# Compensatory strategies in the driving behavior of MCI, AD, and PD patients: Preliminary results from a large driving simulation experiment with the use of distraction


A. Economou[1], M. H. Kosmidis[2], I. Beratis[3], N. Andronas[3], G. Yannis[4], S. G. Papageorgiou[3]

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

aoikono@psych.uoa.gr



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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] Alzheimer's disease (AD) and Parkinson's disease (PD) patients make different kinds of safety errors on road tests, which likely reflect their respective deficits.[2] The nature of their driving errors is difficult to examine during on-road driving due to of lack of control of traffic parameters and safety reasons. Herein, we present initial findings on driving measures of neurology patients and healthy controls in three rural driving simulation environments: Moderate Traffic with No Distraction, High Traffic with and with No Distraction. 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, 63 drivers participated: 22 controls (mean age 56.36 ± 8.89), 22 mild cognitive impairment (MCI) patients (mean age 66.41 ± 10.00), 8 mild AD patients (mean age 73.13 ± 8.81), and 11 PD patients (mean age 63.64 ± 10.96). 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.
**Average time to collision** (in sec) with vehicle ahead (projection).

### Data collection

Measures were taken during a 42 min. drive on a Foerst FPF driving simulator. Specifically, measures were taken from 3 driving environments: **Rural Moderate Traffic no Distraction**, **Rural High Traffic no Distraction**, **Rural High Traffic with Distraction** (conversation). Each driving condition lasted 3:30 min. and took place on a two-lane rural road.

## 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 2-stage neuropsychological assessment and personality testing

**Driving experiment**

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

## Experimental design

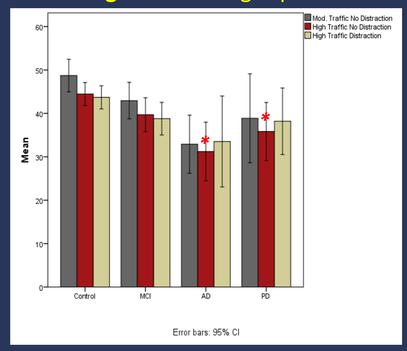
A mixed factorial design, with **within-subjects factors**: area type, traffic flow, and presence/type of distractor, and **between-subjects factor**: participant type. Traffic and distractor are fully counterbalanced for each area type.

| 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. (Figures shown unadjusted for age).

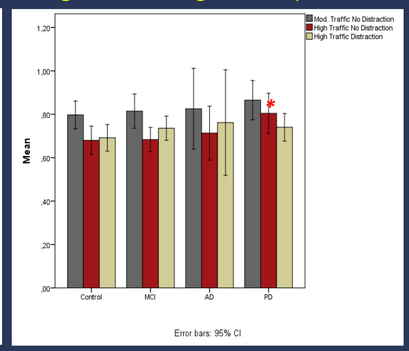
**Figure 1**. Average speed




*$p < .05$

**Age**: $p < .05$ High Traffic No Distraction & Distraction

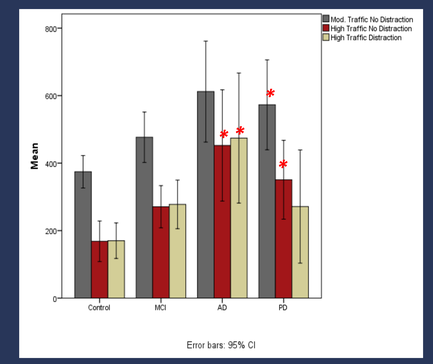
**Figure 2**. Average lateral position




*$p < .05$

## Preliminary results (cont'd)

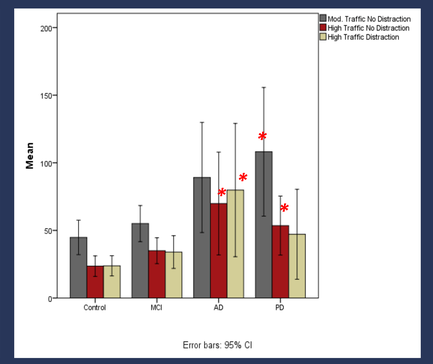
**Figure 3**. Average distance from vehicle ahead




*$p < .01$

**Age**: $p < .01$ Mod. Traffic No Distraction,
$p < .05$ High Traffic No Distraction & Distraction

**Figure 4**. Average time to collision




*$p < .01$

**Age**: $p < .01$ Mod. Traffic No Distraction,
$p < .05$ High Traffic No Distraction

## Discussion

Both **AD** and **PD patients** drove slower than controls in the **High Traffic No Distraction** condition. Slower speed may represent an adaptation to challenging traffic situations in cognitive decline (and aging), as well as impaired motor control.

**AD patients** increased their distance from the vehicle ahead in the **High Traffic** condition irrespective of distraction, and consequently took more time to collision (a projection) than controls, which likely reflects a compensatory strategy for driving difficulties in the more demanding, high traffic environments. **PD patients** increased their distance from the vehicle ahead and consequently took more time to collision than controls in the **Moderate Traffic** and **High Traffic No Distraction** conditions, which likely reflects a compensatory strategy for motor slowing irrespective of traffic volume. Moreover, they deviated more from the road in the **High Traffic No Distraction** condition, reflecting poor motor control.

Small patient samples in these preliminary analyses may conceal other group differences. Greater sample sizes will confirm and extend the above findings in this ongoing study.

## References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2. Grace J, Amick MM, D' Abreu A, et al. Neuropsychological deficits associated with Parkinson's and Alzheimer's disease. *J Int Neuropsychol Soc 2005;* **11**:766-775.



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