



City and rural driving performance in healthy controls, MCI, and AD patients: Preliminary results from a driving simulation experiment with the use of distraction



aoikono@psych.uoa.gr

A. Economou¹, M. H. Kosmidis², I. Beratis³, N. Andronas³, G. Yannis⁴, S. G. Papageorgiou³

¹Department of Psychology, University of Athens, ²Department of Psychology, Aristotle University of Thessaloniki, ³“Attikon” University General Hospital, Department of Neurology, University of Athens, ⁴Department of Transportation Planning & Engineering, National Technical University of Athens

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. The aim of the study is to present preliminary findings on driving measures of middle aged/older healthy controls and neurology patients in in four Urban and four Rural driving environments: Moderate traffic with/without distraction and High traffic with/without distraction (conversation). The study examines the contribution of traffic load and distraction to driving measures in the above groups. It is part of a larger driving simulator experiment funded by the National Strategic Reference Framework (NSRF 2007-2013).

Materials & Methods

Participants

Seventy-six drivers participated: 31 controls >50 years of age (age: 61.11 ±8.63, MMSE: 29.22 ±8.89), 30 mild cognitive impairment (MCI) patients (age: 69.57 ±8.71, MMSE: 27.75 ±2.22), and 15 mild AD patients (age: 73.73 ±7.09, MMSE: 22.80 ±4.73). Number of patients entering each analysis varied.

Measures

- Average speed** (in km) in each condition.
- Lateral position** of the vehicle (in m) from the right road border.
- Average distance** (in m) from the vehicle ahead.

Data collection

Measures were taken during a 42 min. drive on a Foerst FPF driving simulator. They were taken from 8 driving environments: **Urban Moderate Traffic with/without Distraction, Urban High Traffic with/without Distraction, Rural Moderate Traffic with/without Distraction, Rural High Traffic with/without Distraction** (conversation). Each driving condition lasted 3:30 min. Rural driving and took place on a two-lane rural road.

Procedure

<p>Neurological assessment</p> <p>Participants underwent a neurological assessment and clinical history evaluation</p>	<p>Ophthalmological assessment</p> <p>Participants' visual acuity and other possible visual problems were assessed</p>	<p>Neuropsychological assessment</p> <p>Participants underwent a 2-stage neuropsychological assessment and personality testing</p>	<p>Driving experiment</p> <p>Driving was assessed with a Foerst FPF driving simulator, in different conditions</p>
--	--	--	--

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.

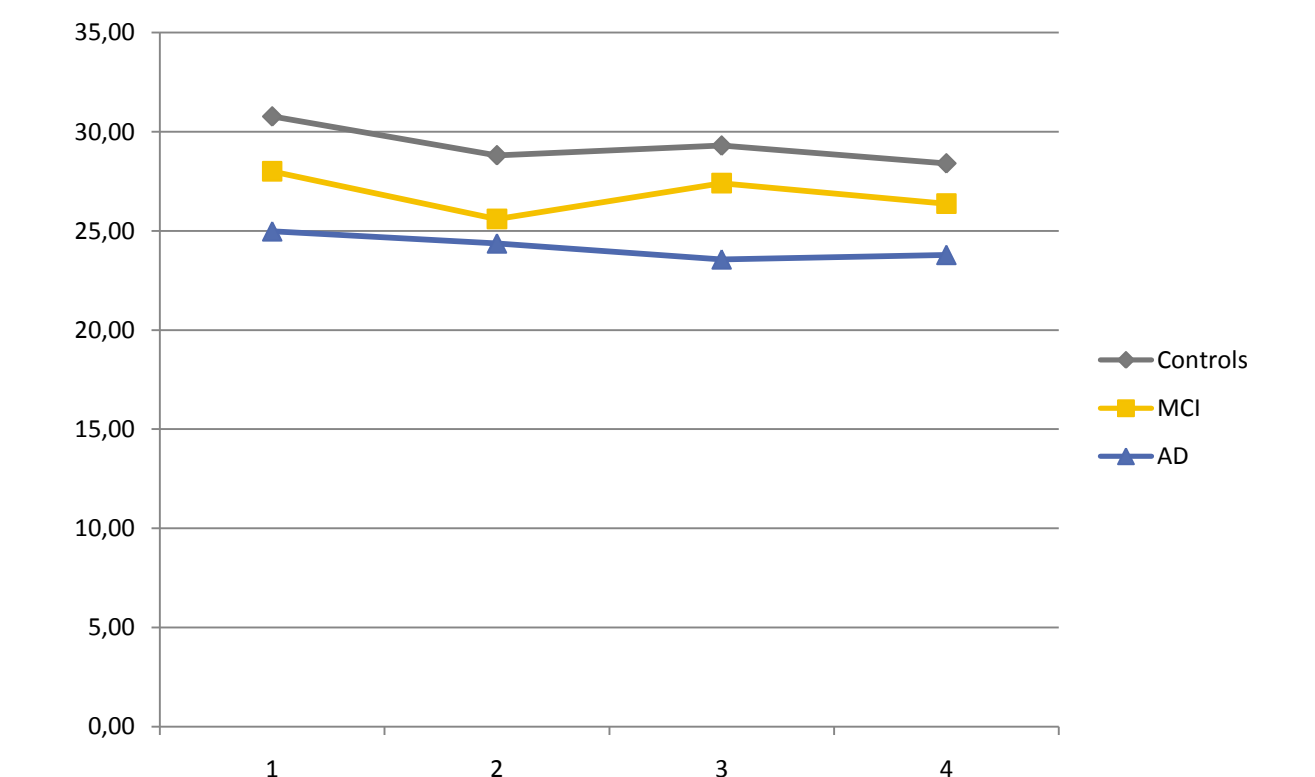
SESSION	AREA TYPE	TRIAL	TRAFFIC	DISTRACTOR	LENGTH (km)	DURATION (min)
1	URBAN	1	MODERATE	NONE	1.7	3:30
		2	HIGH	NONE	1.7	3:30
		3	MODERATE	CELL PHONE	1.7	3:30
		4	HIGH	CELL PHONE	1.7	3:30
		5	MODERATE	CONVERSATION	1.7	3:30
		6	HIGH	CONVERSATION	1.7	3:30
2	RURAL	7	MODERATE	NONE	2.1	3:30
		8	HIGH	NONE	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.

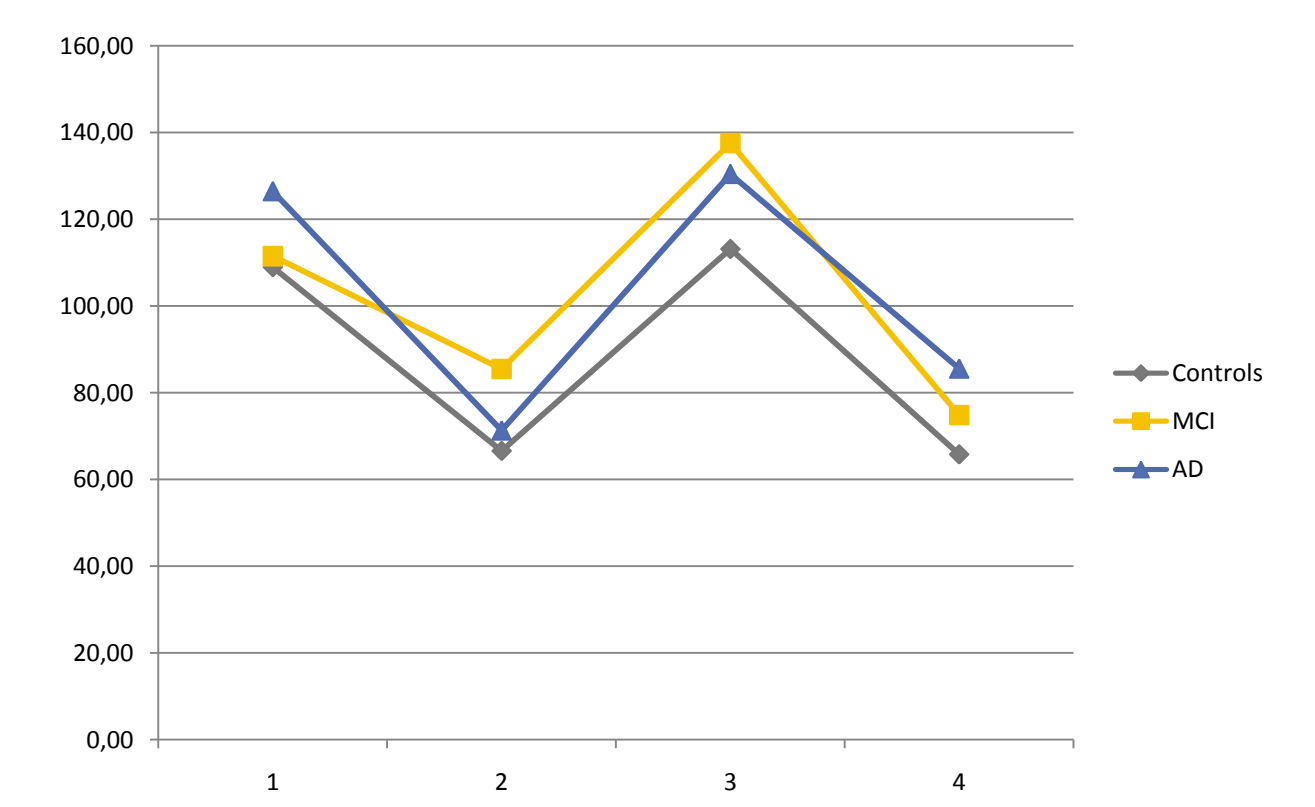
Urban environment – Average speed

- Mod. Traffic no distraction**
No significant differences.
- High Traffic no distraction**
Effect of age ($p < .05$, $\eta^2 p = .08$).
- Moderate Traffic with distraction**
AD slower than controls ($p < .05$).
- High Traffic with distraction**
Effect of age ($p < .05$, $\eta^2 p = .08$).



Urban environment – Average distance from the vehicle ahead

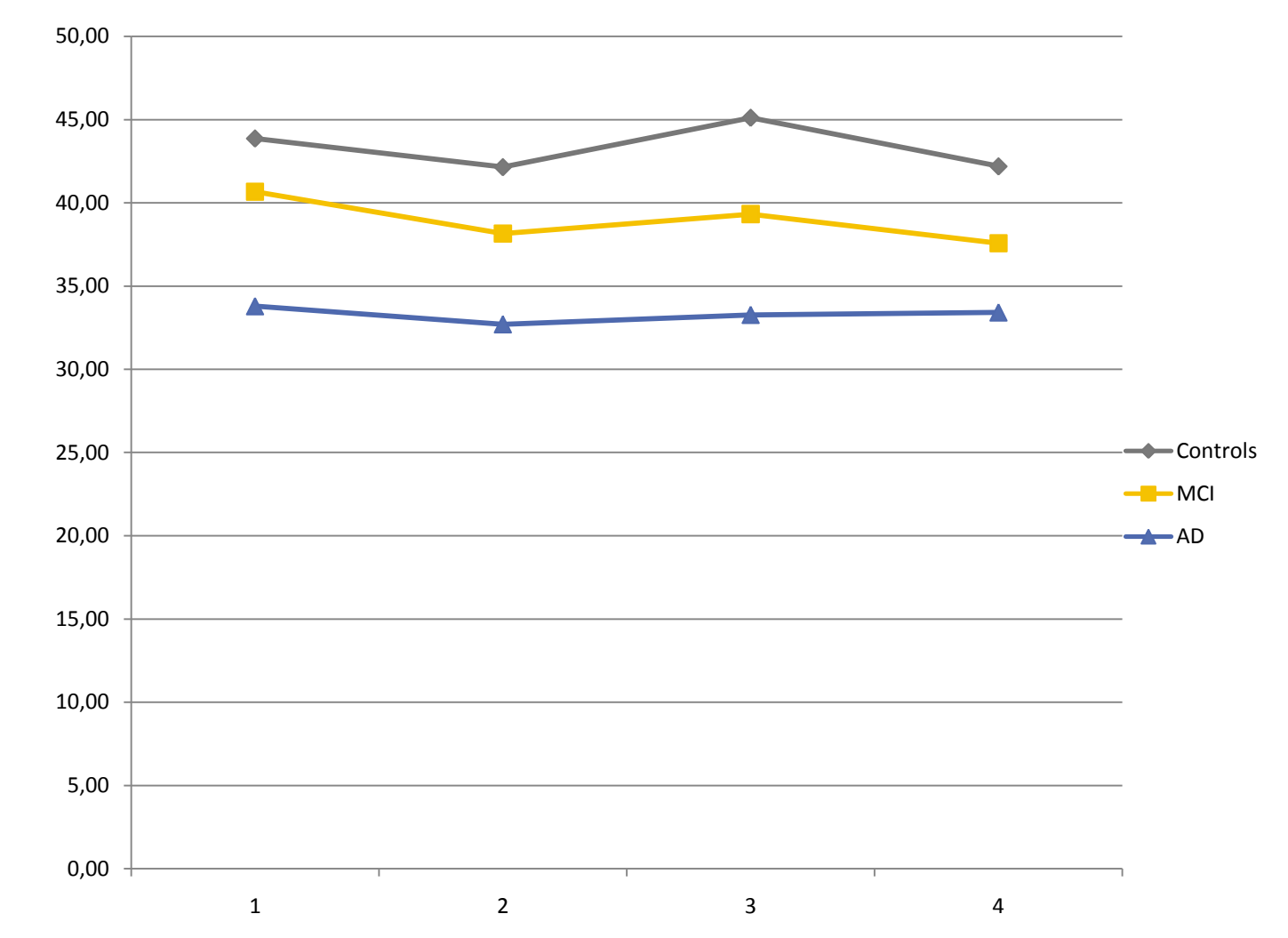
- Moderate Traffic no distraction**
No significant differences.
- High Traffic no distraction**
MCI left longer distances than controls ($p < .05$).
- Moderate Traffic with distraction**
No significant differences.
- High Traffic with distraction**
No significant differences.



Preliminary results (cont'd)

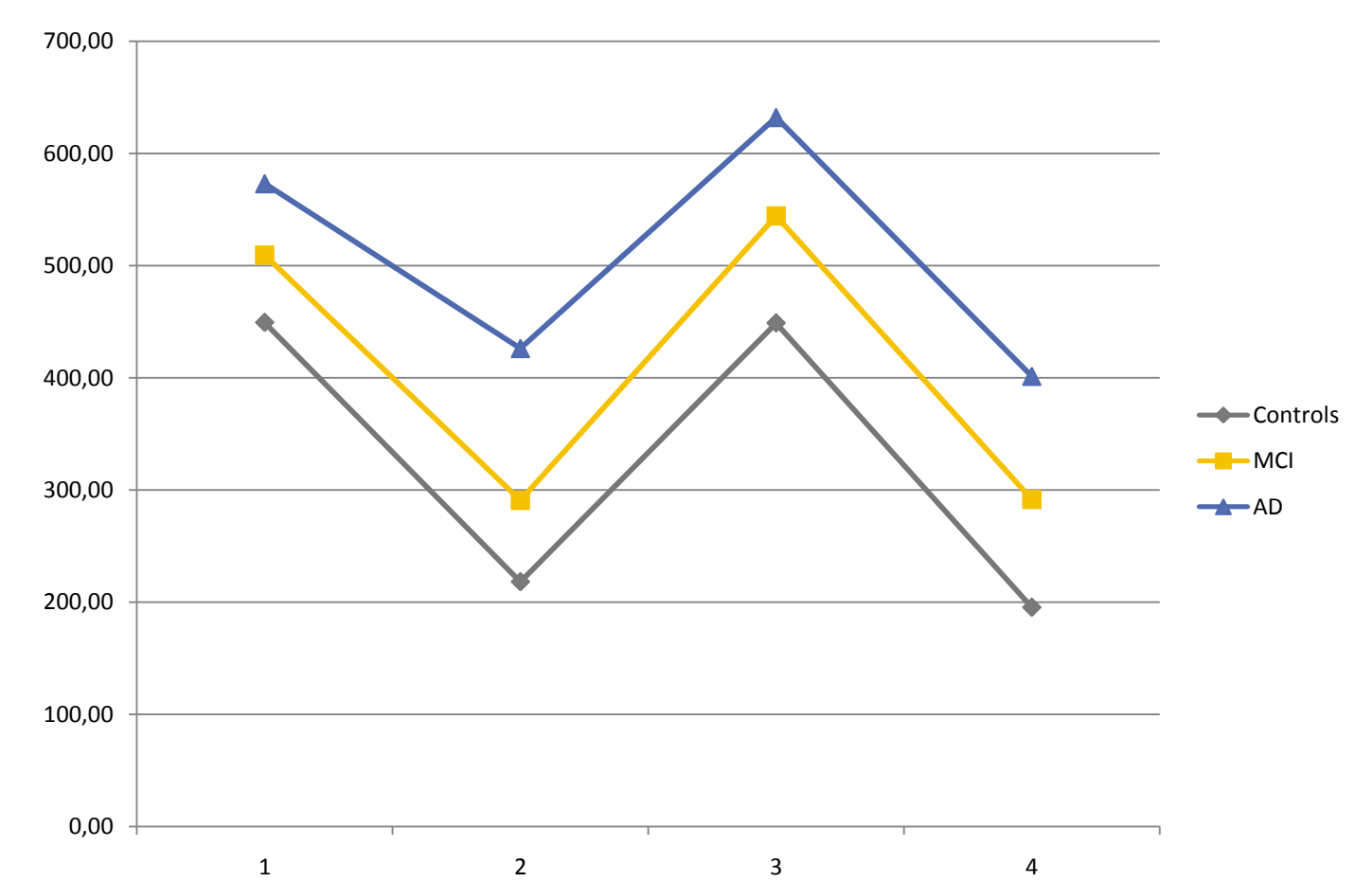
Rural environment – Average speed

- Moderate Traffic no distraction**
Effect of participant ($p < .05$, $\eta^2 p = .10$).
AD slower than controls ($p < .05$).
- High Traffic no distraction**
Effect of participant ($p < .05$, $\eta^2 p = .10$).
AD slower than controls ($p < .01$).
Effect of age ($p < .05$, $\eta^2 p = .08$).
- Moderate Traffic with distraction**
Effect of participant ($p < .01$, $\eta^2 p = .15$).
MCI slower than controls ($p < .05$).
AD slower than controls ($p \leq .001$).
- High Traffic with distraction**
Effect of participant ($p < .05$, $\eta^2 p = .09$).
AD slower than controls ($p < .05$).



Rural environment – Average distance from the vehicle ahead

- Moderate Traffic no distraction**
No significant differences.
- High Traffic no distraction**
Effect of participant ($p < .01$, $\eta^2 p = .14$).
AD left longer distances than controls ($p \leq .001$).
- Moderate Traffic with distraction**
Effect of participant ($p < .05$, $\eta^2 p = .10$).
AD left longer distances than controls ($p \leq .01$).
- High Traffic with distraction**
Effect of participant ($p < .01$, $\eta^2 p = .16$).
MCI left longer distances than controls ($p < .05$).
AD left longer distances than controls ($p < .0001$).



Discussion & Conclusions

No differences in lateral position were found among the groups.

AD patients drove more slowly than controls in the Rural environment irrespective of traffic and distraction. **MCI patients drove more slowly in moderate traffic with distraction.**

AD patients left longer distances than controls in the Rural environment under conditions of high traffic/distraction. MCI patients left longer distances in the most demanding high traffic with distraction condition.

Driving in the **Rural environment** is more taxing for mild AD and to a lesser extent for MCI patients, probably because of higher speed demands. Patients reduced speed and left larger distances from the vehicle ahead as compensation for driving difficulties.