Comparative analysis of young drivers behavior in normal and simulation conditions at a rural road

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Outline

- Objective

- Introduction

- Experiment overview

- Data and analysis methods

- Model development

- Results

- Conclusions

Objective

Objective

to compare the driving performance
of young drivers in normal and simulated
driving conditions

Procedure

31 young drivers aged 20-30 participated in
an experimental process including driving
both in a driving simulator as well in real
traffic condition at an interurban road

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- Driving simulator validity refers to the degree to which behaviour in a simulator corresponds to behaviour in real-world environments under the same conditions (Kaptein et.al, 1996; Blaauw, 1982)

- If the numerical values are identical or near identical, absolute validity is achieved (Godley et.al, 2002)

- Relative validity is achieved when driving tasks have a similar affect on driving performance in both the simulator and real vehicles (Harms, 1992)

Two driving scenarios have been developed in order to compare the driving performance of young drivers in simulated and on-road driving conditions.

- In the driving simulator experiment, a rural route 2,1 km long, single carriageway and the lane width is 3m, with zero gradient and mild horizontal curves

- In the on-road experiment the selected route was consisted of an interurban route 1,9km long, single carriageway and lane of 3,5m width.

Driving simulator

Technical characteristics

- Foerst Driving Simulator FPF
- 3 LCD wide screens 40"
- total angle view 170°
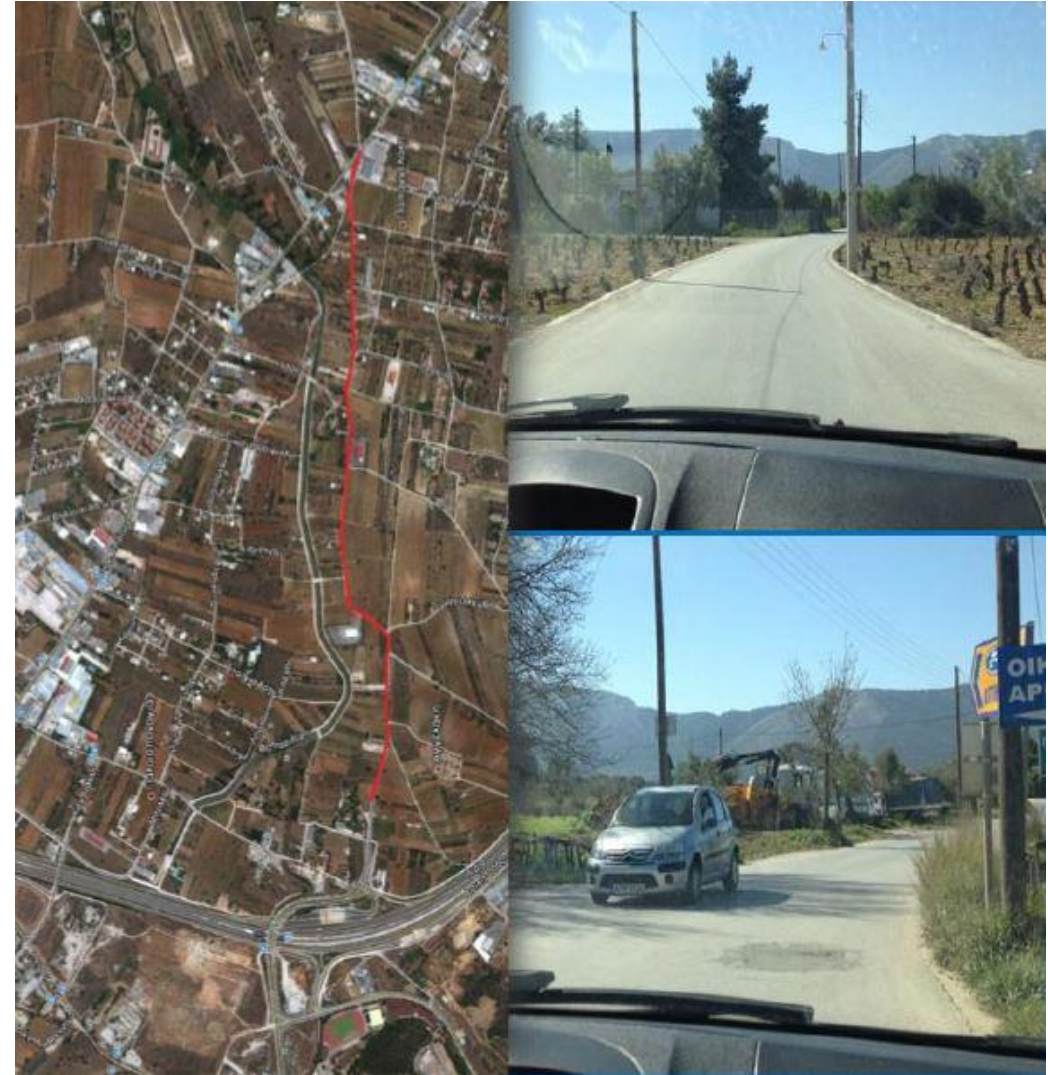- driving position and motion base

Familiarization

During the familiarization with the simulator, the participant 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

Rural Area
(AB)≈2,1km

Interurban road
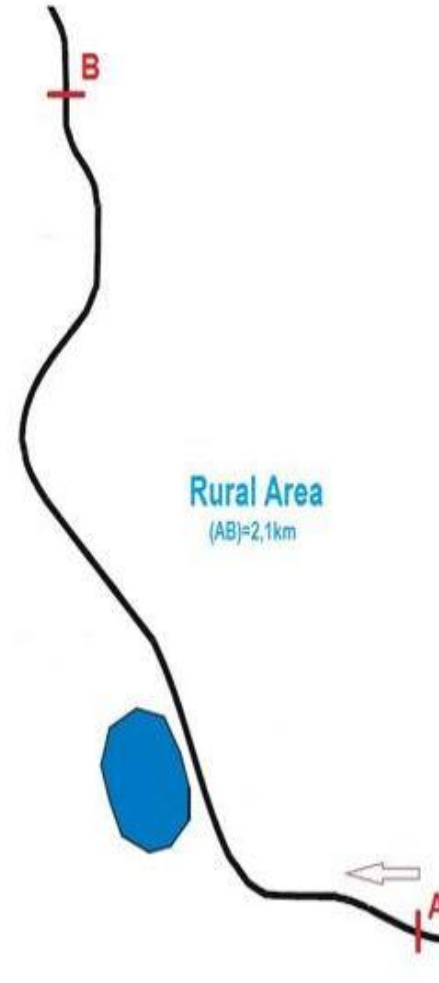
- The on-road experiment took place on the suburbs of Athens, namely in the region of Paiania

- Each driver performed with his/her own car twice every route, without any distraction source and while conversing with the passenger

- Drivers were asked to follow their usual driving behaviour throughout the experiment and try not to be affected by any other factors

Sample characteristics

- 31 young drivers aged between 20 and 30 years
- 18 males and 13 females
- average driving experience of 4.5 years

Distraction conditions

- no distraction
- conversation with the passenger

Questionnaire

- personal characteristics
- distracted driving performance
- driving habits
- driving behaviour in case of a road accident

Analysis methods

Explanatory analysis

Absolute and relative values of driving performance measures were compared in order to give an overall impact of driving performance between simulated and real driving conditions

Model development

Lognormal regression models were developed for the identification of the impact of driving environment driver characteristics as well as driving performance variables on average vehicle speed

1	Average speed (km/h)
2	Logarithm of the average speed
3	Driving on real road conditions (0:no, 1:yes (simulator))
4	(0:no, 1:yes)
5	Distance covered at each trial (km)
6	V(NO TALK) – V(TALK) speed difference between talking and not talking scenario of each driver per driving environment (km) διαφορά ταχύτητας χωρίς ομιλία με την ταχύτητα με ομιλία κάθε οδηγού για κάθε περιβαλλον
7	Ratio of speed when not talking to speed when talking (km)
8	General acceleration -positive or negative-(m/s^2)
9	Acceleration (m/s^2)-positive
10	Logarithm of the acceleration
11	Deceleration (m/s^2)-negative
12	Logarithm of the deceleration
13	Standard deviation of speed
14	Standard deviation of General acceleration
15	Standard deviation of Acceleration
16	Standard deviation of Deceleration
17	Driving Environment
18	Age
19	Gender
20	Week days driving to work
21	Cautious driving while talking to passenger
22	Conversation is risky
23	Speed Reduction by 10-20Km/h

Explanatory analysis

Comparative table of relative values		Road		Simulator		Road	Simulator	$\overline{\Delta\chi}$(Road) – $\overline{\Delta\chi}$(Simulator)	±u*S$_{Dx}$	Result-Difference
	Features	A	B	A	B	$\overline{\Delta\chi}$(Road)	$\overline{}\Delta\chi$(Simulator)			
Average Speed (V)	Talk	53,69	54,61	61,11	61,17	-0,92	-0,06	-0,86	3,554	Non-Important
	Age	54,51	53,72	62,35	59,67	0,79	2,68	-1,89	3,491	Non-Important
	Gender	55,93	51,69	64,18	56,94	4,23	7,24	-3,00	3,144	Non-Important
Average Acceleration (Acc)	Talk	2,53	2,65	1,07	1,10	-0,13	-0,03	-0,10	0,295	Non-Important
	Age	2,58	2,61	1,09	1,08	-0,03	0,01	-0,04	0,293	Non-Important
	Gender	2,70	2,43	1,11	1,05	0,27	0,06	0,21	0,291	Non-Important
Average Deceleration (Dec)	Talk	-2,21	-2,41	-1,27	-1,29	0,19	0,02	0,18	0,236	Non-Important
	Age	-2,28	-2,35	-1,32	-1,23	0,07	-0,09	0,16	0,236	Non-Important
	Gender	-2,40	-2,18	-1,31	-1,23	-0,22	-0,09	-0,13	0,238	Non-Important
Standard Deviation of Speed (StdevV)	Talk	16,02	17,11	16,33	16,25	-1,09	0,08	-1,17	1,583	Non-Important
	Age	16,24	16,95	16,83	15,63	-0,71	1,20	-1,90	1,532	Important
	Gender	17,37	15,45	17,02	15,28	1,93	1,74	0,19	1,522	Non-Important
Standard Deviation of Acceleration (StdevAcc)	Speech	3,68	4,01	0,55	0,55	-0,32	0,00	-0,32	0,602	Non-Important
	Age	3,65	4,09	0,54	0,56	-0,44	-0,01	-0,43	0,578	Non-Important
	Gender	4,11	3,48	0,57	0,52	0,62	0,06	0,57	0,605	Non-Important
Standard Deviation of Deceleration (StdevDec)	Talk	2,65	2,90	1,81	1,83	-0,25	-0,01	-0,24	0,475	Non-Important
	Age	2,64	2,94	1,88	1,75	-0,30	0,13	-0,43	0,461	Non-Important
	Gender	2,97	2,51	1,93	1,66	0,46	0,26	0,20	0,469	Non-Important

The difference of the relative values of speed variability between the two driving environments in terms of the age groups is proved to be important

Model development

The only variables with a positive sign in the model are:

- driving environment
- variability of deceleration

Several other parameters have a statistical significant effect on average speed model including

- driver characteristics (age, gender)
- driving performance variables (speed difference with and without conversation)
- questionnaire variables

Independent Variables	Average Driving Speed			
	β_i	t	Relative Impact	
			e_i	e_i *
Driving Environment	0,069	9,797	0,0196	-3,76
Speed Difference with and without Conversation	-0,003	-2,389	-0,0052	1
Standard Deviation of Deceleration	0,019	5,194	0,0248	-4,75
Age	-0,021	-3,168	-0,0054	1,03
Gender	-0,040	-6,154	-0,0095	1,83
Week days driving to work	-0,004	-2,654	-0,0064	1,22
Cautious driving while talking to passenger	0,049	6,278	0,0063	-1,21
Conversation is risky	-0,024	-3,325	-0,0057	1,10
Speed Reduction by 10-20Km/h	-0,036	-4,737	-0,0059	1,14
R^2=0,659				

- Research results allow a clear view of the extent and manner in which driving conditions in conjunction with driver's characteristics affect driving performance

- Driving environment has the highest effect on average speed indicating that drivers in driving simulator drive in higher average speed compared with on road driving

- Absolute values of drivers' performance vary among simulated and real driving conditions

- Relative differences of driver behaviour at the two driving environments remain mostly the same

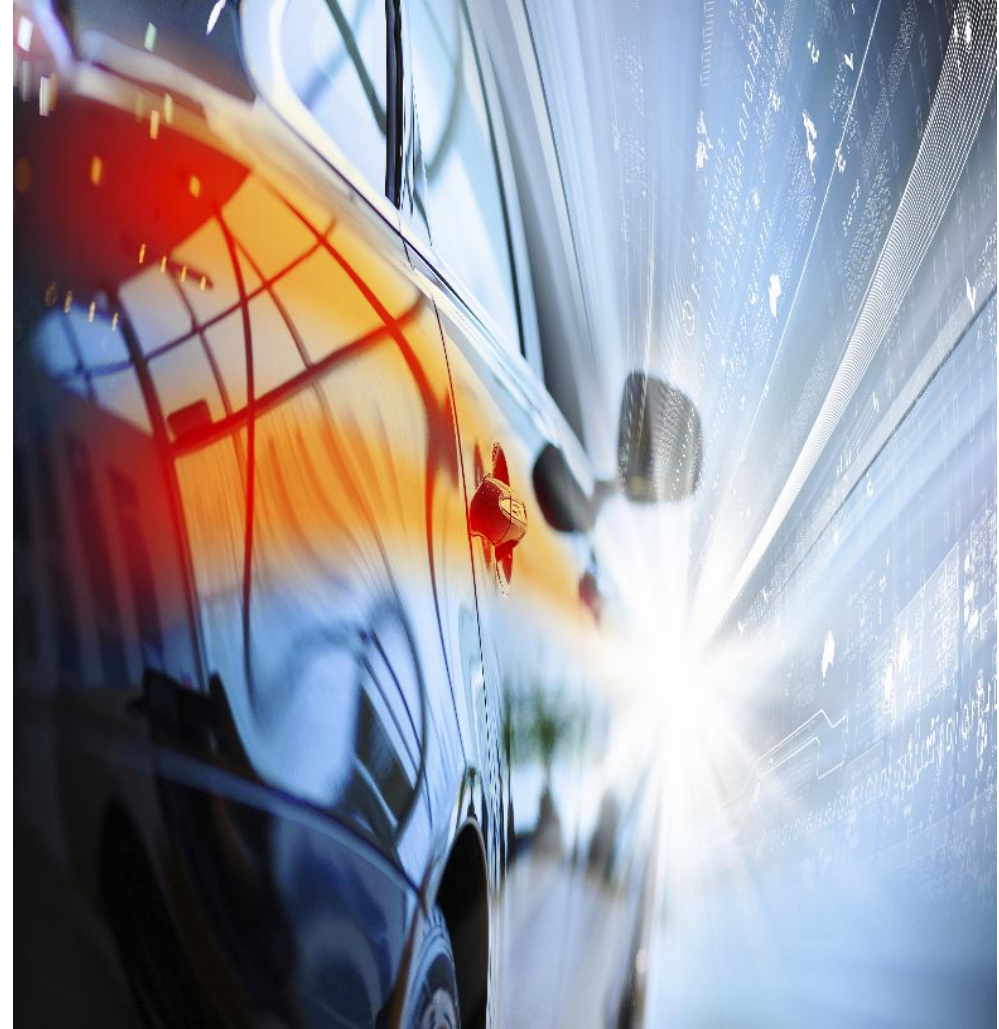- Speed difference between fast and slow drivers is the same at both driving environments

- Speed difference is also the same at the two driving environments between drivers conversing or not conversing to the passenger

- Average speed is significantly affected by the variability of deceleration as drivers that achieved the highest standard deviation of deceleration drove in higher average speed

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