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National Technical University of Athens
Hellenic Institute of Transportation Engineers

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

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Background

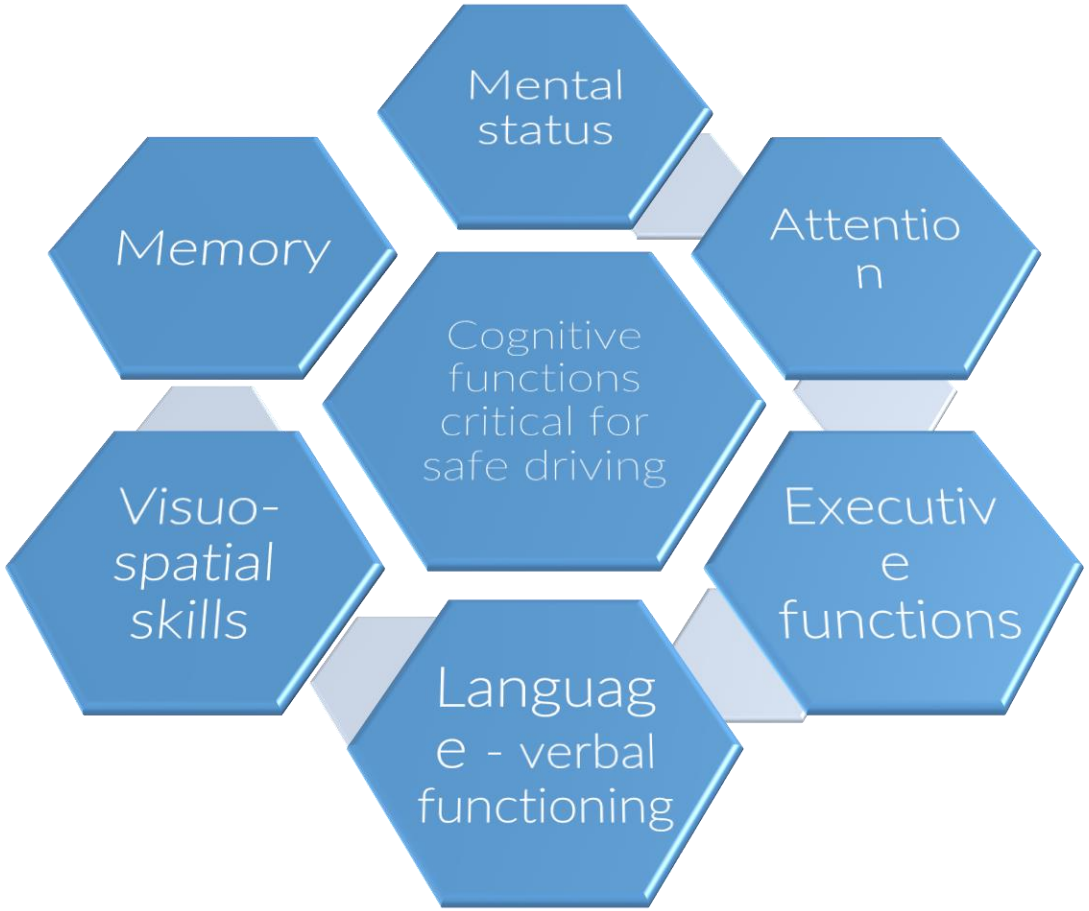
- Driving is one of the most multifaceted, complex and potentially hazardous tasks that people encounter every day.

- 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

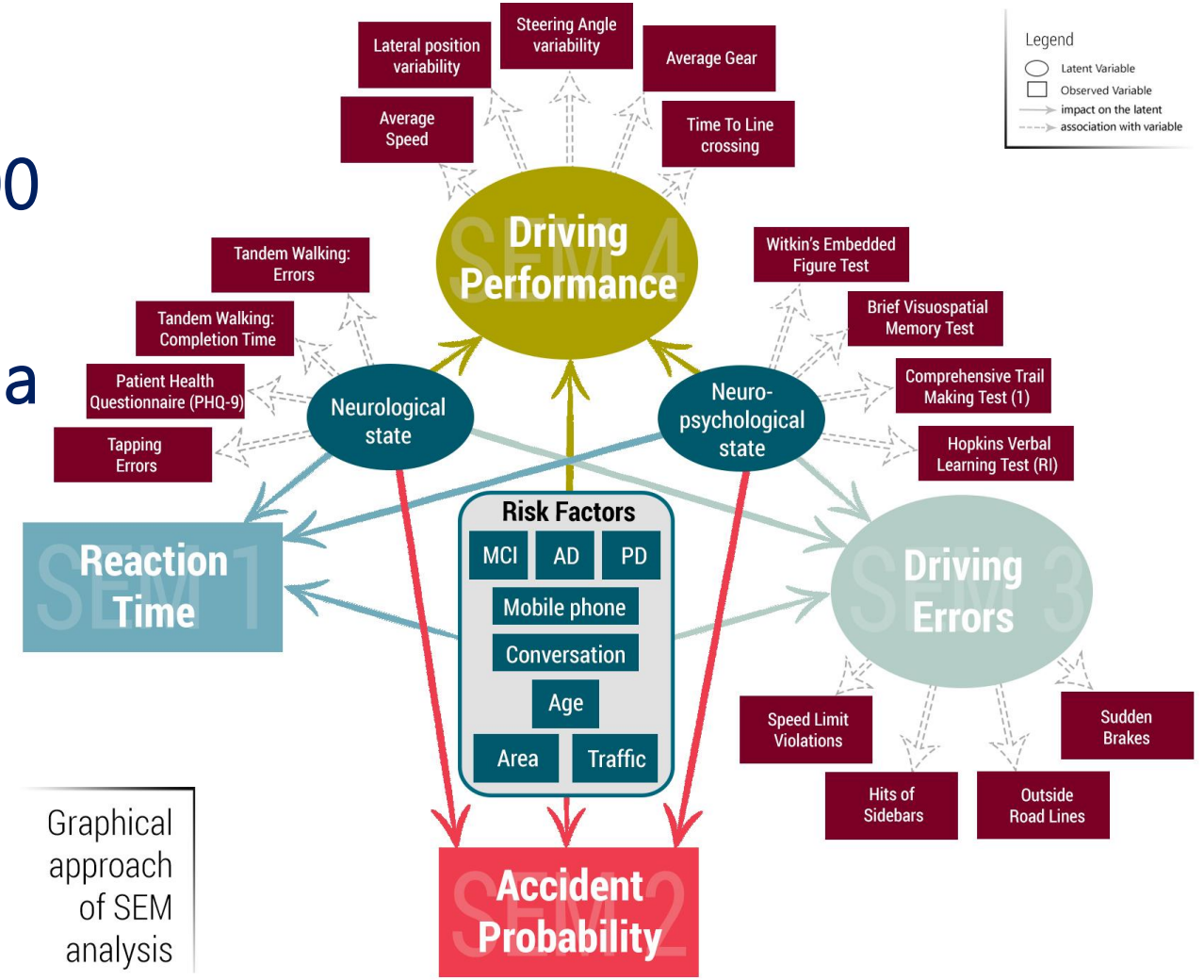


Human Factors and ageing as a risk factor

- 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)*



Graphical approach of SEM analysis

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:

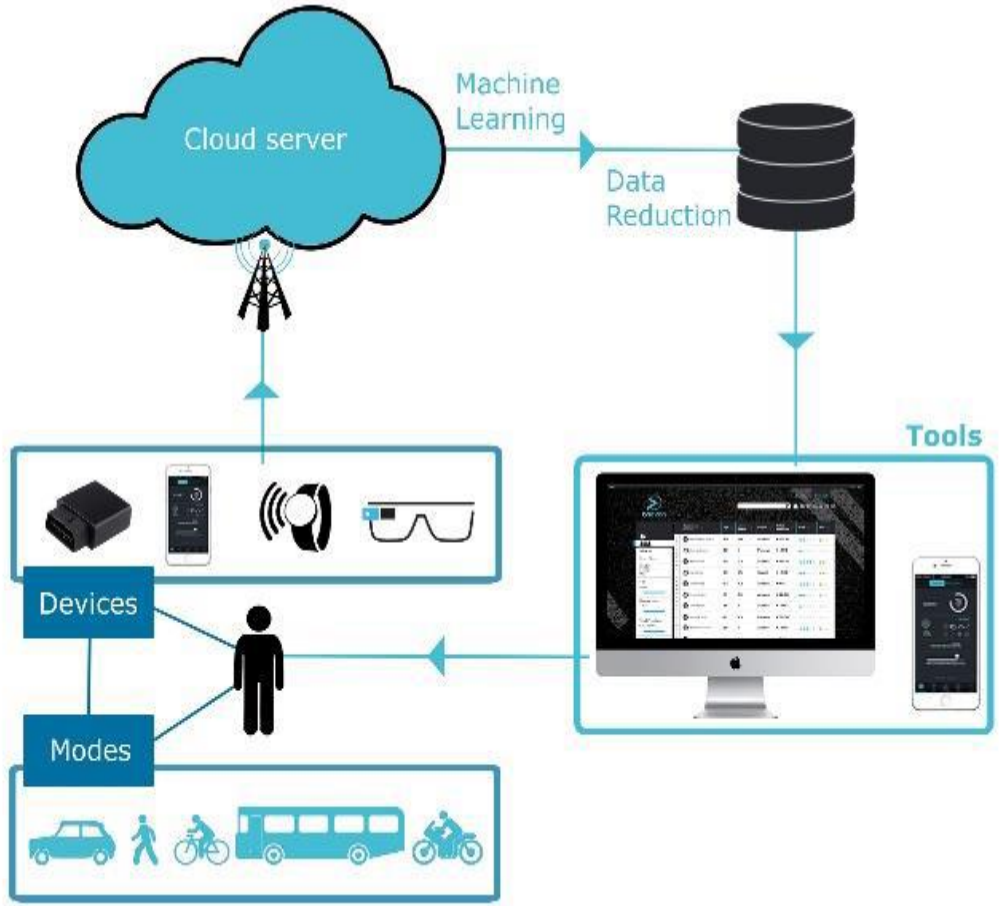
1. A protocol for assessing the driving ability and safety of older drivers, and specific indicators of driving behavior and safety.
2. System and related applications for recording real driving data from mobile phones with orientation to older drivers.

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 acceleratorbut 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.

Acknowledgments

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