Speed and accident rates in MCI and mild AD patients: preliminary results from a large driving simulation experiment

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Background & Aims

Driver performance in different road conditions with and without distraction offers valuable information concerning driving safety, yet it is difficult to investigate during on-road driving.[1] Herein, we present initial findings on speed of driving of mild cognitive impairment (MCI) and mild Alzheimer's disease (AD) patients and middle aged and older healthy controls with and without distraction (conversation) in a driving simulation experiment. Total number of crashes in unexpected incidents, were also computed.

The study aims to examine the contributions of traffic load and distraction to measures of driving behavior in the above groups.

Materials & Methods

Participants

In these analyses, 52 drivers participated: 22 controls (mean age 56.4 ± 8.9), 22 MCI patients (mean age 66.41 ± 10.00), and 8 mild AD patients (mean age 73.13 ± 8.81). Number of patients entering each type of analysis varied slightly.

Measures

Average speed (in km) in each condition and during each unexpected incident. Two unexpected incidents occurred per condition.

Total number of crashes for all Rural and Urban environments (4 conditions per environment: High and Low Traffic, with and without distraction).

Data collection

Two driving sessions (about 20 min. each) on urban streets with multiple lanes, and on a two-lane rural road. An unexpected incident occurs in each of the two sessions (sudden appearance of pedestrian or child on urban roads, of an animal on rural roads).

In these analyses, speed measures were derived from two Rural driving simulation environments: High Traffic with and without distraction (conversation). Moreover, total number of crashes in unexpected incidents, were computed separately for all Rural and Urban driving conditions.

Procedure

Neurological assessment

Participants underwent a neurological assessment and clinical history evaluation

Ophthalmological assessment

Participants' visual acuity and other possible visual problems were assessed

Neuropsychological assessment

Participants underwent a two-stage neuropsychological assessment and personality testing

Driving experiment

Driving was assessed with a Foerst FPF driving simulator, in different conditions

Experimental design

A mixed factorial design, with **within-subjects factors**: area type, traffic flow, and presence/type of distractor, and **between-subjects factor**: participant type. Traffic and distractor are fully counterbalanced for each area type.

SESSION	AREA TYPE	TRIAL	TRAFFIC	DISTRACTOR	LENGTH (Km)	DURATION (min)
1	URBAN	1	MODERATE	NONE	1.7	3:30
		2	HIGH	NONE	1.7	3:30
		3	MODERATE	CELL PHONE	1.7	3:30
		4	HIGH	CELL PHONE	1.7	3:30
		5	MODERATE	CONVERSATION	1.7	3:30
		6	HIGH	CONVERSATION	1.7	3:30
2	RURAL	7	MODERATE	NONE	2.1	3:30
		8	HIGH	NONE	2.1	3:30
		9	MODERATE	CELL PHONE	2.1	3:30
		10	HIGH	CELL PHONE	2.1	3:30
		11	MODERATE	CONVERSATION	2.1	3:30
		12	HIGH	CONVERSATION	2.1	3:30
				TOTAL	22.8	42:00

Preliminary results

Univariate analyses of variance were performed for each of the measures, with group as fixed variable and age as covariate, comparing each patient group to the control group.

Nonparametric (Kruskal-Wallis) tests examined the distribution of total number of crashes in the Rural and Urban conditions, separately.

Figure 1. Average speed of participants in the Rural High Traffic No Distraction condition

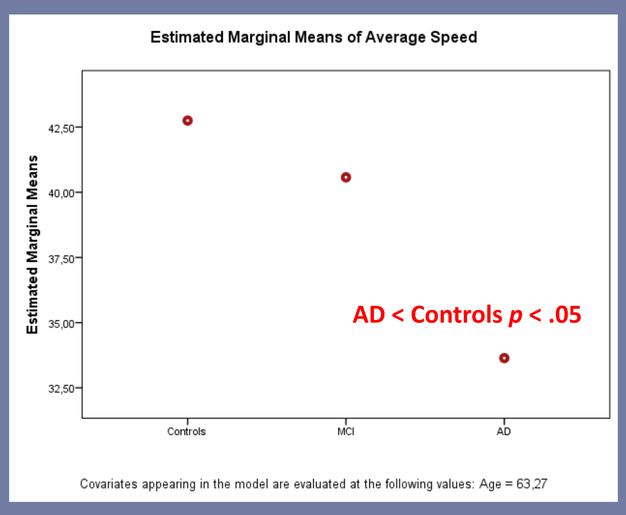
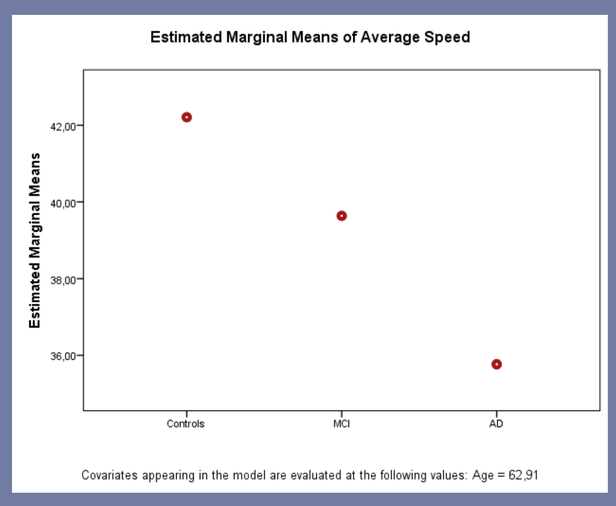


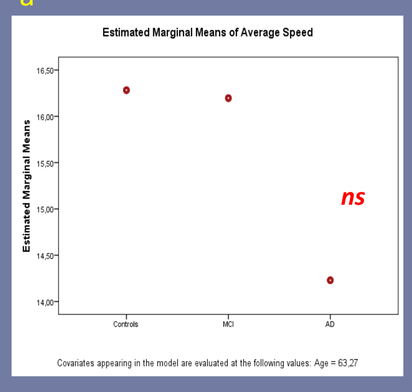
Figure 2. Average speed of participants in the Rural High Traffic Distraction condition



Preliminary results (cont'd)

Figure 3. Average speed of participants in the Rural High Traffic No Distraction condition, in unexpected incidents

a



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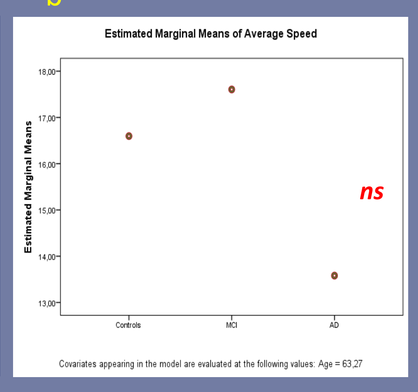

Figure 4. Average speed of participants in the Rural High Traffic Distraction condition, in unexpected incidents

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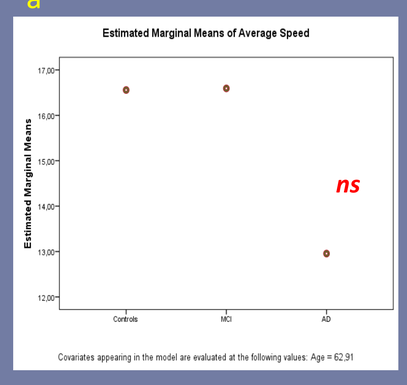

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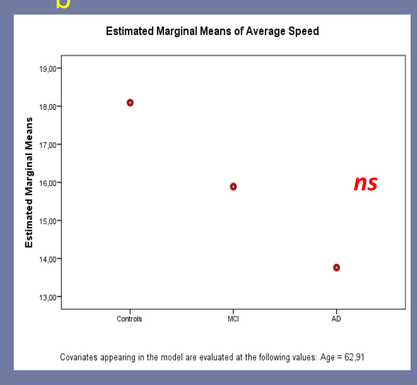

Both **age** and **participant type** were significant in the **Rural High Traffic No Distraction** condition ($p < .05$) . Only **age** was significant in the **Rural High Traffic Distraction** condition ($p < .05$) .

Nonparametric (Kruskal-Wallis) tests showed that the distribution of total number of crashes did not differ in the **Rural** condition, but was significantly different in the **Urban** Condition, with controls showing fewer crashes ($p < .05$).

Discussion

AD patients drove slower than controls in Rural High Traffic with no distraction. Age was also an important determinant of speed in these middle-aged/older samples. Slower speed may represent an adaptation to challenging traffic situations in cognitive decline.

The Urban environment is more demanding of the patients' ability to handle unexpected incidents. Patients had more crashes than controls, without differing in driving speed during the incidents. Crashes indicate failure to meet challenging traffic situations adequately. They represent safety risk potential and are predicted by decline in cognitive functioning.[2]

The small number of patients analyzed thus far may have concealed further differences in the groups. The inclusion of more patients in this ongoing study will clarify differences in driving parameters.

References

1. Shechtman O, Classen S, Awadzi K, Mann W (2009) Comparison of driving errors between on-the-road and simulated driving assessment: A validation study. *Traffic Inj Prev* **10**, 379-85.
2. Aksan N, Anderson SW, Dawson JD, Johnson AM, Uc EY, Rizzo M (2012) Cognitive functioning predicts driver safety on road tests 1 and 2 years later. *J Am Geriatr Soc* **60**, 99-105.

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