Can we predict safe driving for the elderly through a self-assessment of driving behavior?

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Objective

- **Aim.** Obtain practical knowledge that will improve existing **driving recommendations** in order to enhance driving safety among elderly individuals >60 years old.

- **How?** Correlate a driver behavior questionnaire with safe driving behaviour indicators of older drivers who completed a driving simulator experiment. A structured self-assessment questionnaire, which is able to predict driving abilities in people with normal cognition, MCI or dementia was developed.

Background

- Driving is a quite difficult task that requires the **utilization of a wide range of individual skills** as well as practical and psychological abilities.

- Drivers should have **good spatial perception and well-coordinated control**.

- The normal ageing process is associated with increasing motor, cognitive, visual, perceptual and sensory **impairments**.

- According to European Commission, **older drivers have the second highest fatality rate in traffic of all age-groups**.

Framework

- Development of a helpful mechanism for enhancing the accuracy of recommendations for safe driving in the elderly drivers.

- The correlation of their driving performance indicators with their self-assessment of driving behavior.

- Two parts:

  ➢ **Driving at the simulator experiment**
  ➢ **Questionnaire answers**

Procedure of Data Collection

- Concerns the **assessment of driving behaviour** by means of programming of a set of driving tasks for different driving scenarios

- **Quarter-cab driving simulator** manufactured by the FOERST Company

- **3 LCD wide screens** 42'' (full HD: 1920x1080pixels) - total F.O.V. 170 degrees

- **Validated** against a real-world environment

Sample

125 participants (all more than 55 years of age and of similar demographic characteristics):

- **34 Healthy Controls** (aver. 64.1 y.o., 25 males)
- **91 Patients** (aver. 71.2 y.o., 59 males):
  - **43 MCI patients** (aver. 70.1 y.o.)
  - **28 AD patients** (aver. 75.4 y.o.)
  - **20 PD patients** (aver. 66.1 y.o.)

Table 1 Comparison of patients with neurological diseases affecting cognitive functions and of the Control group without neurological history on various demographics with the use of the Wilcoxon Rank Sum Test (age >55 y.o.)

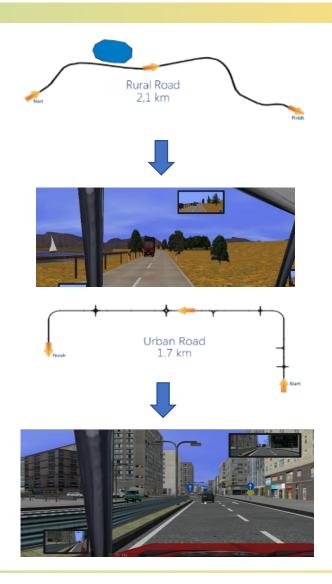|	"MCI, AD, PD Patients" group	"Control" group	P-values
Age, y, mean±SD	71.2±7.2	64.1±6.6	0.122
N, M/F (Gender)	91, 59/32	34, 25/9	0.141
Driving experience, y, mean±SD	41.3±5.8	38.7±2.8	0.271
Days/week, median (range)	4 (2-7)	5 (2-7)	0.359
Kilometers driven/week[a], median (range)	3 (2-5)	3 (2-5)	0.416
Accidents (2 years) - reported, median (range)	0 (0-0)	0 (0-0)	1.000
Education, y, mean±SD	12.1±3.5	13.5±2.2	0.812
Simulator sickness[b] - reported, median (range)	0.23 (0-3)	0.18 (0-3)	0.726

[a] 1=1-20km; 2=21-50km; 3=50-100km; 4=100-150 and 5>150

[b] Question: Did you feel dizzy at the simulator? 0=Not at all, 1=Just a little, 2=To some extent, 3=A lot

Experiment

- Two sessions:
  1. Rural route that is 2.1km long, single carriageway and the lane width is 3m, with zero gradient and mild horizontal curves

  2. Urban route that is 1.7km long, at its bigger part dual carriageway, separated by guardrails, and the lane width is 3.5m.

- During each trial, 2 unexpected incidents:
  1. Rural Road: the sudden appearance of an animal.

  2. Urban Road: the sudden appearance of an adult pedestrian or of a child chasing a ball on the roadway or of a car suddenly getting out of a parking position and getting in the road.

Driving Parameters

4 key driving performance measures:
1. Mean speed
2. Accident probability
3. Reaction time
4. Driving errors

Self-Assessment Questionnaire

The sections of the questionnaire are:

a. Driving experience - car use

b. Self -assessment of the older driver

c. Distraction-related driving habits

d. Emotions and behavior of the driver

e. Anger expression inventory during driving

f. History of accidents, near misses and traffic violations

ID	Question
Q1	Do you avoid driving alone?
Q2	How many times, in the last 6 months, did you avoid driving because you were afraid of your driving skills?
Q3	How would you assess your driving performance now, in comparison with 5 years ago?
Q4	When conversing with a passenger while driving, do you usually speed down and be more careful?
Q5	How many times, in the last year, have you experienced an argument with a passenger while driving?
Q6	How often do you use your seat belt while driving?
Q7	How often do you drive without being concentrated?
Q8	How many accidents have you experienced as a driver?
Q9	How many times did you avoid an accident "at the very last moment", in the last two years?
Q10	Do you have difficulties in perceiving vehicles and pedestrians that suddenly approach in front of you?
Q11	How many times have you violated the Traffic Code as a driver, in the last two years?
Q12	How many times have you been fined because you violated the Traffic Code as a driver, in the last two years?

Results (1/3)

	How would you assess your driving performance now, in comparison with 5 years ago?			
	Much worse	**Worse**	**Same**	**Better**
Older driver mean speed	35.4	37.7	39.3	45.2

	Do you have difficulties in perceiving vehicles and pedestrians that suddenly approach in front of you?			
	Never	**Rarely**	**Sometimes**	**Often**
Older driver mean speed	39.2	39.3	36.9	22.2

	How would you assess your driving performance now, in comparison with 5 years ago?			
	Much worse	**Worse**	**Same**	**Better**
Older driver driving errors	3	0.7	0.6	1

Results (2/3)

	How would you assess your driving performance now, in comparison with 5 years ago?			
	Much worse	**Worse**	**Same**	**Better**
Older driver reaction time	2458	2307	1934	1470

	Do you have difficulties in perceiving vehicles and pedestrians that suddenly approach in front of you?			
	Never	**Rarely**	**Sometimes**	**Often**
Older driver reaction time	1952	1958	2278	3250

	In case of an unexpected incident your reaction time, is:			
	Quick	**Just ok**	**Slow**	**Very Slow**
Older driver reaction time	1946	2048	2137	2817

Results (3/3)

	Do you have difficulties in perceiving vehicles and pedestrians that suddenly approach in front of you?			
	Never	Rarely	Sometimes	Often
Older driver accident probability	25.0%	32.1%	31%	100%

	Do you avoid driving alone?			
	Never	Sometimes	Often	Always
Older driver accident probability	24.10%	36.40%	50%	100%

Conclusions

- There are **clear patterns** which older drivers follow in their self-assessment answers which indicate unsafe driving behaviour.
- Older drivers who self-assessed difficulties in several categories, which means that the are aware of their deteriorated driving performance, **actually had the riskiest driving profiles**, namely, worse reaction times, more driving errors and higher accident probability.
- Based on the answers that an older driver will give in these specific questions, **we can classify them as probably unsafe drivers**.
- That way, this study helps **enhancing the accuracy of recommendations for safe driving in the elderly drivers and the prediction of safe vs unsafe driving behavior** in the specific population, which is quite important as an assessment protocol is missing and the job of the doctors and practicians when it comes to fitness (or not) – to – drive for the older drivers is very difficult.

Thank you for your attention!

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