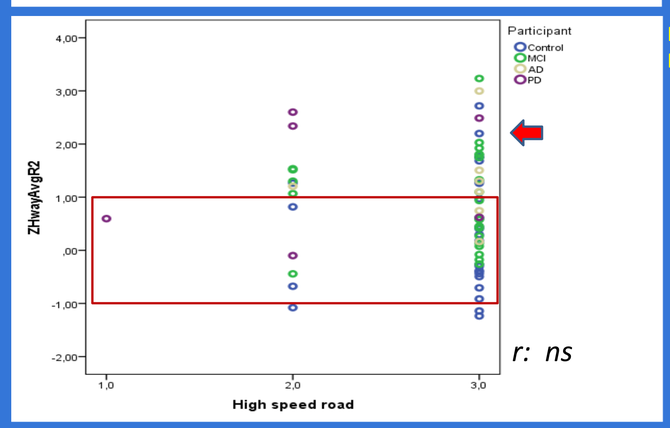


Fig. 8. Hway avg.- Rural high traffic

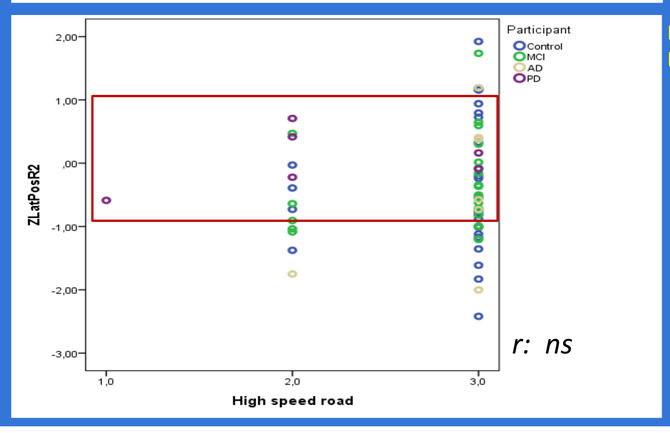


Fig. 9. Lat. position- Rural high traffic

No associations were found between the above Qs and **Rural** measures for moderate traffic (not shown here).

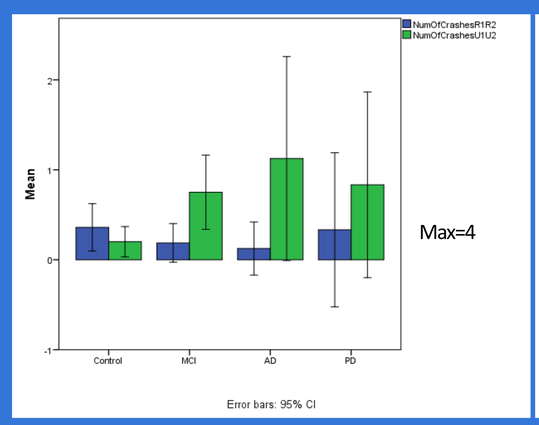
Rural, Moderate Traffic: PD <Controls in Average Speed, $p<.05$, PD >Controls in Headway Average, $p<.01$, controlling for age.

Rural, High Traffic: PD & AD <Controls in Average Speed, $p<.01$, PD & AD >Controls in Headway Average, $p<.01$, controlling for age.

Q1. *Delay of reaction in event of sudden break*
Q2. *Difficulty in perceiving vehicles and pedestrians that approach suddenly in front of you from a lateral position*
Q3. *Difficulty focusing on traffic signs in an environment where there are other signs*

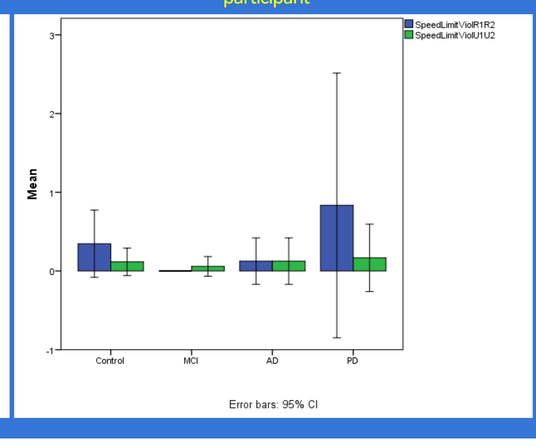
1=never 2=rarely 3=sometimes 4=often 5=always

Fig. 10. No. of crashes in Rural and Urban areas by participant



Max=4

Fig. 11. No. of speed limit violations in Rural and Urban areas by participant



No associations were found between Q1, Q2 & no. of crashes, Q3 & speed limit violations in **Rural** and **Urban** conditions (in moderate & high traffic). **Rural** condition: No. of crashes correlated with speed limit violations ($p<.05$).

Discussion & Conclusions

The driving simulator measures employed are poorly associated with self-assessment of driving performance.

Outliers (>±1SD) were more evident in the Rural condition, most likely due to higher speed demands. Slower speed and the correlated measure of larger headway distance in the AD and PD patients may reflect an adaptation to decline in abilities and therefore may not be perceived as a decline in self-assessment.

Self-assessment of readiness to sudden events is not associated with unexpected event crashes in the simulator. Crashes are rare events in real life and one's readiness to them may be difficult to self-assess.

All patients crashed more often in the Urban condition, with AD patients crashing more than 1 out of 4 times. PD patients made more speed limit violations in the Rural condition but showed the greatest variability.

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