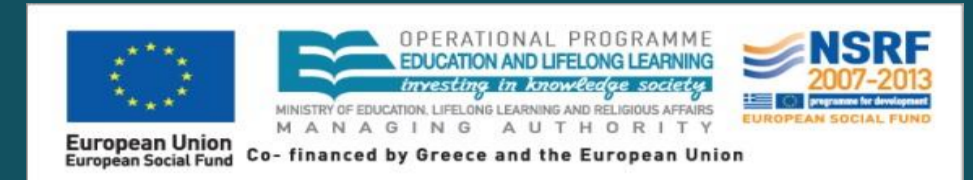


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5th conference

Transport Solutions:  
 from Research to Deployment  
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 Paris - La Défense CNIT, 14 - 17 April 2014

## Introduction

Driving performance may be affected by a number of cerebral diseases, in the general population and particularly in the elderly, who exhibit a higher risk of involvement in a road accident.

The objective of this research is the investigation of the **driving performance - assessed on driving simulator** - of drivers with cerebral diseases, especially at unexpected incidents.



## Method

The driver performance is examined in terms of both traffic and safety parameters.

A large experiment is carried out, which includes three types of assessment:

- Medical/neurological assessment
- Neuropsychological assessment
- Driving at the simulator

The driving performance measures examined include speed, lateral position, reaction time at incidents etc.



## Overview of the experiment



This study is carried out within the framework of two research projects: the **DriverBrain** (<http://www.nrso.ntua.gr/driverbrain>) and the **DistrACT** (<http://www.nrso.ntua.gr/distract>) research projects, carried out by an **interdisciplinary research team of engineers, neurologists and psychologists.**

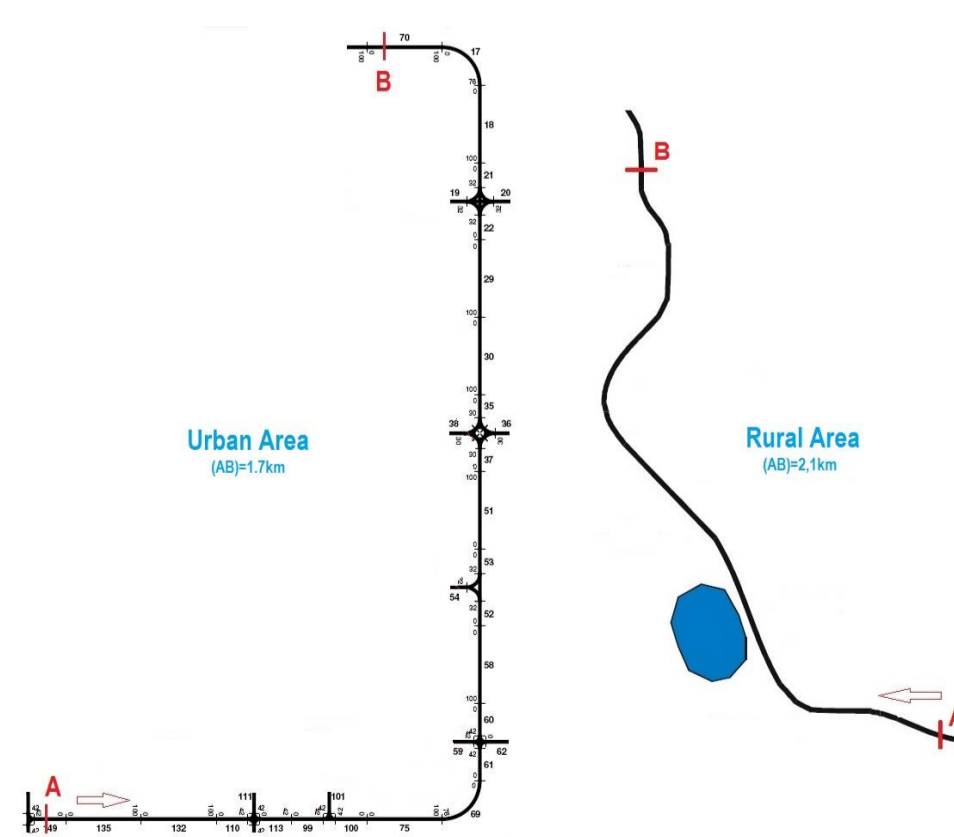
In this research 39 participants have been through all phases and assessments of the experiment. Three groups are compared: 15 AD/MCI drivers\*, 7 PD drivers, and 17 drivers from the Control group, in rural and urban driving session, without any kind of external distraction, in low and high traffic volume.



\*AD and MCI conditions are grouped together, due to the known similarities between the two pathologies, in order to have an acceptable sample size for this group.

## Experiment design

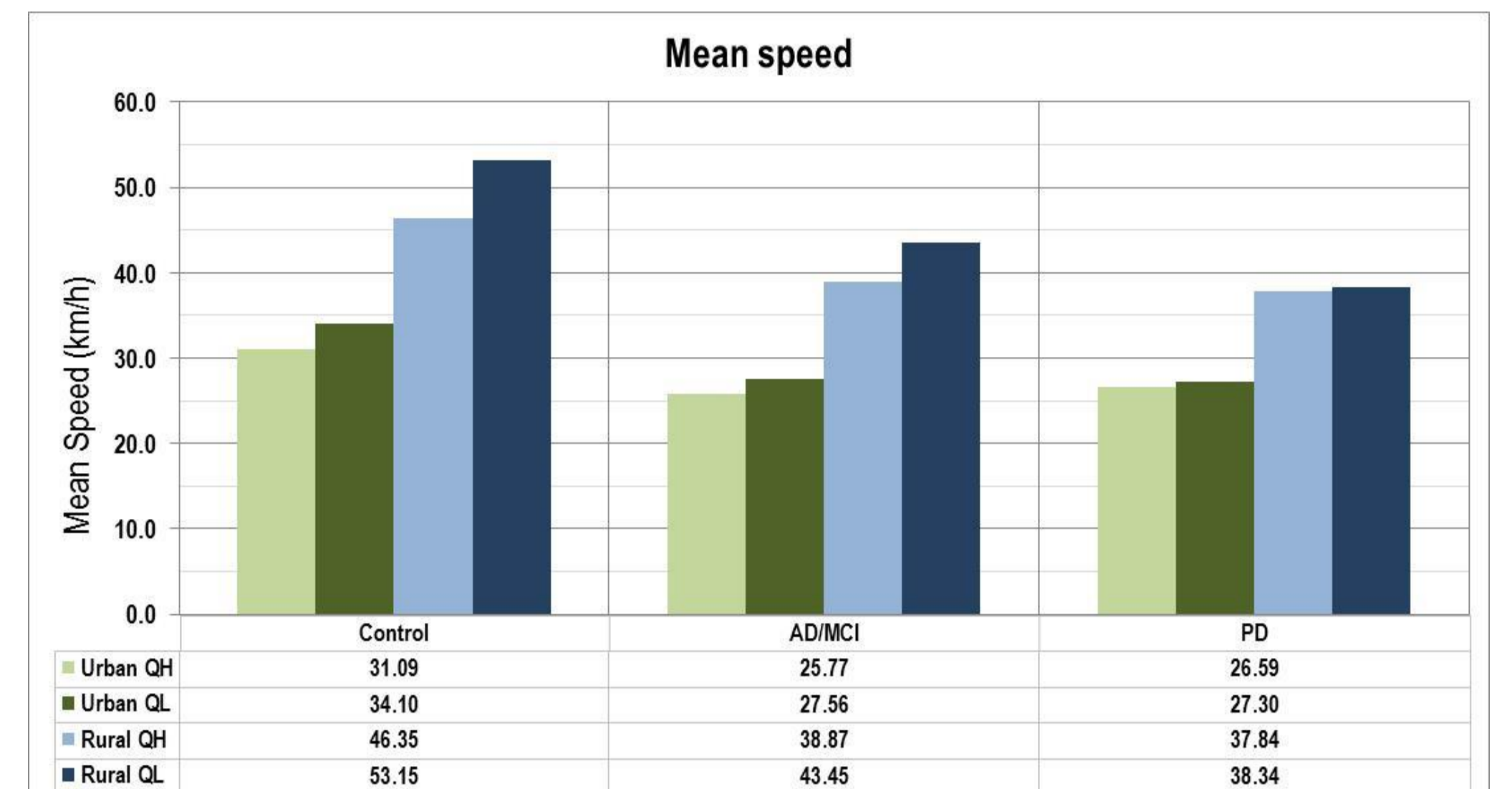
- Full factorial within-subject design
- 1 driving simulator  
Foerst Driving Simulator FPF (1/4 cab)
- 2 road environments  
Rural: undivided two-lane rural road  
Urban: divided urban arterial
- 2 traffic scenarios  
QM: Moderate traffic conditions  
QH: High traffic conditions
- 2 unexpected incidents at each trial  
Deer or donkey at rural area  
Child crossing the road or sudden appearance of a car at urban area



## Results

### A. Mean Speed

- Control drivers 24% higher speed overall than impaired
- AD or MCI drivers slightly higher speed than drivers with PD
- In urban areas, especially at high traffic volume, impaired drivers' mean speed 50% lower than the speed limit

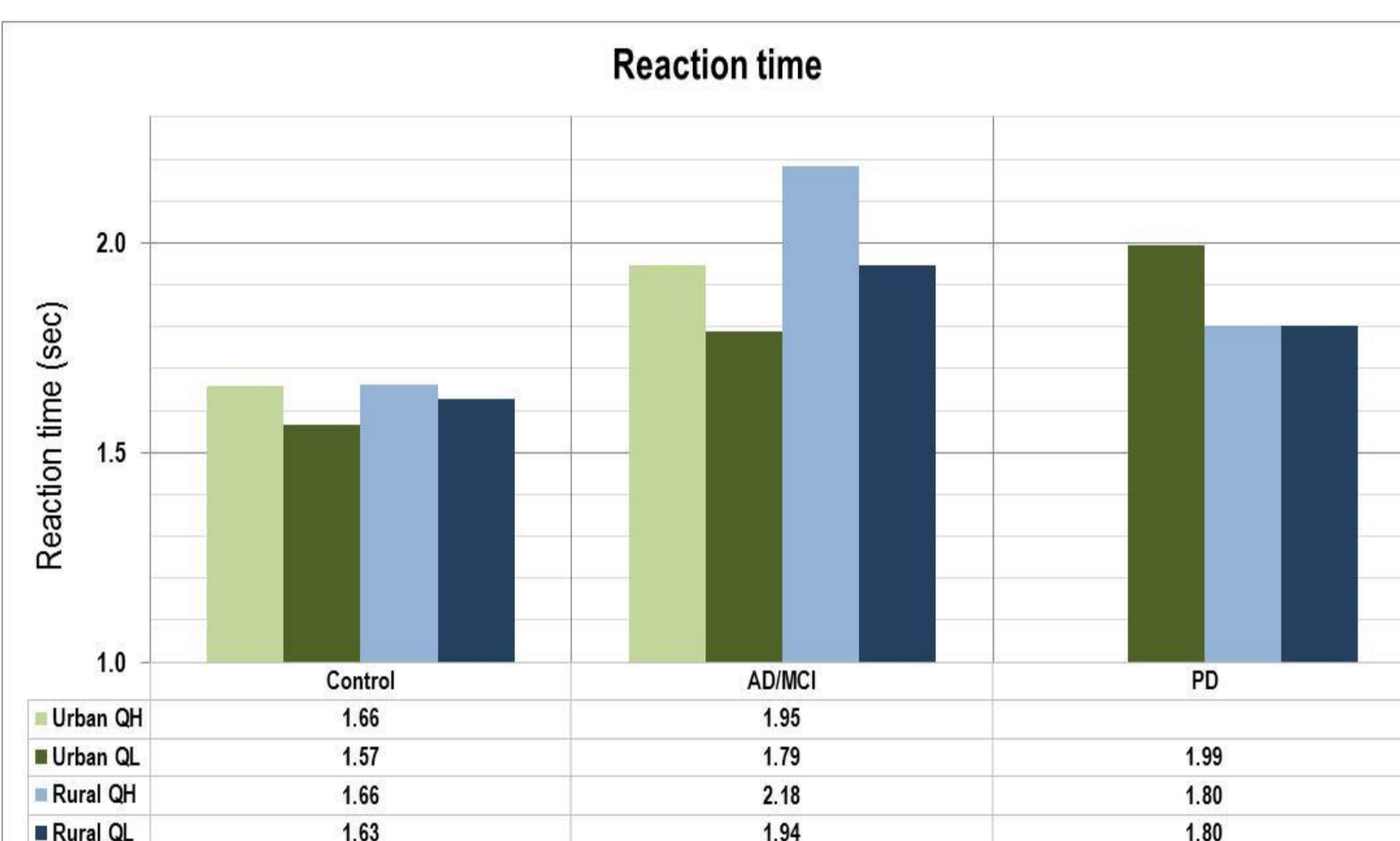


### B. Headway

- Impaired drivers (especially PD drivers) keep much larger headways compared to the control group

### C. Lateral position

- In urban area, control drivers show somewhat increased variability in lateral position, because there are parts of the road with two lanes per direction, and these drivers take initiatives for lane changing or overtaking, whereas the impaired group drives more conservatively



### D. Reaction Time

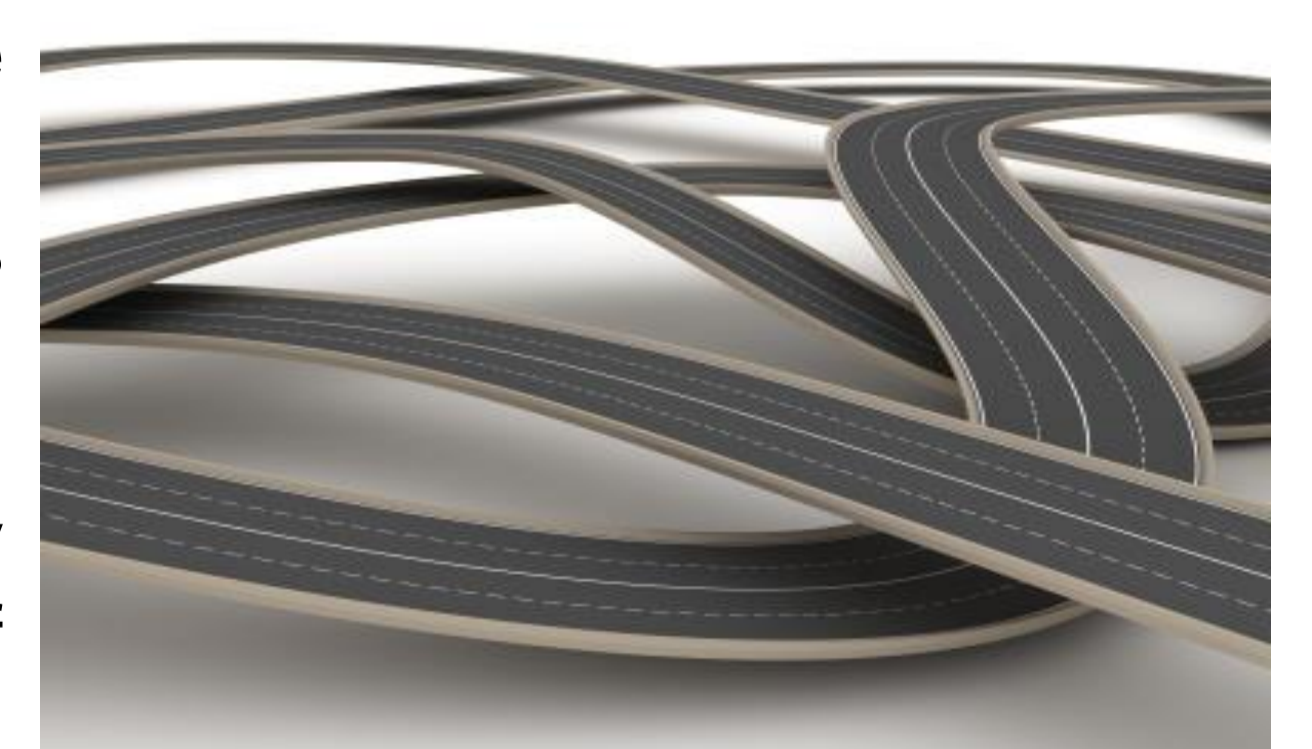
- In lower traffic volume reaction times are faster; it is possible that the more complex traffic environment makes incidents less detectable
- Impaired drivers have higher reaction times in all driving conditions (by 18% overall) than the control group

### E. Accident probability

- Control drivers in urban area have lower accident probability than impaired
- In rural area all drivers seem to have the same probability of getting involved in an accident at the event
- PD drivers appear to have strikingly higher accident probability in urban areas, possibly due to the complexity of the road and traffic setting

## Conclusions

Overall, cerebral diseases appear to have **considerable impact on longitudinal driving performance measures**, but less identifiable impact on lateral driving performance measures. It should be kept in mind, however, that this may be partly attributed to the road geometric design of the simulated drive.



It is possible that the relatively small sample size does not allow for all potential effects of cerebral diseases on driving performance to be identified. The representativity of the sample also needs improvement. However, the above results are quite promising and it is likely that once a larger and more representative sample is available, the analysis may be enhanced in several ways. The application of appropriate statistical techniques on a larger sample, and the combined analysis of specific medical, neurological and neuropsychological indicators with the driving simulator data may **shed some light on the mechanisms of impaired driving due to cerebral diseases.**

### Acknowledgements

This study is based on a research project is implemented within the framework of the Action «ARISTEIA» of the Operational Program "Education and Lifelong Learning" (Action's Beneficiary: General Secretariat for Research and Technology), and is co-financed by the European Social Fund (ESF) and the Greek State

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