



Design of an on-road driving experiment on assessing driving behavior of older drivers

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Structure

- Background
- Driving and cognitive functions
- Human Factors and ageing as a risk factor
- Objectives
- Methodological approach
- Preliminary results
- Conclusions and next steps



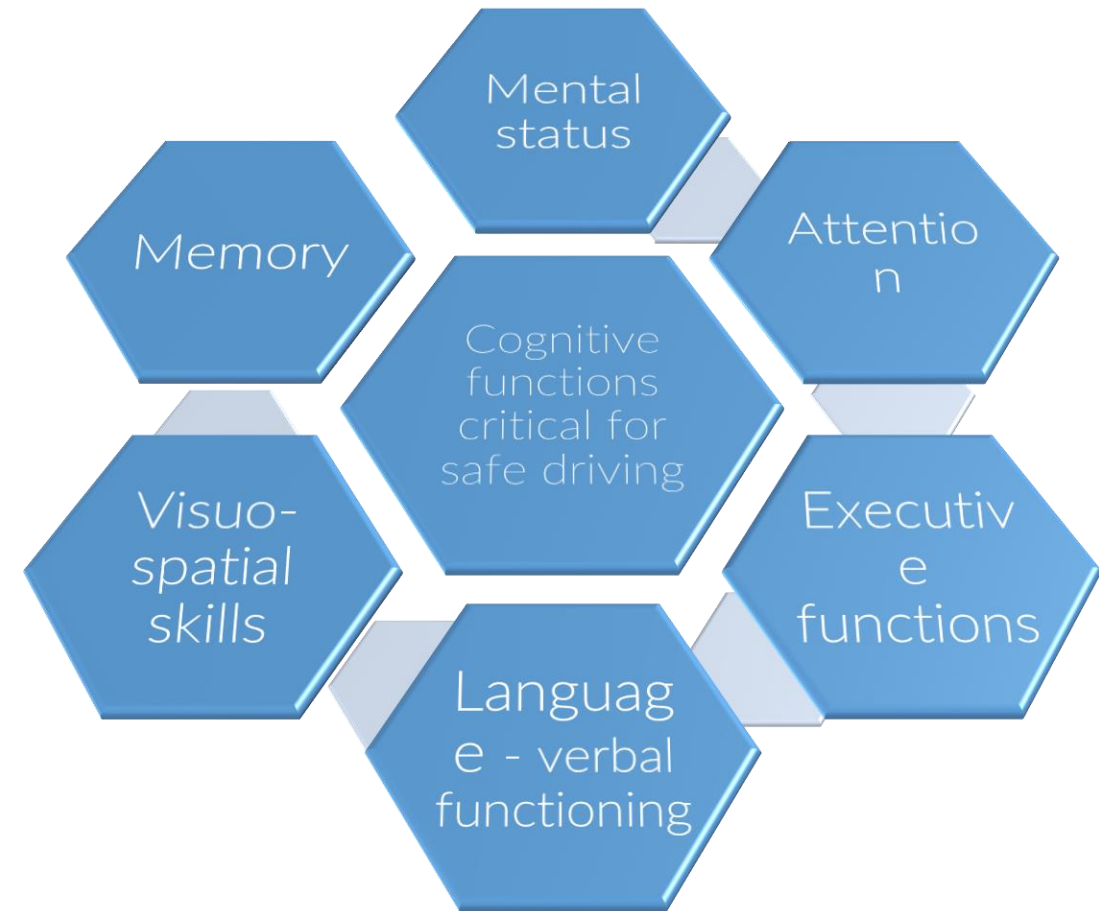
Background

- **Driving** is one of the most multifaceted, complex and potentially hazardous tasks that people encounter every day.
- It requires a **combination** of motor and mental skills as well as the execution of several sub-tasks and simultaneous environmental cues in a safe way.



Cognitive functions critical for safe driving

- The task of driving requires the **ability** to receive sensory information, process the information, and to make proper, timely judgments and responses
- **Cognitive** functions related to driving may be categorized into six neuropsychological domains



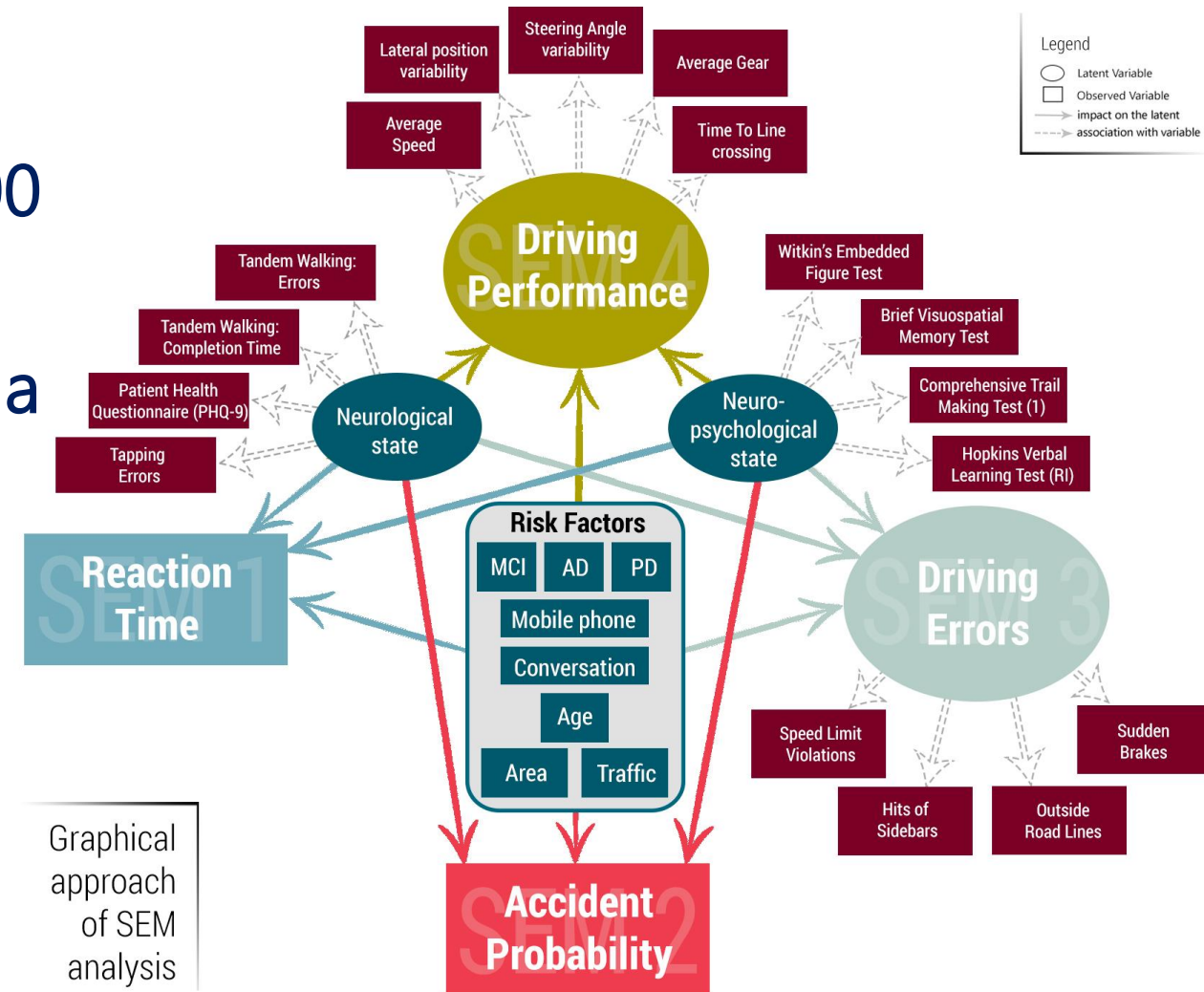
Human Factors and ageing as a risk factor

- Human factors, which are considered the cause of **more than 80%** of road crashes, refer to an individuals' driving skills, personality measures and cognitive abilities.
- The deterioration of many mental functions critical to driving, either due to physiological ageing, or due to a neurological disease (i.e. mild cognitive impairment, mild dementia, etc.), may significantly affect driving performance.



Previous study with older drivers

- SEM analysis from a simulator experiment including more than 300 individuals indicated that advanced age as an individual risk factor had a **significant negative impact** on:
 - reaction time (+190ms, $p < .001$),
 - driving errors (+0.11, $p < .001$) and
 - driving performance (as a latent variable) (-1.3, $p < .001$)



Objectives

- The aim of the present study is to:
 - **assess** the driving performance of older drivers this time in an on-road driving experiment,
 - **classify** them according to their fitness (or not) to drive safely and
 - **suggest** appropriate measures, facilitating and thus supporting the Ministry of Transport, in the currently unclear decision-making procedures on the renewal or not of the driving licenses for the elderly.



Benefits

- The benefits will be both **scientific and socio-economic**. The final results concern a toolbox for the evaluation and possible improvement of the driving ability and safety of older drivers:
 1. A **protocol** for assessing the driving ability and safety of older drivers, and specific indicators of driving behavior and safety.
 2. **System and related applications** for recording real driving data from mobile phones with orientation to older drivers.



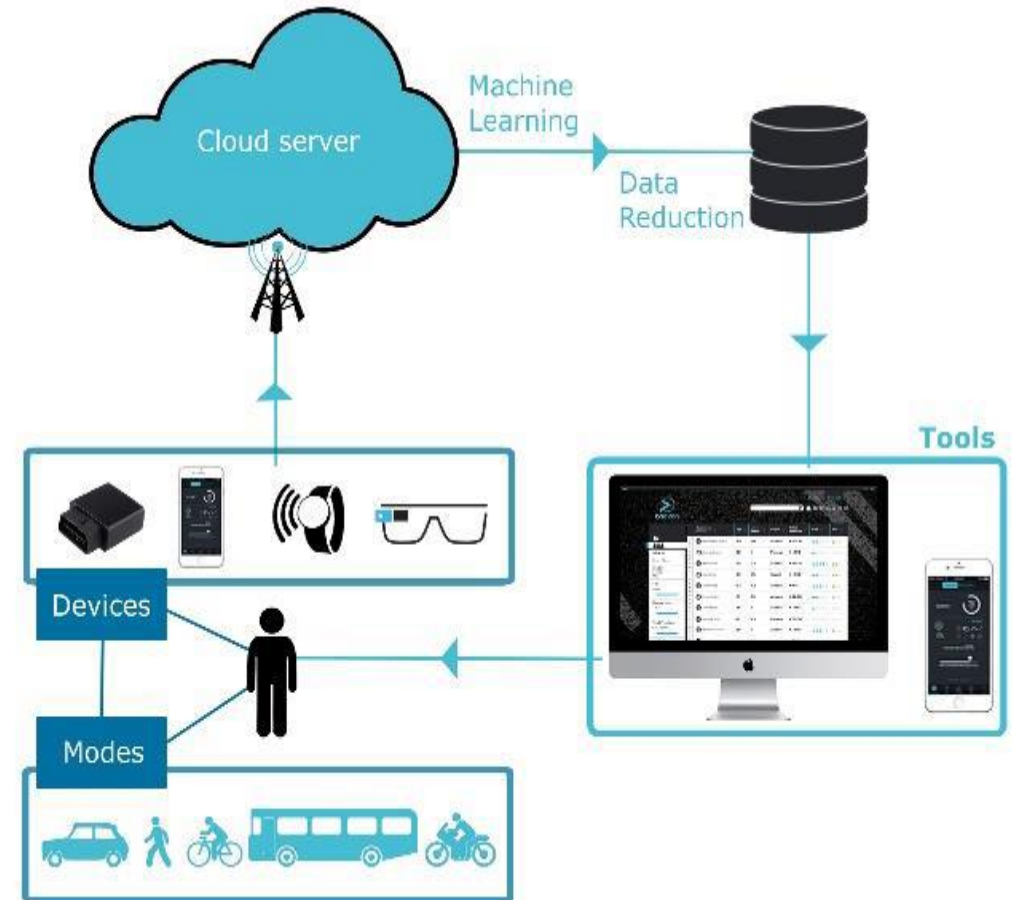
Methodological approach

- 100 elderly active drivers (over 60 years old)
- 1 on-road driving experiment, on a specific route
 - duration of 45 minutes, including road sections inside and outside urban area, in the region of Attica.
- Recording and evaluating the driving behavior of the elderly using real time driving data.
 - Objective driving data collected through the OSeven smartphone application and
 - A driving behavior assessment through a specific driving behavior questionnaire.



OSeven smartphone application

- **Driving behavior analytics** are recorded, using smartphone device sensors.
- A set of **sophisticated and personalized interactive tools** are applied by OSeven, powered by breakthrough technology, smart algorithms and reliable metrics.
- Through this process data is being **filtered and cleaned** and the composition of several significant safety indicators is taking place.
- Most crucial driving performance indicators:
 - **driving aggressiveness** (i.e. acceleration and braking),
 - **speeding**



Specialized driving evaluation checklist

Information obtained from a specialized driving evaluation checklist which has been developed by NTUA research team based on the **AGILE project** (EC AGILE, 2006) and the **TRIP** (Test Ride for Investigating Practical Fitness-to-Drive) (Withaar et al., 2000; Tant et al., 2002)

| Checklist | B | I | S | G | Bad | Insufficient | Sufficient | Good |
|----------------------------------------------------------------|---|---|---|---|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Speed adaptation | | | 1 | | Completely unable to adapt his speed | Drives always with not enough room to adapt his speed | Drives with just enough room to adapt his speed | Completely able to adapt his speed |
| Braking | | | 1 | | Candidate's use of the brake is disturbed and exhibits poor braking | Candidate's use of the brake is abrupt and exhibits below average braking | Candidate efficiently and fluently uses the brake but sometime makes | Candidate efficiently and fluently uses the brake and exhibits good braking |
| Accelerating | | | 1 | | Candidate's use of the accelerator is disturbed and exhibits poor accelerating | Candidate's use of the accelerator is abrupt and exhibits below average | Candidate efficiently and fluently uses the accelerator but sometime makes | Candidate efficiently and fluently uses the accelerator and exhibits good |
| Turning | | 1 | | | Candidate never obeys the right of way rules at the junctions where it is | Candidate looks a little to the side but treats the information poorly such that it | Candidate looks well and treats information correctly but sometimes | Candidate always obeys the right of way rules at the junctions where it is |
| Headways | | 1 | | | Cannot keep proper distance despite several cueings | Keeps proper distance only with the help of the information from the | Keeps proper distance only with the help of the information from himself | Adequate distance from vehicle ahead without further correction |
| Lateral position | | 1 | | | Drives too close or sometimes crosses the margin | Drives too close but never crosses the margin | Stays in the middle of the lane but occasionally drives close to the margin | Stays always in the middle of the lane |
| Ability to choose the correct lane | | 1 | | | Poor ability to choose the correct lane | Below average ability to choose the correct lane | Above average ability to choose the correct lane | The ability to choose the correct lane is good |
| Lane change | 1 | | | | Poor ability to change lanes correctly | Below average ability to change lanes correctly | Above average ability to change lanes correctly | The ability to change lanes correctly is good |
| Understanding, perception and quality of traffic participation | | 1 | | | Candidate's traffic insight, perception or participation is poor | Candidate's traffic insight, perception or participation is below average | Candidate's traffic insight, perception or participation is above average | Candidate's traffic insight, perception or participation is good |
| Crossing or junction | 1 | | | | Poor behaviour when approaching and entering a crossing or junction | Below average behaviour when approaching and entering a crossing or | Above average behaviour when approaching and entering a crossing or | Good behaviour when approaching and entering a crossing or junction |
| Anticipation and perception of road signs and traffic signals | | 1 | | | Candidate sees only the road before him | Candidate sees the road but with less lateral information | Candidate sees the road sufficiently with a total central and peripheral vision | Candidate sees the road sufficiently with a total central and peripheral vision |
| Joining the traffic stream | | 1 | | | Ability of candidate to join the traffic stream is poor | Ability of candidate to join the traffic stream is below average | Ability of candidate to join the traffic stream is above average | Ability of candidate to join the traffic stream is good |
| Visual behaviour and communication | | | 1 | | Candidate makes almost no head and eye movements | Candidate rarely makes head and eye movements | Candidate makes head and eye movements only at complex junctions | Candidate always makes head and eye movements |
| Mirror use | | | 1 | | Candidate does not make use of the mirror despite several cueing | Candidate rarely makes use of the mirror despite several cueing | Candidate often makes use of the mirror without cueing | Candidate always correctly makes use of the mirror without cueing |
| Use of direction indicator | | 1 | | | Poor use of direction indicator | Below average use of direction indicator | Above average use of direction indicator | Use of direction indicator is good |
| Steering firmness | | 1 | | | Poor use of the steer | Below average use of the steer | Above average use of the steer | Good use of the steer |

Preliminary results

- Although older drivers had lower speeds and less harsh accelerations compared to their younger counterparts, they had more harsh brakings, especially in urban areas and in highway.
- Older drivers had lower scores (insufficient or bad) in the road test checklist in the following indicators:
 - Speed adaptation
 - Lane change capability
 - Mirror use
 - Steering firmness



Conclusions and next steps

- It seems than older drivers **have some difficulties in adapting** to demanding driving situations, they try to compensate that by lowering their driving speed but the probability of getting involved in an accident is high.
- Next steps include **final statistical analyses and classification** of older drivers to safe and at-risk along with the most critical driving parameters that differentiate them from the younger.





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