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Critical factors affecting mobile phone use while driving through the exploitation of smartphone sensor data



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Introduction

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- Mobile phone use while driving is one of the most critical factors affecting road safety and one of the leading cause of road crashes
- Drivers who use a mobile phone while driving exhibit impairment in their driving performance (higher speed variations, vehicle lateral position, etc.) due to high levels of workload
- Increased reaction times are being observed in case of an incident or event and therefore high probability of being involved in a crash
- Effective effort is required to identify crucial factors affecting mobile phone use while driving by employing evidence-based approaches







Objective

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- Aim of this study is:
- To identify critical driving parameters affecting mobile phone use while driving using data obtained from smartphone sensors during naturalistic driving
- To determine the influence of road type (urban, rural and highway) on the mobile phone use while driving as well as any underlying correlations with other factors such as driving behaviour and self-reported features





Procedure of Data Collection (1/2)

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- An innovative data collection system using a smartphone application was exploited
- The recording starts automatically when smartphone sensors detect a driving condition
- The data are temporally stored and sent in the central database of the OSeven backend office via wi-fi or 3G/4G
- Sophisticated and Machine Learning techniques are implemented to detect the driving characteristics and conditions







Procedure of Data Collection (2/2)

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- This procedure results to the creation of risk exposure and driving behaviour indicators
- With these tools:
 - the system can recognize for every route the driving conditions and sets average values for all driving characteristics
 - the drivers are informed, when they were speeding or how long they use their mobile phone
- The OSeven platform has very clear privacy policy statements and uses technologies in compliance with (GDPR)







Experimental Process

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- A naturalistic driving experiment
- Participants: 100 participants
- Duration: 6-months
- Two databases were constructed:
 - A large database of 49,019 trips, which include all risk exposure and driving behaviour indicators
 - A detailed questionnaire containing 4 sections
 - 1st part: driving experience
 - 2nd part: vehicle's characteristic
 - 3rd part: driving behaviour
 - 4th part: demographic characteristics







Descriptive statistics

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50 40 Number of drivers 30 20 10 0 0.00 0.05 0.10 0.15 0.20 Mobile Phone Use Percentage

Histogram for Mobile Phone Use Percentage



The average percentage of mobile use of the sample collected on a driver basis

The average percentage of mobile use per road type



Methodology

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Analysis scope

Among the recorded risk factors, the **frequency of mobile phone use** per trip is investigated in the present study

 Selection of statistical method: Need for event prediction - data counting (data modeling)

Generalized Linear Models (GLMs) to capture mobile phone use instances, given by the following formula: $log(\lambda_i) = \beta_{0i} + \beta_{ji}x_{ji} + \beta_{n-1}x_{n-1} + \varepsilon$







Results (1/2)

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Parameter	Overall model		Urban model		Rural model		Highway model	
	В	P-value	В	P-Value	В	P-value	В	P-value
intercept	-1.223	0.097	0.963	0.025	0.411	0.004	-1.941	<0.001
speeding_perc	4.112	<0.001	2.841	<0.001	7.358	<0.001	-	-
distance	0.032	<0.001	-0.122	<0.001	-	-	7.932	<0.001
dec_avg	-1.383	<0.001	-0.625	0.005	-1.182	0.008	-0.075	<0.001
speed_avg	-	-	-	-	-	-	-0.820	<0.001
km_avg_day	-	-	-0.355	0.046	-0.497	0.045	-	-
sp_familiarity	1.172	<0.001	1.070	0.017	1.376	<0.001	-	-
self-declared mbu never	-2.433	<0.001	-2.532	<0.001	-2.556	<0.001	-	-
self-declared mbu often	-0.729	<0.001	-0.753	<0.001	-0.558	<0.001	-	-
self-declared mbu rarely	-1.697	<0.001	-1.769	<0.001	-1.746	<0.001	-	-
self-declared mbu smt	-1.178	<0.001	-1.151	<0.001	-1.089	<0.001	-	-
AIC	527.08		527.94		438.61		148.93	
McFadden pseudo R ²	0.258		0.253		0.321		0.241	



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Results (2/2)

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- In all four regression models the frequency of deceleration is associated with reduced mobile use while driving
- In three out of four models the speeding percentage, the total distance of the trip and the self-reported familiarity of the driver with smartphones are associated with increased mobile use while driving
- The self-reported frequency of the mobile use by drivers is also found statistically significant
- The highway model contains different variables from the other three models, indicating a different driving behaviour





Conclusions

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- Both naturalistic driving data and questionnaire data are found statistically significant in the analysis
- An interesting finding is that across the four models, average deceleration had the most consistent impact, appearing to have a statistically significant negative correlation with mobile use integer values
- The positive correlation of the percentage of speeding time and mobile phone use indicates that drivers who don't comply with the speed limits are those who don't comply with the banning of mobile phone use while driving







Future Research

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- The influence of weather and traffic conditions while driving by using naturalistic driving data
- The presence of a passenger in terms of distraction
- Alcohol consumption and the use of seat belt
- The examination of additional methods of analysis:
 - factor analysis
 - logistic regression
 - econometric techniques such as time-series analysis







Thank you!

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