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Simulation of Texting Impact on Young Drivers' Behaviour and Safety in Urban and Rural Roads

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Objectives

- Analysis of impacts of texting to young drivers' behaviour and safety in urban and rural roads through a driving simulator experiment.

- Examination of the impact of contributory factors in speed variation, reaction time and accident probability.
  - Text messaging;
  - Drivers' characteristics (age, gender, etc.)
  - Factors affecting drivers' behaviour (acceleration, revolution per minute, etc.)
  - Traffic type (urban, rural)
  - Environmental conditions (good weather, rain, night)

Research Hypotheses

- Both naturalistic studies and driving simulator studies emphasize that driver distraction and inattention are contributing factors to more than one quarter of recorded road accidents.
- Texting is considered even more dangerous than talking on the mobile while driving.
- Texting is found to cause difficulty in retaining a stable position within the traffic lane and to double reaction time.
- Among young drivers, very few alter their driving behaviour in order to contemplate the recognized risk of texting while driving.

Simulator Experiment (1/2)

- Quarter-cab simulator with a motion base and three 40" LCD monitors (Foerst driving simulator)
- 34 participants aged between 18 and 28 years old, out of which 19 were males and 15 were females
- The participants completed a questionnaire on their personal characteristics, their driving habits, as regards distraction and their perception on the risk associated with texting while driving
- The experiment included 4 simulated drives (5 minutes each) in urban and rural roads in daytime and at night, with good and rainy weather conditions

Simulator Experiment (2/2)

- A researcher supervised each participant, in real time, through a pc connected to the simulator.
- While driving in rural areas, drivers received a sms thanking them for participating to the experiment and to write the first two lines of the national anthem in an sms.
- While driving in urban areas, drivers were asked to read a message comprising of an approximately 30 character simple question and reply to it.
- Each texting process usually lasted 30 to 40sec

Basic Results of the Experiment

		GOOD WEATHER			RAINY WEATHER			NIGHT		
		free driving	sms reading	sms writing	free driving	sms reading	sms writing	free driving	sms reading	sms writing
RURAL ROADS	Mean Speed (km/h)	50	41	39	46	41	37	47	40	36
	Reaction Time (sec)	0,77	1,01	1,13	1,08	1,35	1,41	0,91	1,20	1,21
	No of accidents	0	5	7	6	15	12	8	7	9
URBAN ROADS	Mean Speed (km/h)	37	25	21	35	27	23	35	25	21
	Reaction Time (sec)	1,10	1,29	1,39	1,18	1,44	1,57	1,08	1,33	1,53
	No of accidents	2	9	17	5	16	20	2	11	17

- More accidents in urban roads.
- More accidents during sms writing, rather than sms reading.
- Decrease of speed, increase of reaction time and number of accidents during texting.

Results – Driver's Speed (1/2)

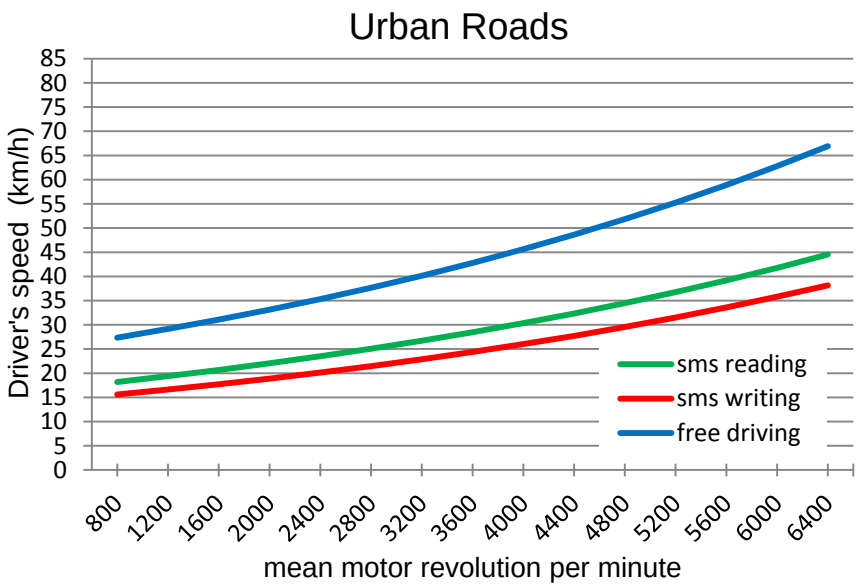
- Two lognormal regression models were developed for mean speed, one for urban roads and one for rural roads.
- Parameter estimates (βi), t-tests (t), elasticities(e), relative elasticities (e_i^*).

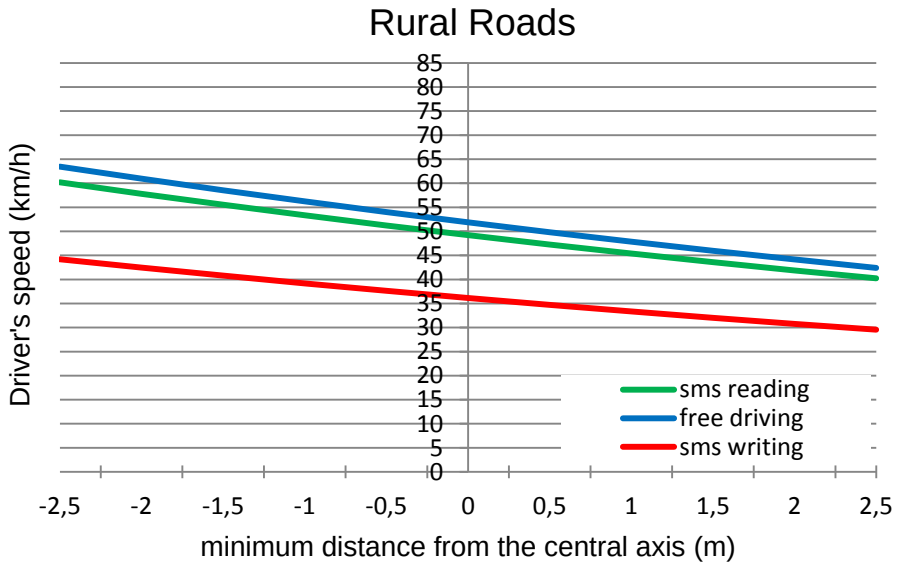
Independent Variables	Urban roads				Rural roads			
	β_i	t	e_i	e_i^*	β_i	t	e_i	e_i^*
free driving					0.157	12.36	0.05	8.17
sms reading	-0.177	-18.43	-0.06	-12.40	0.134	10.79	0.04	6.83
sms writing	-0.244	-24.45	-0.09	-17.20				
mean distance from the central axis	-0.045	-3.36	-0.05	-10.60				
mean motor revolution per minute	0.00007	15.88	0.15	30.20				
minimum distance from the central axis					-0.035	-4.59	-0.02	-2.83
acceleration					0.060	13.95	0.12	20.60
touch screen	-0.014	-1.92	-0.01	-1.00	-0.021	-2.31	-0.01	-1.00
regular drivers	0.030	3.50	0.01	2.00	0.022	1.78	0.01	1.12
speed reduction while reading/writing sms					-0.021	-2.29	-0.01	-1.00
R^2	0.700				0.542			

- Texting leads to statistically significant reduction of mean speed.
- Higher reduction of speed with the usage of mobile phone with touch screen.
- Variables "Rainy" and "Night" are not statistically significant.

Results – Driver's Speed (2/2)

- Correlation of driver's speed with mean motor revolution per minute (urban roads) and with minimum distance from the central axis (rural roads) in relation to texting.





- Texting while driving leads to reduction of driver's speed regardless of urban or rural roads.

Results – Driver's reaction time (1/2)

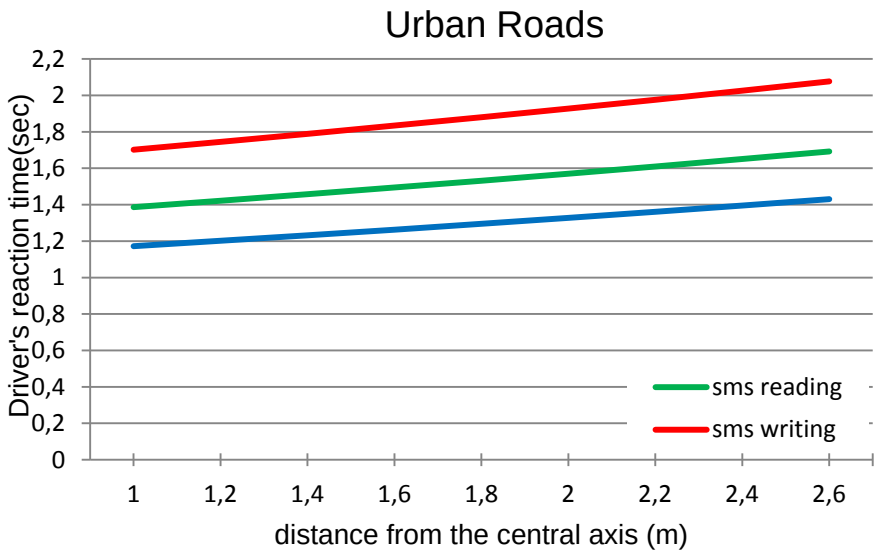
- Two lognormal regression models were developed for reaction time, one for urban roads and one for rural roads.

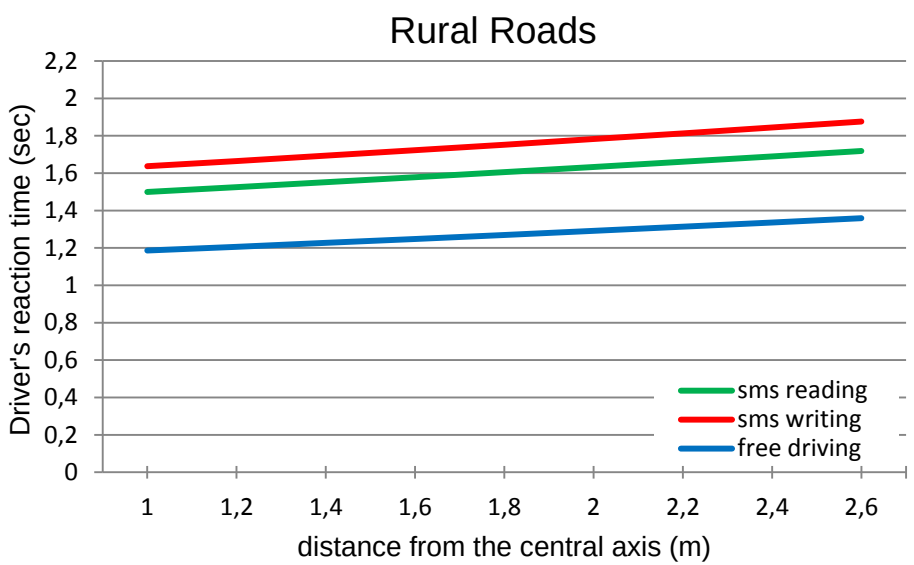
Independent Variables	Urban roads				Rural roads			
	β_i	t	e_i	e_i^*	β_i	t	e_i	e_i^*
driving during night	0.029	1.86	0.15	1.00	0.036	2.34	0.85	1.03
driving in rainy conditions	0.064	4.09	0.34	2.21	0.062	4.02	1.47	1.77
free driving					-0.141	-8.40	-3.35	-4.03
sms reading	0.073	4.17	0.39	2.53	-0.038	-2.25	-0.90	-1.09
sms writing	0.102	5.63	0.54	3.52				
mean distance from the central axis	0.054	2.25	0.96	6.23	0.037	1.61	3.12	3.65
accident occurrence	0.106	7.12	0.56	3.66	0.141	8.36	3.35	4.03
reading/writing sms often	0.106	7.12	0.56	3.66	0.141	8.36	3.35	4.03
R^2	0.249				0.276			

- Texting leads to statistically significant increase of reaction time.

Results – Driver's reaction time (2/2)

- Correlation of driver's reaction time with mean distance from the central axis in relation to texting.





- Texting while driving leads to increase of driver's reaction time regardless of urban or rural roads.

Results – Accident Probability (1/2)

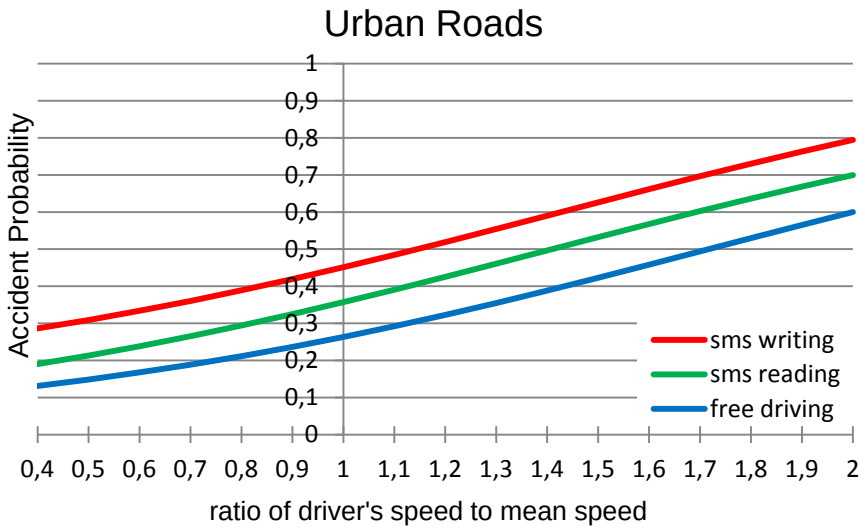
- Two binary logistic regression models (Accident: yes / no).

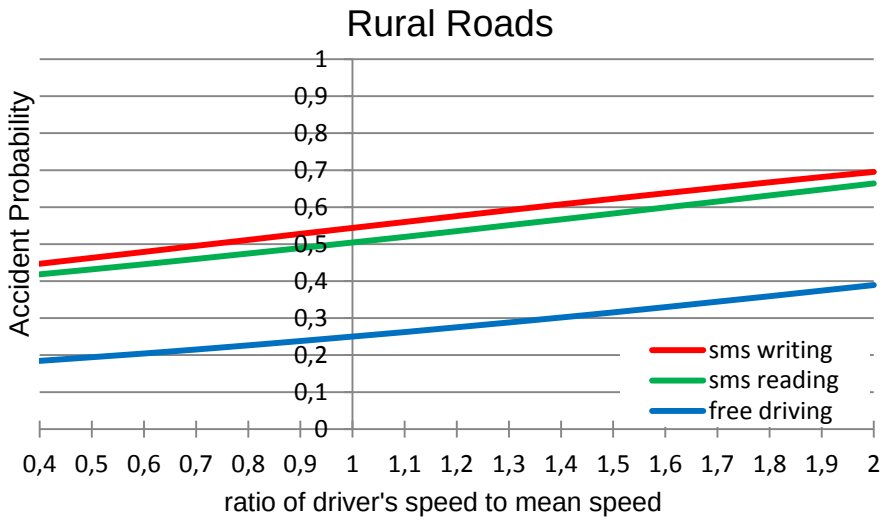
Independent Variables	Urban roads				Rural roads			
	β_i	Wald	e_i	e_i^*	β_i	Wald	e_i	e_i^*
driving during night	0.477	3.76	0.29	2.42	0.481	3.88	0.33	1.65
driving in rainy conditions	0.914	14.53	0.62	5.17	0.923	14.99	0.75	3.75
sms reading	0.581	5.41	0.35	2.92	0.411	2.65	0.28	1.40
sms writing	1.270	21.41	1.00	8.33	0.436	2.77	0.30	1.50
touch screen	0.268	1.82	0.16	1.33	0.283	2.05	0.21	1.05
driver's gender	-0.229	1.41	-0.12	-1.00	-0.375	3.59	-0.20	-1.00
failure to compose sms					-0.787	9.38	-0.40	-2.00
mean distance from the right edgeline					0.14	2.02	0.03	1.00
driver's speed / mean speed	0.648	3.74	0.13	1.00	1.43	21.03	0.19	6.33
Null log-likelihood	378.089				337.109			
Final log-likelihood	655.364				662.262			
Degrees of freedom	7				9			

- Texting leads to statistically significant increase of accident probability in case of an unexpected incident.
- Variables “Rainy” and “Night” increase accident probability.

Results – Accident Probability (2/2)

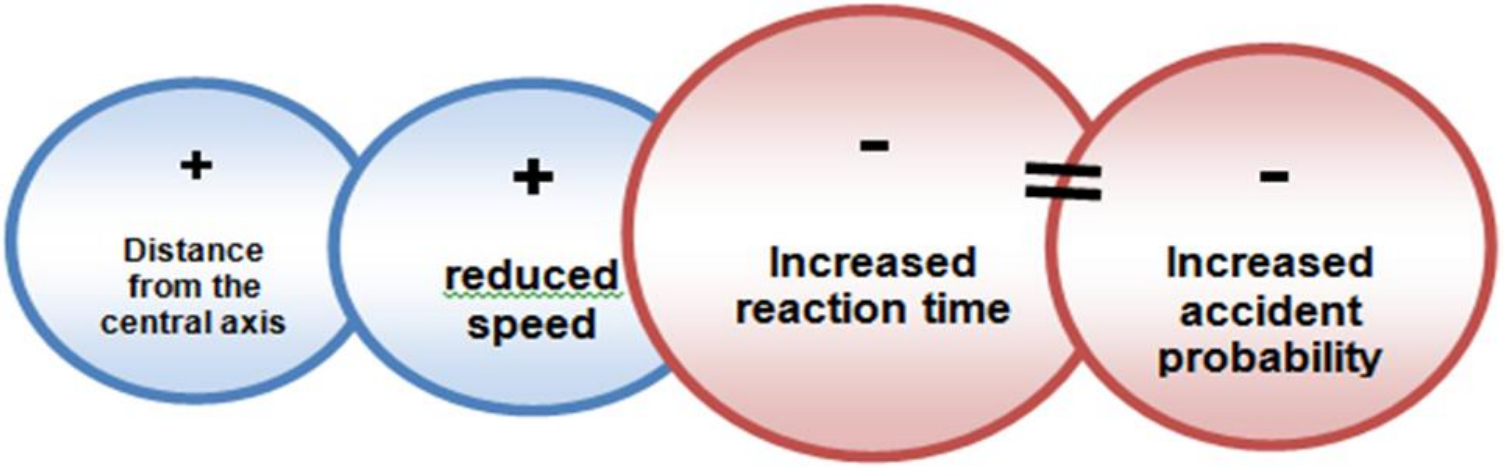
- Correlation of accident probability with the ratio of driver's speed to mean speed in relation to texting.





- Increase of ratio of driver's speed to mean speed leads to increase of accident occurrence.

Distracted driving accident risk – The Mechanism



The decrease in speed
and the increase in the distance from the central axis,
during distracted driving might be considered beneficial for road safety,
however, they cannot always counter-balance
the related increased reaction times,
and eventually increased accident probability,
especially at unexpected incidents.

Conclusions (1/2)

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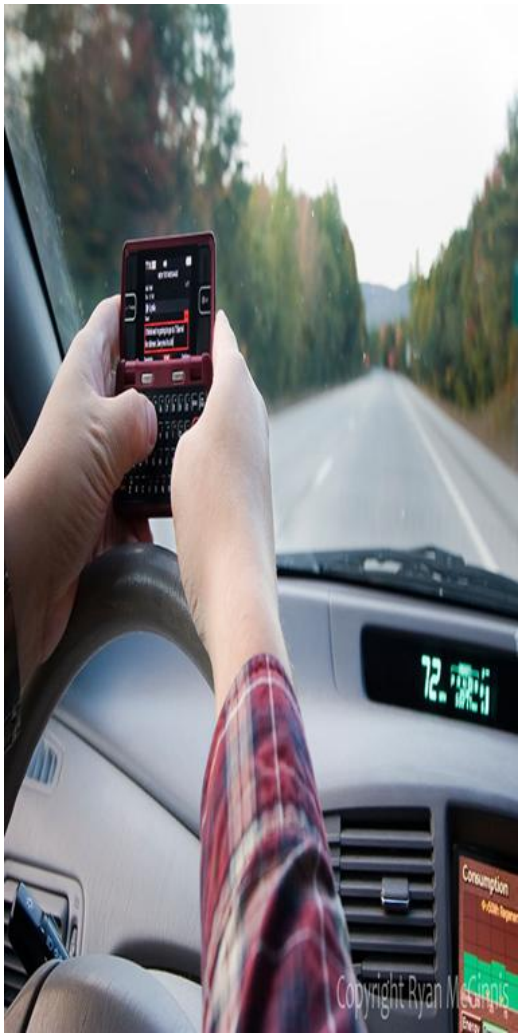
- Texting while driving, increases the accident probability despite a reduction in speed, possibly due to an increase of reaction time.
- It was found from international literature that texting is more impairing than talking to the mobile while driving.
- Drivers using mobile phones with touch screens have increased accident probability despite a higher reduction in speed.
- Driving in rainy conditions and during night also increases accident probability, especially on rural roads where these two variables had the greatest impact.



Conclusions (2/2)

- On rural roads, accident probability is 1,4 and 1,5 times higher, when driver reads or writes a sms, compared to driving without texting.
- Respectively, on urban roads accident probability is 2,9 and 8,3 times higher, when driver reads or writes a sms, compared to driving without texting.
- This might be an indication that sms writing is even more impairing than sms reading during driving.
- Driving in rainy conditions is more impairing than driving during night.

Recommendations – Further Research

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- This study may serve as a basis for further research in such types of experiments on a larger sample with participants of various age groups.
- Different driving environments and different traffic conditions should be further investigated, to explore the impairment caused by texting in more complex road environments, more traffic density, adverse weather conditions etc.
- Comparison of different distraction factors such as smoking, discussion with passengers, eating, music etc. would allow a classification in terms of risk.
- New texting interfaces could also be examined with regard to their contribution to the improvement of road safety.

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