Investigating the different distraction mechanism between cell phone use and conversation with the passenger, through a driving simulator experiment

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BACKGROUND

Driver distraction is estimated to be an important cause of vehicle accidents. Driver distraction factors can be subdivided into those that occur outside the vehicle and those that occur inside the vehicle. While the factors that occur inside the vehicle seem to have greater effect on driver behaviour and safety the distraction mechanism is different between each different factor.

OBJECTIVE

The objective of this research is the investigation of the **distraction mechanism** between **cell phone use** and **conversation with the passenger**. For this purpose, a driving simulator experiment is carried out, in which 95 drivers from three different age groups (young, middle aged and older) were asked to drive under different types of distraction (no distraction, conversation with passenger, cell phone use) in rural and urban road environment, in low and high traffic.

EXPERIMENT PROCEDURE

Driving scenarios
- A rural route that is 2.1 km long, single carriageway and the lane width is 3m, with zero gradient and mild horizontal curves
- An urban route that is 1,7km long, at the bigger part dual carriageway, separated by guardrails, and the lane width is 3.5m

Rural Road 2,1 km

Urban Road 1.7 km
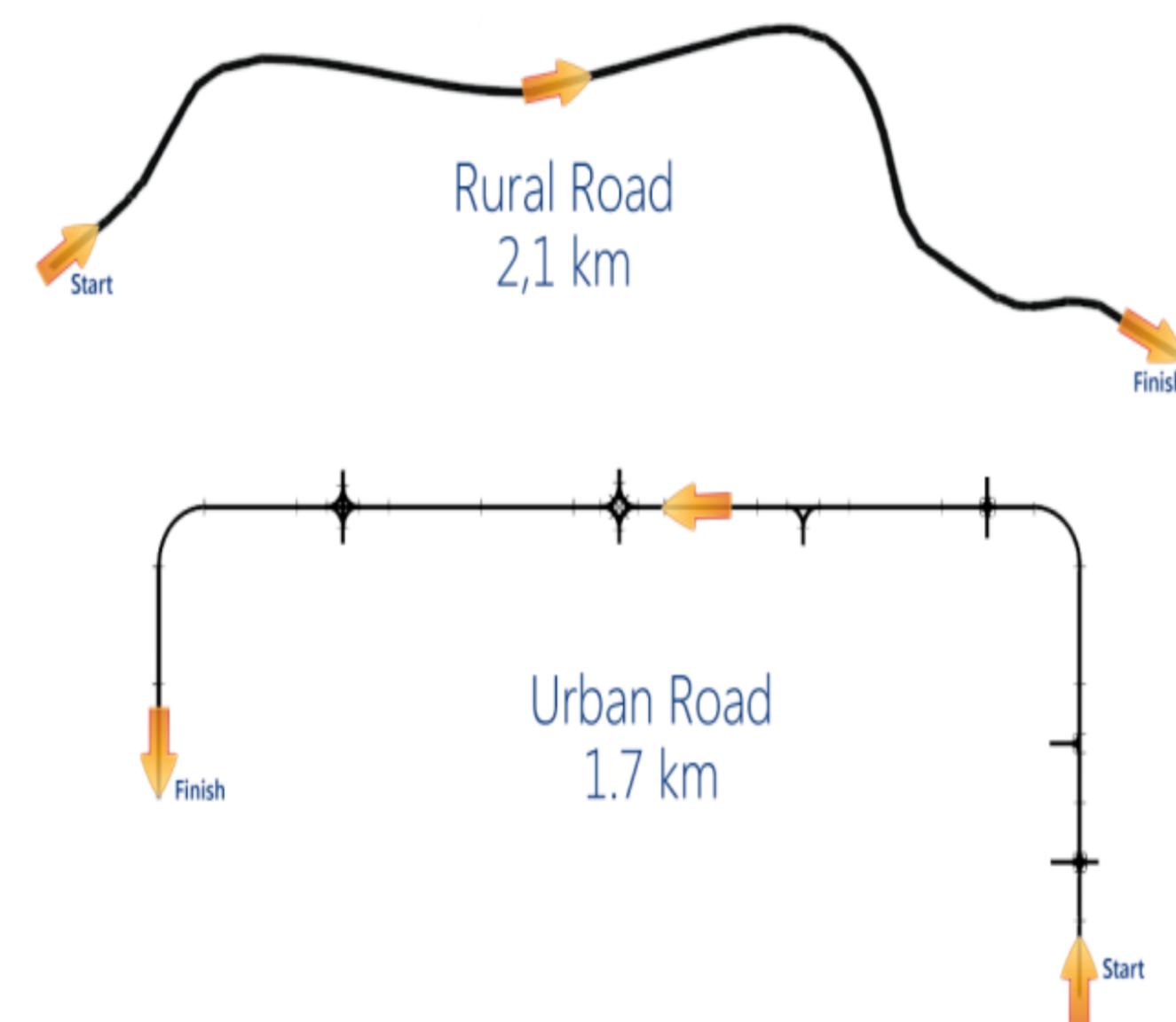
Traffic scenarios:
- Moderate traffic conditions, corresponding to an average traffic volume Q=300 vehicles/hour
- High traffic conditions, corresponding to an average traffic volume of Q=600 vehicles/hour

Randomisation
A randomization in the order of the area type in which the participant is going to drive, as well as in the order of the traffic and distraction scenarios is taking place

Familiarization
During the familiarization with the simulator, the participants practiced in:
- handling the simulator (starting, gears, wheel handling etc.)
- keeping the lateral position of the vehicle
- keeping stable speed, appropriate for the road environment
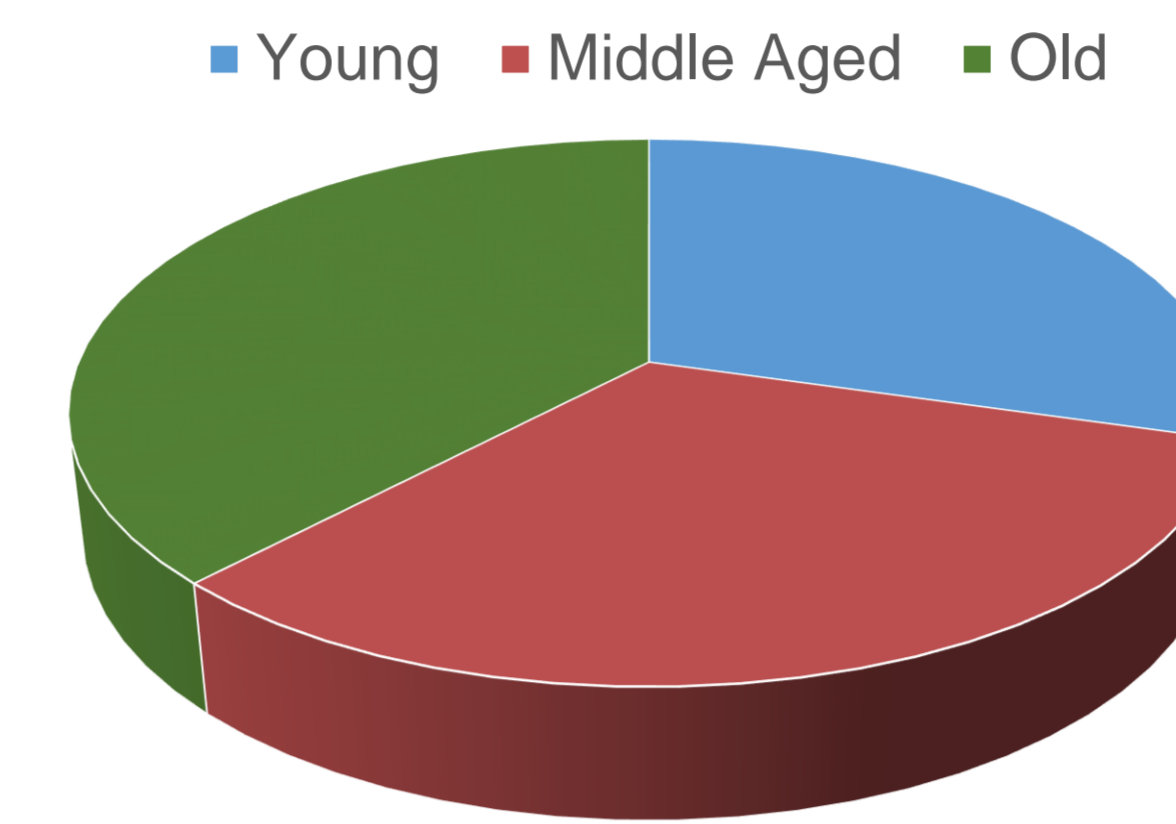- braking and immobilization of the vehicle.

Unexpected incidents
During each trial of the experiment, 2 unexpected incidents were scheduled to occur along the drive:
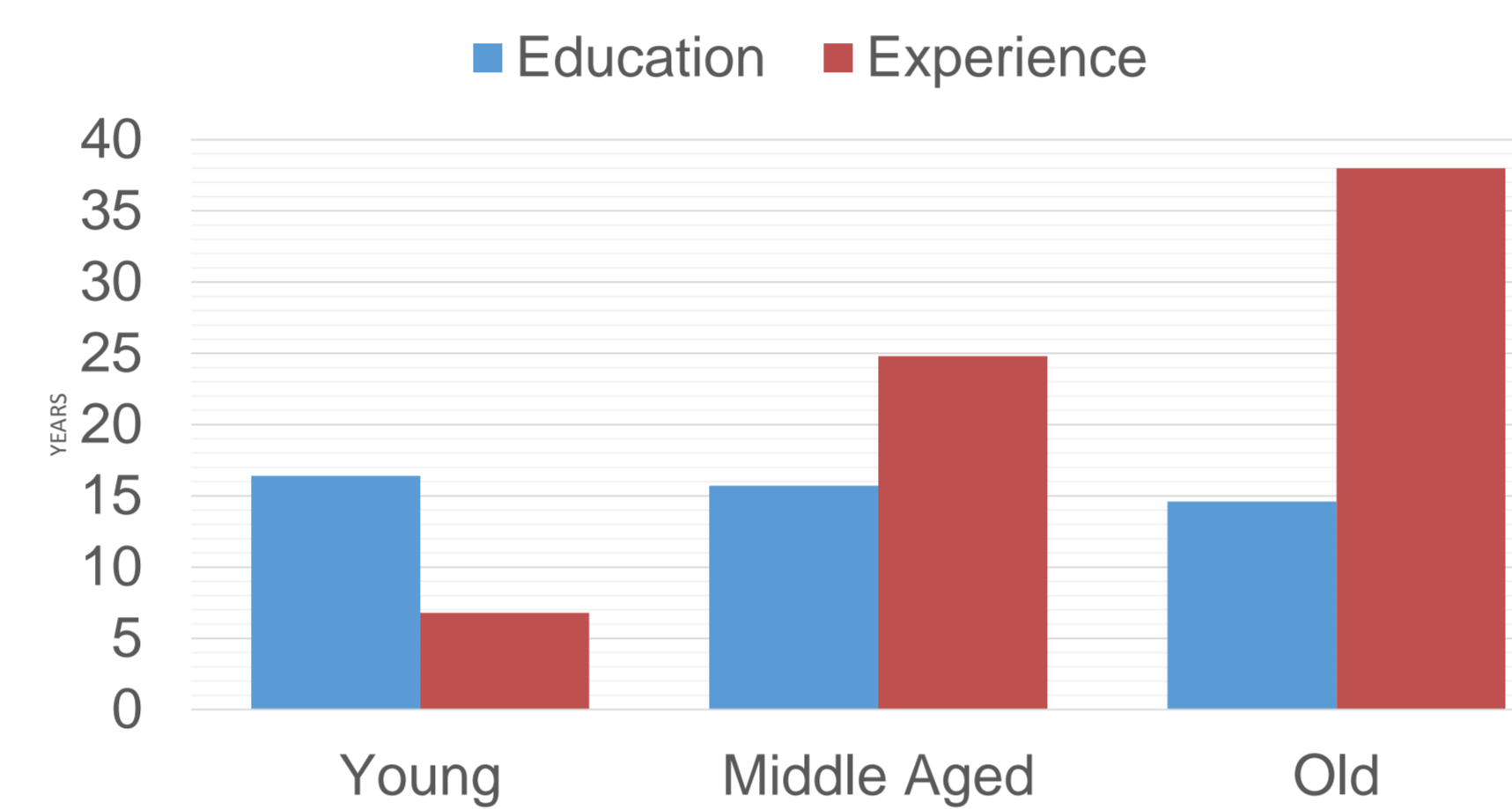
SAMPLE CHARACTERISTICS

The sample of participants is 95 healthy drivers
- 28 young drivers aged 18-34 years old
- 31 middle aged drivers aged 35-54 years old
- 36 older driver aged 55- years old

There is a balance in the sample regarding **gender** and **age group**

The average years of **education** were 15,5 for the whole sample while the average years of driving **experience** 25,5, indicating that the majority of participants are experienced drivers.

ANALYSIS METHOD

Linear regression analysis is implemented in order to identify several sets of explanatory variables that covary with specific driving performance measures of the driving simulator dataset.

Generalised linear mixed models **(GLMM)** are developed regarding the following driving performance measures:

- **Average speed** - refers to the average speed of the driver along the route, excluding the small sections in which incidents occurred, and excluding junction areas
- **Reaction time** - refers to the time between the first appearance of the event on the road and the moment the driver starts to brake
- **Lateral position** - refers to the distance between the simulator vehicle and the right border of the road

Variables	Generalised Linear Model Est.	Generalised Linear Model t value	Generalised Linear Mixed Model Est.	Generalised Linear Mixed Model t value
Intercept	44,85	111,04	44,85	60,69
Distraction - Cell phone	-1,22	-2,82	-1,22	-6,96
Age group - Older	-6,15	-14,99	-6,15	-7,32
Gender - Male	2,68	7,25	2,68	2,68
Area type - Urban	-14,54	-39,31	-14,54	-56,22
Traffic - Low	3,17	8,64	3,17	11,94
Summary statistics				
df	7		8	
Initial Log-Likelihood	-2.584,90		-2.396,94	
AIC	5.183,80		4.809,87	

Average speed

- Cell phone use results in **reduced speeds** for all drivers which is an indication of the drivers' attempt to counter-balance the increased mental workload resulting from the activity in addition to the physical distraction of the handheld mode

- While conversing with the passenger, drivers **do not change** significantly the average speed.

Variables	Generalised Linear Model Est.	Generalised Linear Model t value	Generalised Linear Mixed Model Est.	Generalised Linear Mixed Model t value
Intercept	1,49	37,75	1,47	24,20
Distraction - Cell phone	0,07	1,86	0,07	2,30
Age group - Middle Aged	0,19	5,17	0,20	3,11
Age group - Older	0,19	4,8	0,20	3,19
Area type - Urban	1,54	50,67	1,53	56,71
Traffic – Low	-0,11	-3,57	-0,10	-3,97
Gender – Male	-0,1	-3,26	-0,10	-1,78
Summary statistics				
df	7		8	
Initial Log-Likelihood	-486,61		-451,26	
AIC	989,23		920,51	

Lateral position

- **Cell phone** use slightly increases lateral position indicating that drivers find difficult to keep the vehicle in a constant distance from the right board of the lane probably due to the fact that while talking on the cell phone they hold the steering wheel with one hand
- **Conversing** with a passenger was not found to affect significantly the lateral position of the vehicle

Reaction time

- While talking on the cell phone or conversing with passenger, drivers achieved **higher reaction times** compared with undistracted driving

- Cell phone use leads to higher reaction times on **older** drivers while conversing with the passenger leads to higher reaction time on **young** and **middle aged** drivers

Variables	Generalised Linear Model Est.	Generalised Linear Model t value	Generalised Linear Mixed Model Est.	Generalised Linear Mixed Model t value
Intercept	1.546,15	42,31	1.544,04	35,22
Distraction - Passenger	66,62	1,79	69,82	1,96
Distraction - Cell phone	85,74	2,04	91,84	2,25
Age group - Older	286,3	7,9	292,70	6,09
Gender – Male	-181,9	-5,59	-180,36	-4,00
Area type - Urban	-189,01	-5,76	-188,73	-5,98
Summary statistics				
df	7		8	
Initial Log-Likelihood	-6.121,50		-6.086,52	
AIC	12.257,00		12.189,87	

CONCLUSIONS

- Results indicate the different distraction mechanism that takes place when talking on the cell phone versus when conversing with a passenger while driving
- **Cell phone** use is consisted of prolonged and repeated glances to the cell phone and older drivers have difficulty in maintaining cell devices while driving because they are not as practiced and efficient as technological multi-taskers, commonly younger drivers
- When **conversing** with a passenger, drivers' glance is out of the road very often and this has a more pronounced effect on young and middle aged drivers

ACKNOWLEDGEMENT