Monitoring behaviour of drivers with cognitive impairments

**DriverBrain**

**Dimos Pavlou**
Civil - Transportation Engineer, PhD
Research Associate

Department of Transportation Planning and Engineering,
National Technical University of Athens, Athens, Greece

Website: [www.nrso.ntua.gr/dpavlou](http://www.nrso.ntua.gr/dpavlou)
e-mail: dpavlou@central.ntua.gr

Together with:
Eleonora Papadimitriou, Panagiotis Papantoniou, Sophia Vardaki, Costas Antoniou, John Golias, George Yannis
Dimos Pavlou, Monitoring behaviour of drivers with cognitive impairments - DriverBrain

**DRIVERBRAIN**
Performance of drivers with cerebral diseases at unexpected incidents

- **ARISTEIA research programme**
  - (2012-2015)

- **Inter-disciplinary project**
  - Transportation Engineers (NTUA)
  - Neurologists (Attikon Hospital - NKUA)
  - Neuropsychologists (Attikon Hospital - NKUA)

- **Objective:** Investigation of the performance of drivers with cerebral diseases (AD, PD, and MCI) at unexpected incidents through a driving simulator experiment
The problem

- Driving requires the ability to receive sensory information, process the information, and to make proper, timely judgments and responses.

- Various motor, visual, cognitive and perceptual deficits can affect the ability to drive and lead to reduced driver fitness and increased accident probability.

- More specifically, diseases affecting a person's brain functioning may significantly impair the person's driving performance (Mild Cognitive Impairment, Alzheimer’s Disease, Parkinson’s Disease).
Methodological Challenges

- Medical/neurological assessment: administration of a full clinical medical, ophthalmological and neurological evaluation

- Neuropsychological assessment: administration of a series of neuropsychological tests and psychological - behavioral questionnaires to the participants which cover a large spectrum of Cognitive Functions

- Driving at the simulator:
  - 1 rural route and 1 urban route
  - 2 traffic scenarios for each route:
    - QL: Moderate traffic conditions (Q=300 vehicles/hour)
    - QH: High traffic conditions (Q=600 vehicles/hour)
  - 3 distraction conditions for each route:
    - Undistracted driving
    - Driving while conversing with a passenger
    - Driving while conversing on a hand-held mobile phone
  - 2 unexpected incidents during each trial
Dimos Pavlou, Monitoring behaviour of drivers with cognitive impairments - DriverBrain

Dataset in numbers

316 participants in total
800 hours of neurological/neuropsychological tests
200 hours of driving at the simulator
2,500 trials driven in the simulator
6,000,000 bytes of “row” data
13,000,000 rows in the database
635 variables (driving simulator + questionnaire + neurological/neuropsychological)
Main findings 1/2

Dimos Pavlou, Monitoring behaviour of drivers with cognitive impairments - DriverBrain
Main findings 2/2

- Patients have a **more conservative and cautious** driving pattern
- Patients **drive significantly slower** than healthy controls
- Patients have significantly **worse reaction time** and **higher accident probability**
- **#SlowDown** is not sufficient to **counterbalance** the driving deficits due to cognitive impairments
Solutions to implement

- **Periodically assess** the driving behaviour of patients with cerebral diseases over time, in order to identify to which extent, **the progression of the disease deteriorates several driving performance measures**

- Structural Equation Models can be developed on **on-road and naturalistic experiments**

- Every driver with a neurological disease affecting cognitive functions **should be treated individually**, through a modern interdisciplinary driving evaluation
Future challenges

• The **continuous monitoring** of the driving behaviour of drivers with neurological diseases affecting cognitive functions will allow the identification of the driving ability threshold.

• **Early detection** of the degradation of fitness to drive is highly useful for early implementation of early remedial measures.

• Scientific **inter-disciplinarity** is the key success factor for monitoring behaviour of drivers with cognitive impairments.
Monitoring behaviour of drivers with cognitive impairments

**DriverBrain**

Dimos Pavlou

Civil - Transportation Engineer, PhD Research Associate

Department of Transportation Planning and Engineering, National Technical University of Athens, Athens, Greece

Website: [www.nrso.ntua.gr/dpavlou](http://www.nrso.ntua.gr/dpavlou)

e-mail: dpavlou@central.ntua.gr

Together with:

Eleonora Papadimitriou, Panagiotis Papantoniou, Sophia Vardaki, Costas Antoniou, John Golias, George Yannis