Impact of texting on young drivers' behaviour and safety on motorways by the use of a driving simulator

G. Yannis, A. Laiou, P. Papantoniou, C. Gkartzonikas

National Technical University of Athens, Greece

3rd International Conference on Driver Distraction and Inattention
4-6 September, 2013, Gothenburg, Sweden

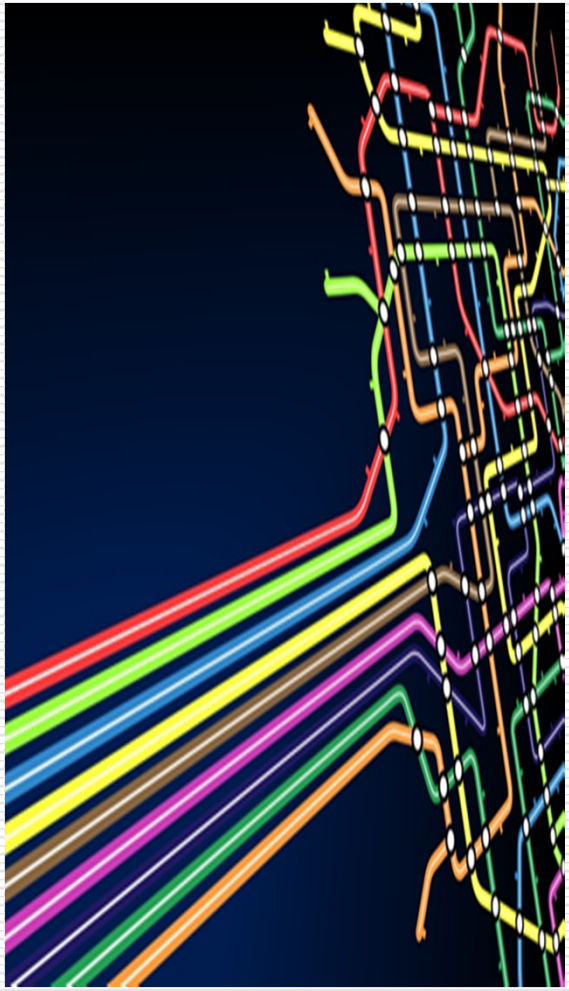
Objectives

- Analysis of impacts of texting to young drivers' behaviour and safety in motorways through a driving simulator experiment

- Examination of the impact of contributory factors in speed variation, headway and accident probability
  - Text messaging
  - Drivers' characteristics (age, gender, weekly distance traveled, etc.)
  - Factors affecting drivers' behaviour (lateral variability, etc.)
  - Traffic type (moderate, heavy)
  - Environmental conditions (good weather, rain)

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 3 simulated drives (5 minutes each) in a motorway environment during good and rainy weather conditions, in moderate and heavy traffic

Simulator Experiment (2/2)

- A researcher supervised each participant, in real time, through a pc connected to the simulator.
- While driving in moderate traffic, drivers received a 180 character sms asking for specific directions on traveling from the center of Athens to the NTUA Campus by public transport.
- While driving in heavy traffic, drivers received a 180 character sms asking for instructions on how to prepare a simple recipe.
- Each texting process usually lasted 60 to 90sec
- While still driving in heavy traffic, drivers were asked to set the alarm function on their mobile phones.

Basic Results of the experiment

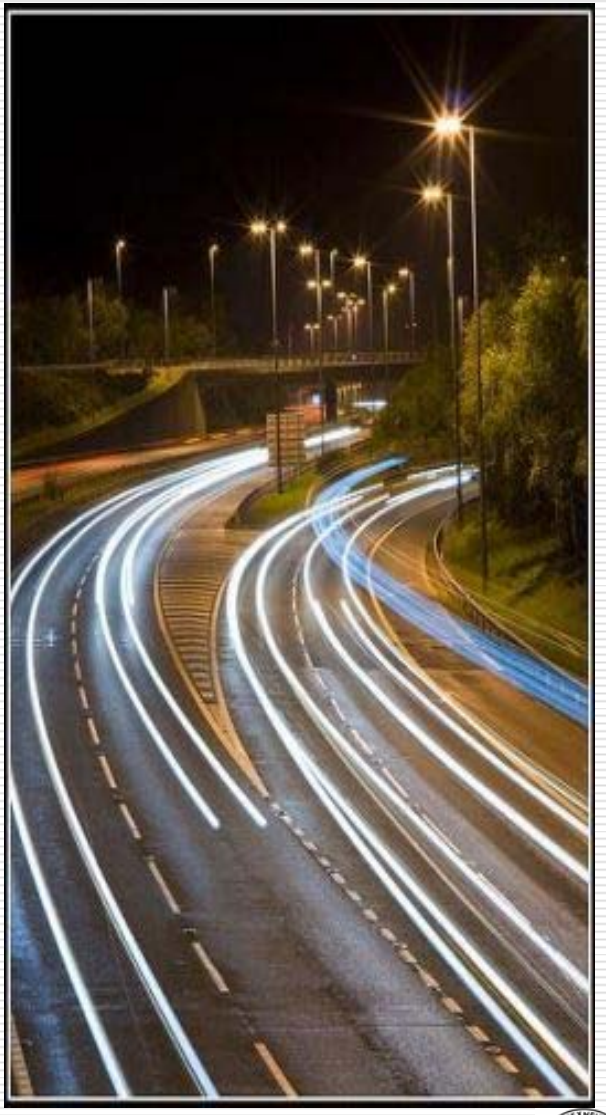
		GOOD WEATHER				RAINY WEATHER			
		free driving	sms reading	sms writing	alarm function	free driving	sms reading	sms writing	alarm function
MODERATE TRAFFIC	Mean Speed	94	84	79		90	85	79	
	Vehicle's headway	300	220	180		420	290	200	
	No of accidents	0	2	3		1	9	4	
HEAVY TRAFFIC	Mean Speed	88	80	78	81	83	77	73	75
	Vehicle's headway	710	495	405		780	560	450	
	No of accidents	0	2	3	3	2	6	4	4

- Mean speed and headway decreased during texting
- The number of accidents increased during texting.

Results – Driver's speed (1/3)

List of statistically significant independent variables used for driver's speed model.

- logV: mean speed
- Rainy: driving in rainy conditions
- Free_Q1: free driving – moderate traffic
- RM_1: read message – moderate traffic
- RM_2: read message – heavy traffic
- WM_2: write message – heavy traffic
- Time_fix: set the alarm function – heavy traffic
- touch: mobile phone with touch screen
- rspur: mean distance from the central axis
- sex: driver's gender
- love_d: driver enjoying driving
- dist_week: distance traveled per week
- Incident: accident occurence or not
- wm2_rain: failure to send message – heavy traffic



Results – Driver's speed (2/3)

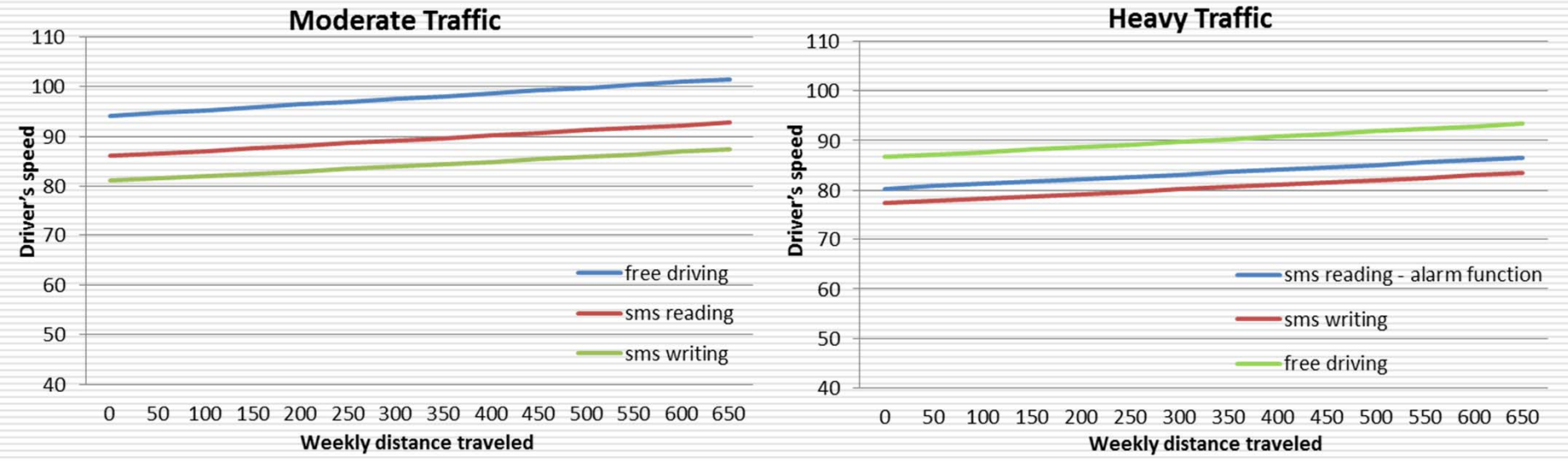
- Two lognormal regressions models were developed for mean speed, one for moderate traffic and one for heavy traffic.
- Parameter estimates (βi), t-tests (t), elasticities(e), relevant elasticities (e_i^*).

Independent variables	Moderate traffic				Heavy traffic			
	β_i	t	e_i	e_i^*	β_i	t	e_i	e_i^*
Rain	-0.011	-2.40	-0.003	-1.00	-0.009	-1.95	-0.002	-1.00
Free driving	0.065	10.30	0.016	5.61				
sms reading	0.026	4.05	0.007	2.36	-0.033	-4.77	-0.009	-3.67
sms writing					-0.049	-6.98	-0.013	-5.44
Alarm activation					-0.037	-5.38	-0.010	-4.11
Touch screen	0.015	-2.95	-0.004	1.36	-0.014	-2.70	-0.004	-1.56
Mean distance from the central axis	-0.012	-9.23	-0.046	-16.14	-0.013	-9.37	-0.049	-20.78
Driver's gender	0.013	2.85	0.003	1.18	0.014	2.85	0.004	1.56
Driver enjoying driving	-0.048	-4.84	-0.012	-4.35	-0.051	-4.93	-0.013	-5.65
Distance travelled per week	0.00005	3.43	0.004	1.31	0.00005	3.16	0.004	1.56
Accident occurence	0.034	4.45	0.009	3.09				
Failure to send sms					0.023	2.64	0.006	2.56
R^2	0.484				0.385			

- Texting leads to statistically significant reduction of mean speed.
- Reduction of speed with the usage of mobile phone with touch screen while driving.
- Driving in rainy conditions leads to reduction of mean speed.

Results – Driver's speed (3/3)

- Correlation of driver's speed with weekly distance travelled in relation to texting.



- Texting while driving leads to reduction of driver's speed regardless of moderate or heavy traffic.

Results – Vehicle's headway (1/3)

List of statistically significant independent variables used for vehicles' headway model.

- logHway: vehicles' headway in meters
- Rainy: driving in rainy conditions
- Free_Q1: free driving – moderate traffic
- Free_Q2: free driving – heavy traffic
- RM_1: read message – moderate traffic
- RM_2: read message – heavy traffic
- Time_fix: set the alarm function – heavy traffic
- touch: mobile phone with touch screen
- sex: driver's gender
- dist_week: distance traveled per week.

Results – Vehicle's headway (2/3)

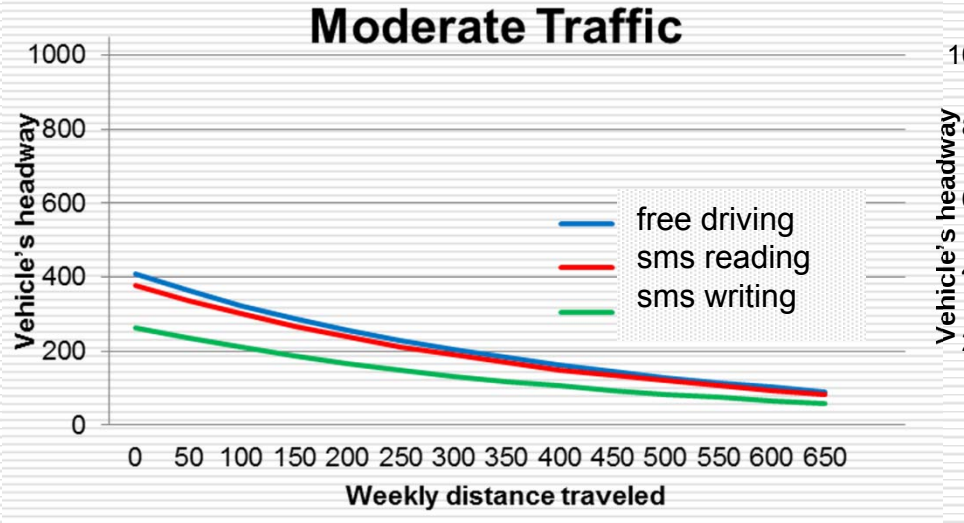
- Two lognormal regression models were developed for vehicle's headway, one for moderate traffic and one for heavy traffic.

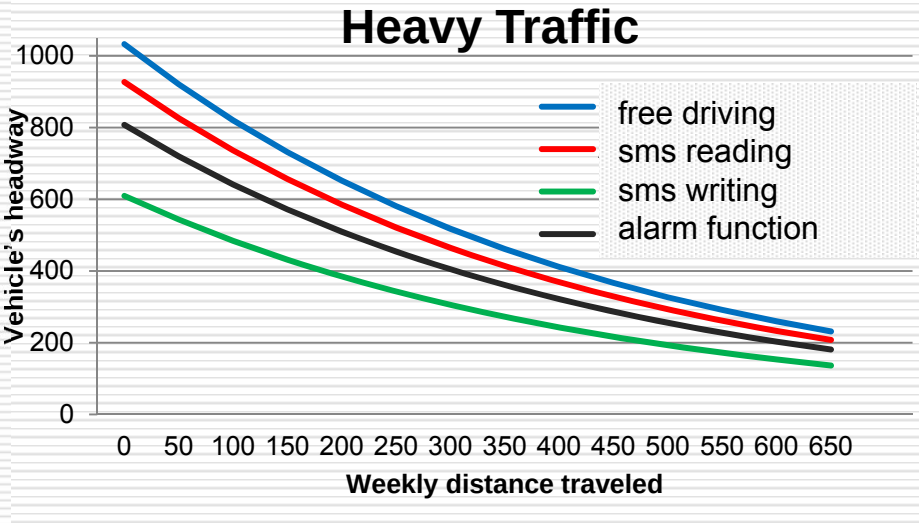
Independent variables	Moderate traffic				Heavy traffic			
	β_i	t	e_i	e_i^*	β_i	t	e_i	e_i^*
Rain	0.14	2.31	0.056	2.07	0.164	2.71	0.063	2.52
Free driving	0.187	1.91	0.072	2.67	0.229	1.69	0.088	3.52
sms reading	0.154	2.16	0.059	2.19	0.182	1.86	0.070	2.80
Alarm activation					0.122	1.85	0.047	1.88
Touch screen	0.116	2.31	0.030	1.11	0.127	2.75	0.049	1.96
Driver's gender	-0.071	-1.92	-0.027	-1.00	-0.065	-1.84	-0.025	-1.00
Distance travelled per week	-0.001	-2.9	-0.077	-2.65	-0.001	-3.228	-0.077	3.08
R^2	0.312				0.307			

- Texting leads to statistically significant reduction of headway.
- Drivers who use mobile phone with touch screen, maintain longer headways.
- Occurrence of rainy conditions leads to increase of headway.

Results – Vehicle's headway

- Correlation of vehicle's headway with weekly distance travelled in relation to texting.



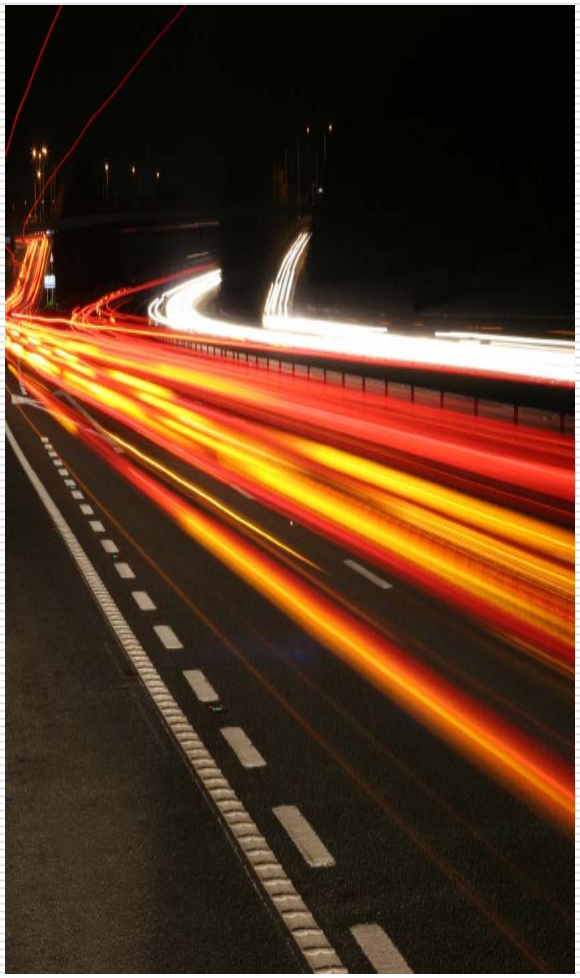


- Drivers while texting reduce their headway in both models.
- In heavy traffic, drivers reduce their headway while they set the alarm function.

Results – Accident Probability (1/3)

List of statistically significant independent variables used for Accident Probability's model.

- Rainy: driving in rainy conditions
- RM_1: read message – moderate traffic
- RM_2: read message – heavy traffic
- Wm_1: write message – moderate traffic
- Wm_2: write message – heavy traffic
- touch: mobile phone with touch screen
- d_experience1: driving experience less than 3 years
- Vi/Vm: ratio of driver's speed to mean speed
- Rspur_min: minimum distance from the central axis
- love_d: whether participant stated that he/she like driving
- Thead_min: time distance from the vehicle ahead in seconds



Results – Accident Probability (2/3)

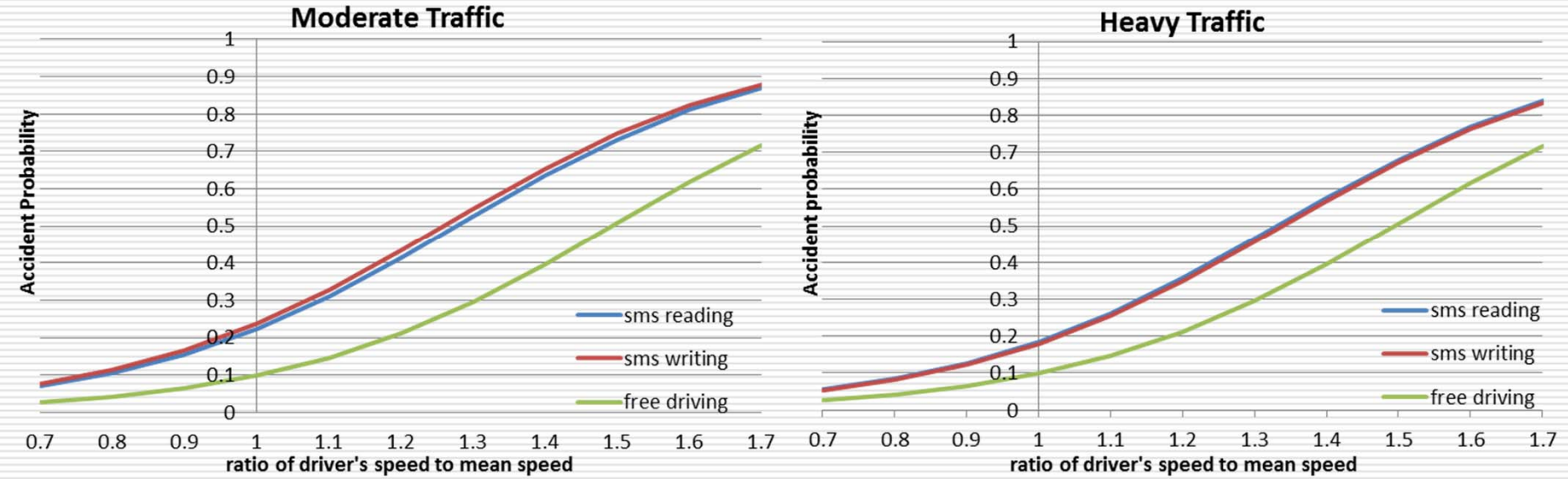
- Two binary logistic regression models (Accident: yes / no).

Independent variables	Moderate traffic				Heavy traffic			
	β_i	Wald	e_i	e_i^*	β_i	Wald	e_i	e_i^*
Rain	1.372	11.51	1.976	3.55	1.410	13.13	2.160	5.02
sms reading	0.971	4.92	1.053	1.89	0.725	2.51	0.760	1.77
sms writing	1.051	4.73	1.113	2.00	0.691	1.83	0.710	1.65
Touch screen	0.569	2.17	0.556	1.00	0.439	1.65	0.430	1.00
Driving experience >3years	0.715	3.20	0.706	1.27	0.807	4.34	0.990	2.30
Minimum distance from the central axis	-0.213	-4.75	-0.793	-4.13	-0.206	-5.19	-0.830	-1.00
Time distance from the vehicle ahead (sec)	-0.038	-1.69	-0.192	-1.00				
Driver's speed / mean speed	4.495	10.46	2.610	12.54	4.479	11.16	2.780	3.35
Null log-likelihood	133.927				246.312			
Final log-likelihood	229.778				148.758			
Degrees of freedom	8				7			

- Texting leads to statistically significant increase of accident probability.
- Drivers who use mobile phone with touch screen, had increased accident probability.
- Occurrence of rainy conditions leads to increase of accident probability.

Results – Accident Probability (3/3)

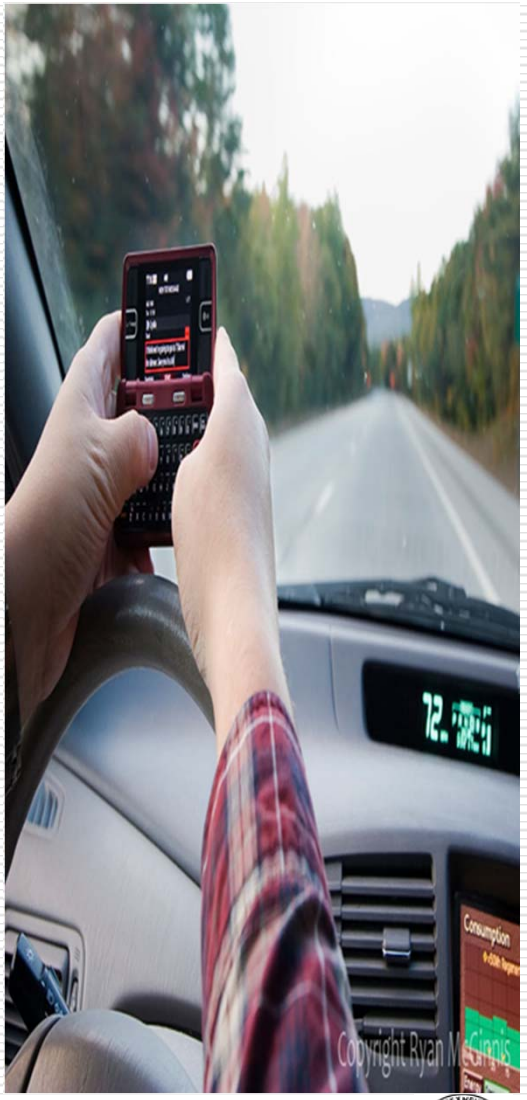
- Correlation of accident probability with the ratio of driver's speed to mean speed in relation to texting.



- Decrease of ratio of driver's speed to mean speed leads to decrease of accident occurrence.

Conclusions (1/2)

- Texting while driving, increases the accident probability despite a reduction in speed, possibly due to a decrease of headway.
- It was found from international literature that texting is more impaired than talking to the mobile while driving.
- Drivers using mobile phones with touch screens tend to reduce their speed more and keep a longer distance from the vehicle ahead.
- Driving in rainy weather leads to a higher accident probability, despite the decrease of mean speed.

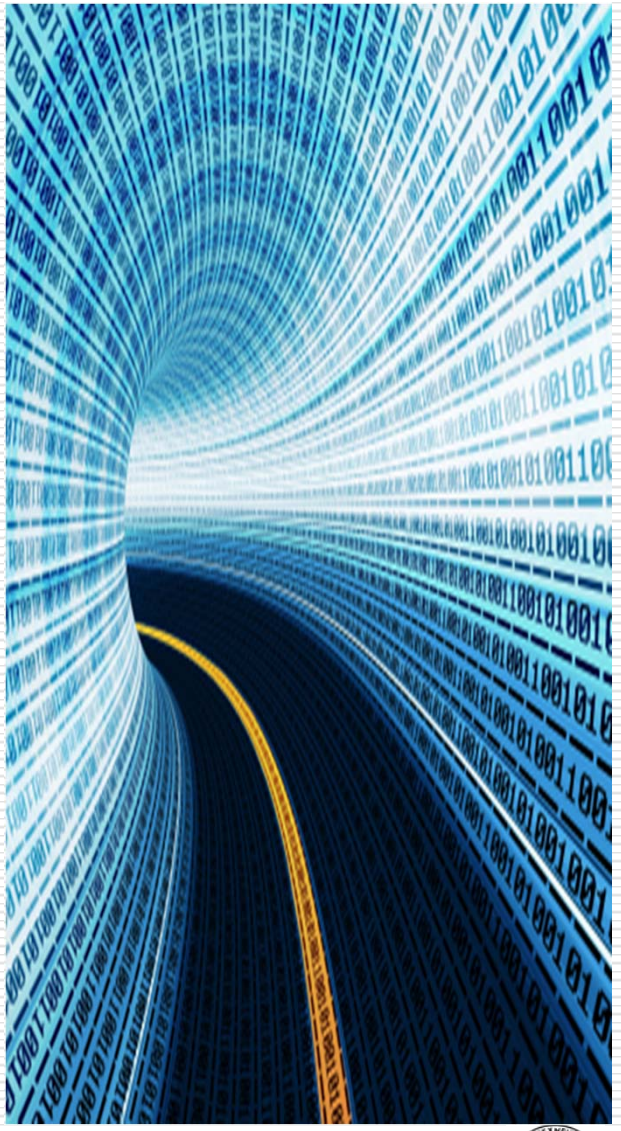


Conclusions (2/2)

- In moderate traffic, accident probability is 1.9 and 2 times higher, when driver reads or writes an sms, compared to free driving
- Respectively, in heavy traffic accident probability is 1.8 and 1.7 times higher, when driver reads or writes an sms, compared to free driving
- This might be an indication that both sms reading and sms writing are equally dangerous during driving
- Female young drivers had larger decrease of mean speed and headway compared to male young drivers.

Recommendations – Further Research

- This study may serve as a basis for further research using a similar experiment 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 technologies used for texting in modern devices could also be examined with regard to their contribution to the improvement of road safety.



Impact of texting on young drivers' behaviour and safety on motorways by the use of a driving simulator

G. Yannis, A. Laiou, P. Papantoniou, C. Gkartzonikas

National Technical University of Athens, Greece

3rd International Conference on Driver Distraction and Inattention
4-6 September, 2013, Gothenburg, Sweden