

The Demands of Road Environments as Perceived by Vulnerable Road Users

Sophia Vardaki , Anne E. Dickerson, Ion Beratis, George Yannis, Sokratis Papageorgiou



Dr Sophia Vardaki

sophiav@central.ntua.gr

BACKGROUND INFORMATION

Studies suggest that

- declines in cognition increase crash risk among older drivers
- neurological diseases such as dementia can lead to driving impairments
- older adults, especially over 70 years of age, have difficulties with demanding driving situations
- older drivers with cognitive impairment but not dementia may have sufficient insight into their deficits



MOTIVATION

- The driver's capability to make a correct assessment of driving difficulty and their performance capabilities is crucial from a safety perspective.
- It is important to design training and/or driving evaluation programs as well as in-vehicle technologies to assist older drivers when encountering difficult situations or situations perceived as difficult.
- individuals with Mild Cognitive Impairment (MCI) as well as those in the earliest stages of a progressive, dementing illness may be able to continue to drive safely for some time: a proper diagnosis is important.
- As a result of the rise in population age and mobility, road designers face the challenge of providing a safe road environment for older people with increased mobility needs.



STUDY OBJECTIVES

The present investigation used data from an extensive questionnaire to identify the factors determining driving difficulties as seen from the perspective of active older drivers with mild cognitive impairment (MCI) and age-matched controls without measurable cognitive impairment.



STUDY PARTICIPANTS

From a sample from a prior driving simulator experiment designed for the purposes of the DriverBrain and the DISTRACT projects aiming to assess the driving performance of drivers with cerebral diseases, a convenience sample of drivers diagnosed with MCI and controls without measurable cognitive impairment was purposely selected because their demographics matched.



DEMOGRAPHICS AND COGNITIVE STATUS

- MCI group (classified with amnesic MCI): 30 subjects; mean age = 65.4 years (s.d. = 7.6); M/F 18/12.
- Control group: 30 subjects with no pathological condition; mean age = 62.2 years (s.d.=7.0).; M/F 17/13.
- The two groups were not statistically different ($\alpha=0.05$) in terms of age, gender, driving experience and exposure
- The analysis revealed significant differences between the control group and the MCI group in measures of general cognitive functioning (MMSE), in specific executive cognitive function impairments (FAB), in measures of verbal episodic memory (Hopkins Verbal Learning Test), information processing speed (SDMT), psychomotor speed (TMTA), mental flexibility (TMTB), working memory (LNS) and selective attention (UFV3).



DRIVING DIFFICULTIES QUESTIONNAIRE

- All study participants were asked to report the frequency with which they experienced difficulties related to functional deficits:
visuo-perceptual abilities, useful field of view, reaction time, selective attention, divided attention, sustained attention, psychomotor performance, knowledge and mental flexibility.



ANALYSIS

Drivers' Perceptions of their Driving Difficulties

- Exploratory factor analysis was used to investigate the factors determining driving difficulties, as perceived by older drivers with MCI and age-matched controls.

Cognitive and functional assessments

- Individuals with MCI demonstrated significantly lower scores in cognitive assessments.
- No differences in the functional assessments which test practiced or overlearned skills.



RESULTS FOR THE MCI GROUP

Two factors underlie MCI perceptions:

- factor 1 - difficulty in detecting peripheral stimuli and in responding to spatial and temporal information from the environment, in moving head, neck and feet and in attending to relevant signs while ignoring irrelevant ones.
- factor 2 - capacity to divide attention between several tasks and to switch from automatic to conscious processing in new or unexpected situations and ability to maintain attention on a task.



RESULTS FOR THE HEALTHY GROUP

Three factors underlie the perceptions of healthy controls:

- factor 1 - speed and distance judgment of approaching vehicles, ability to divide attention between several tasks and to selectively attend relevant signs and to ignore the irrelevant ones.
- The other two factors represent relatively lower concerns related mainly to slowed movements and problems with switching from automatic to conscious actions.



DISCUSSION

While both groups' analysis represents difficulties with switching from automatic to conscious processing, the difficulties are different.

Most older adults appreciate the significant changes in their physical abilities; they report this, and may even compensate by using advanced vehicle technologies.

The present study reveals specific driving tasks that are perceived as difficult by active older drivers and thus draw engineers' attention during safety evaluations.



CONCLUSIONS

These findings

- have the potential to assist road designers and road safety engineers providing information for road safety evaluation from a human factors perspective,
- call attention to the considerations for designing vehicle technology that can assist older adults in prolonging their driving lifetime,
- have implications for fitness to drive, particularly for senior driving assessment and training.



STUDY LIMITATIONS AND FUTURE WORK

- Factor analyses, based as they are on selected items administered to thirty participants in each group, is exploratory in nature and must be replicated.
- Specific problems in driving cannot be attributed to distinct functions.
- Study results provide no evidence of self-awareness.
- Our future research will attempt to relate perceptions and performance in visual, perceptual, cognitive and motor functions.



Acknowledgment

Vardaki, S., Dickerson, A.E., Beratis, I., Yannis, G., Papageorgiou, S.G.. (2019) Driving difficulties as reported by older drivers with mild cognitive impairment and without neurological impairment, *Traffic Injury Prevention*, 2019.

DOI: 10.1080/15389588.2019.1626986.

This study is based on two research projects implemented within the framework of the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF), namely the Research Funding Program: THALES. Investing in knowledge society through the European Social Fund, and the Action: ARISTEIA (Action's Beneficiary: General Secretariat for Research and Technology), co-financed by the European Union (European Social Fund, ESF) and Greek national funds.



Questions & Answers

Contact

sophiav@central.ntua.gr

