National Technical University of Athens
Road Safety Observatory

www.nrso.ntua.gr

Monday
15 May
at 14:00

Workshop

in the framework of the

FOURTH UNITED NATIONS GLOBAL ROAD SAFETY WEEK

8-14 May 2017

Save Lives
#SlowDown

The future of road safety research

NTUA Zografou Campus, Athens
Railways Amphitheatre of the
Department of Transportation Planning and Engineering

Monitoring behaviour of drivers with cognitive impairments
DriverBrain

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

- 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

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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)
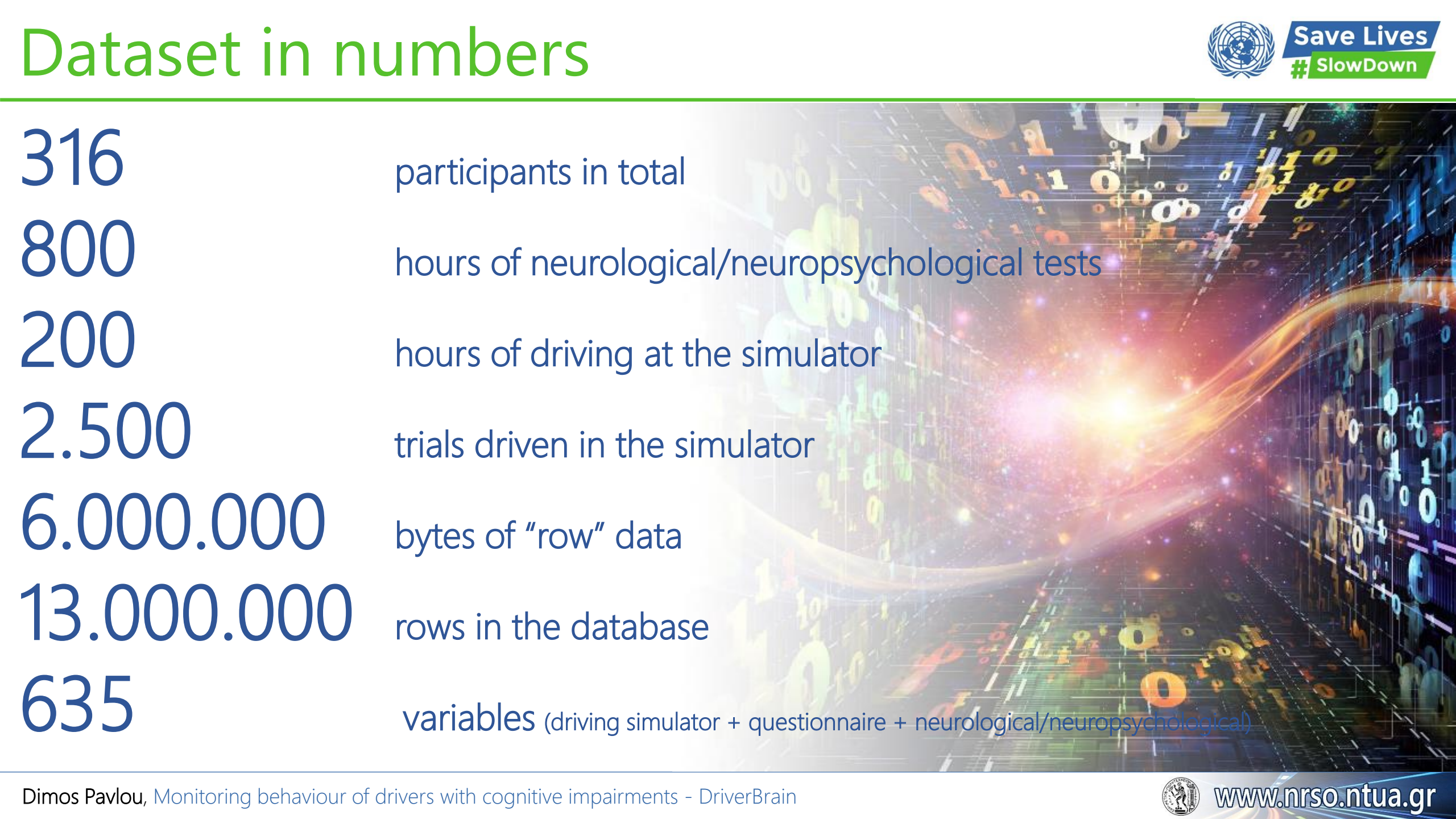
Methodological Challenges

- **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
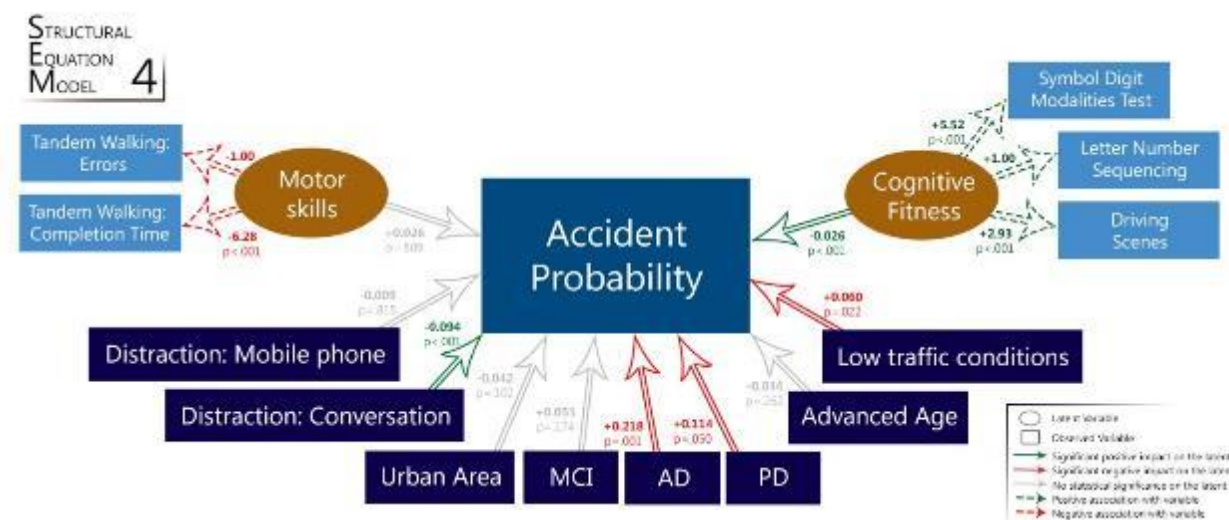
Dataset in numbers
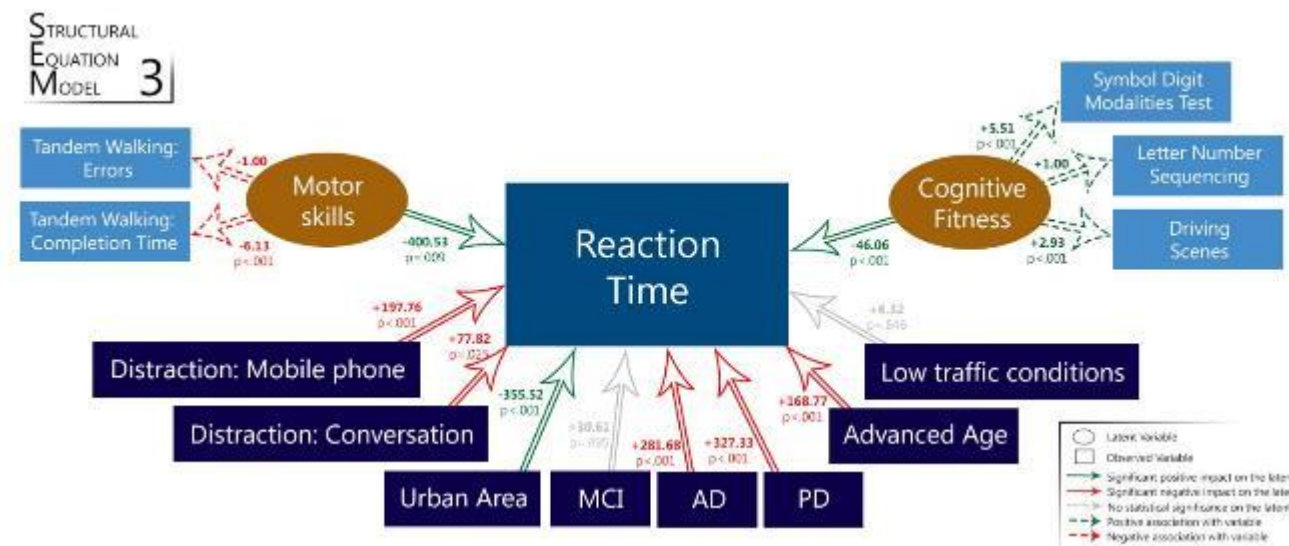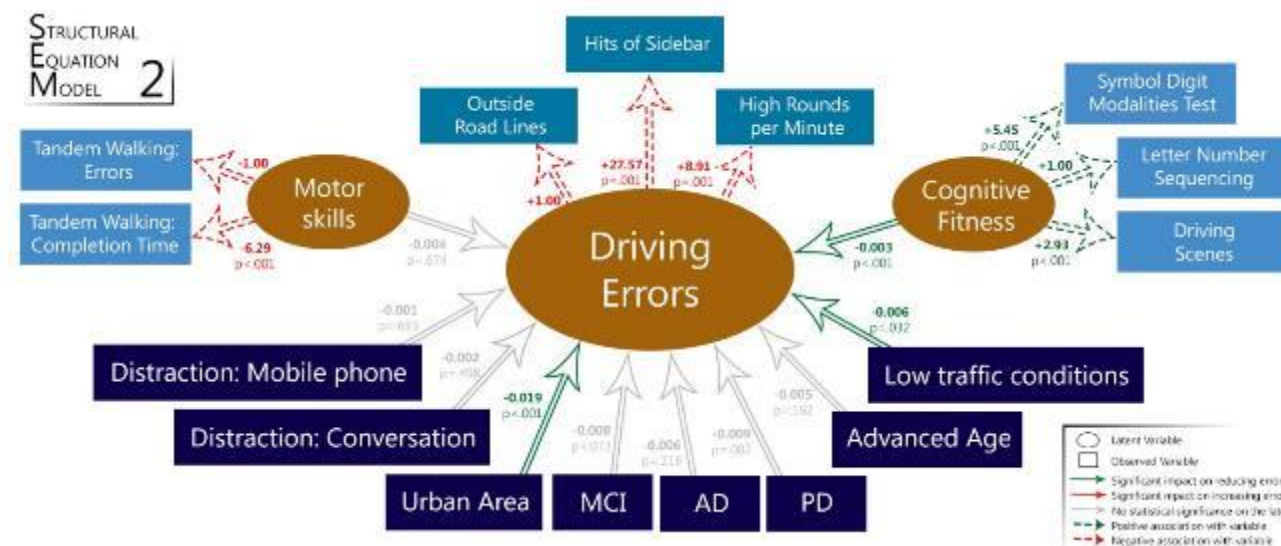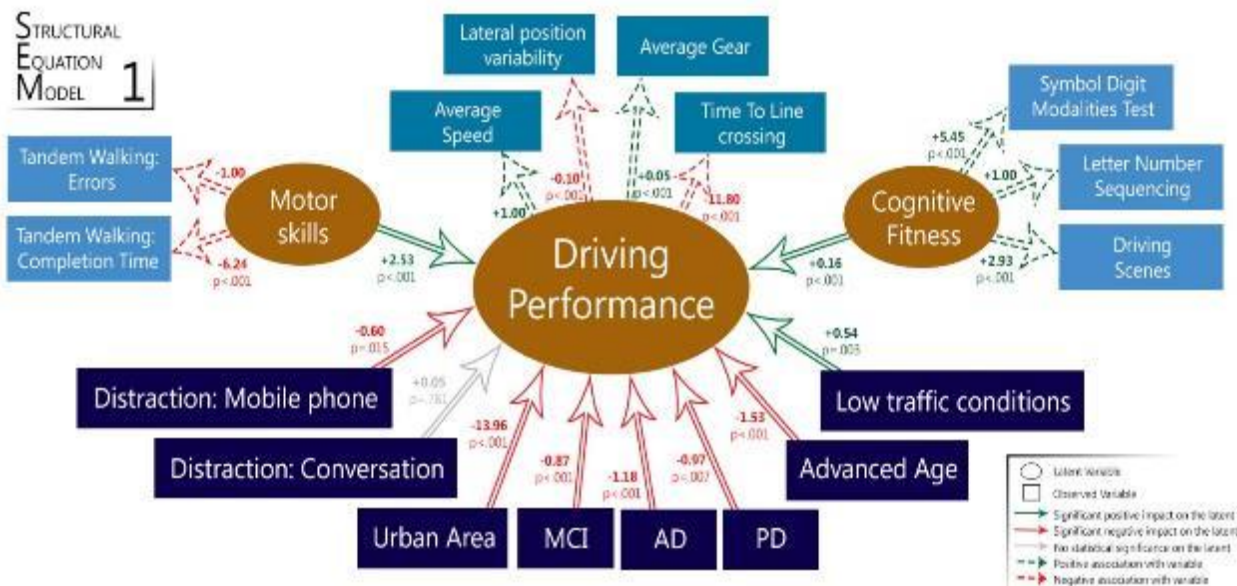
316   participants in total

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

- 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

MCI, AD and PD drivers compared to healthy controls

	Rural	Urban	Comment
Mean speed	⬇	⬇	Lower speed for all groups of patients in all examined contitions
Time headway	⬆	▢	Larger headways for AD and PD group in rural area
Lateral position	▢	➡	More closely to the right border for the MCI group in urban road
Steering angle variability	⬇	▢	Lower variability in steering angle for the PD group in rural area in high traffic
Reaction time	⬆	⬆	Larger reaction times for all groups of patients in all examined contitions
Accident probability	⬆	⬆	Higher accident probability for the AD group in all examined conditions and for the MCI and PD groups in urban area
Driving errors	▢	▢	No significant differences

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
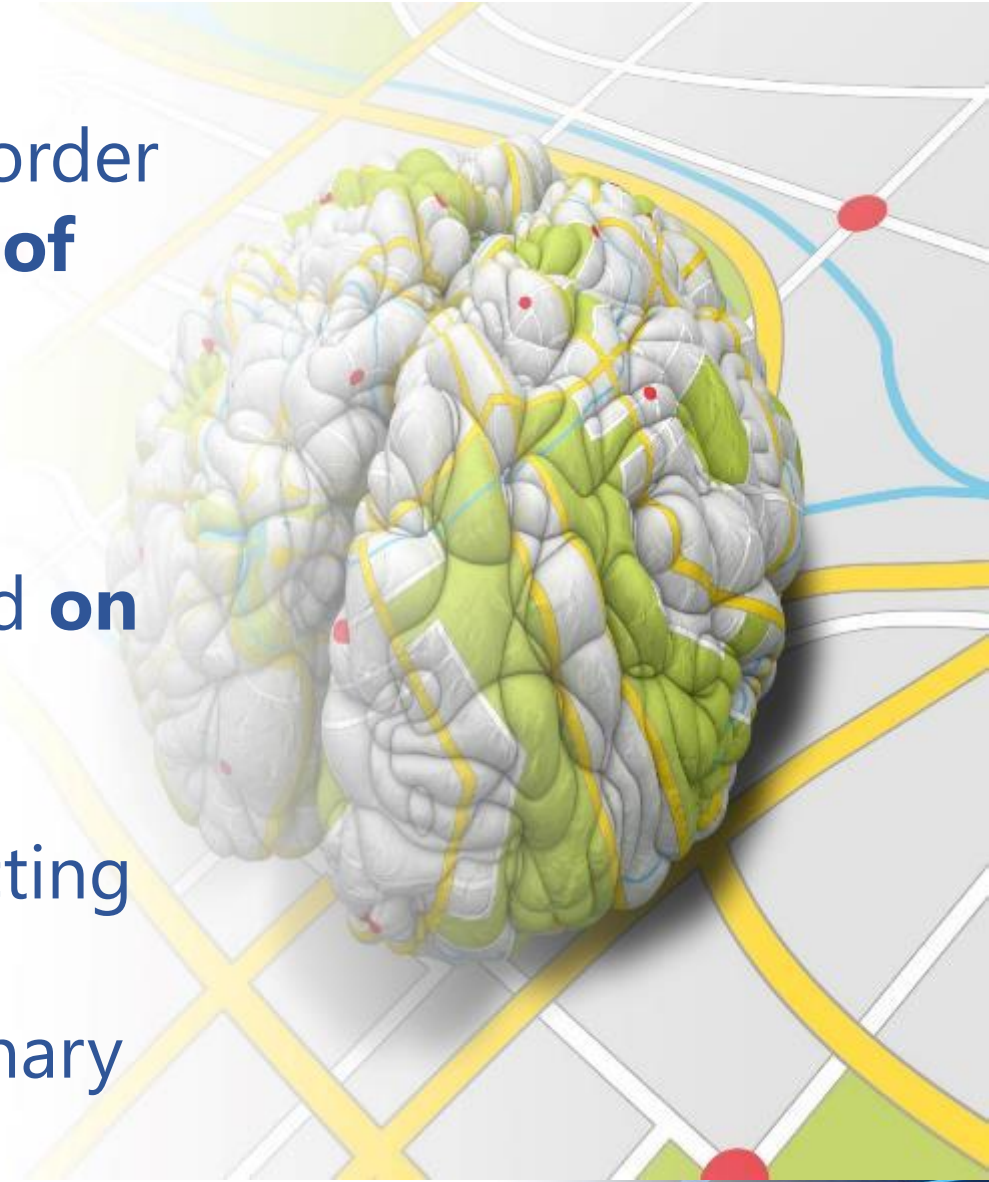
Future challenges

- 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

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