



Which driving performance parameters affect speeding? A naturalistic driving experiment

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Objective

Aim of this study is:

- To investigate which driving performance parameters affect speeding using data obtained from smartphone sensors during naturalistic driving
- In particular, to investigate which factors are correlated with speeding while driving in different driving environments
 - Urban
 - ≻ rural





Background

- Speeding is considered as the most important road accident contributory factor as is a key factor in around 30% of road fatal accidents
- In Greece, 40-50% of drivers drive faster than the recommended speed limit and 10-20% exceed the limit by more than 10kph
- Speeding apart from increasing the possibility for a driver to get involved in an accident, also increases the posiibilities of severe injuries or fatalities
- Speeding includes: excessive speed (driving above the speed limit) and inappropriate speed (driving too fast for the conditions, but within the limits)





Smartphone data collection (1/2)

- A mobile application to record user's driving behaviour (automatic start / stop)
- A variety of APIs is used to read mobile phone sensor data
- Data is transmitted from the mobile App to the central database
- Data are stored in a sophisticated database where they are managed and processed







Procedure of Data Collection (2/2)

Indicators are designed using:
machine learning algorithms
big data mining techniques

Data collected for 49,018 trips from 116 drivers for a period of 6 months (2019-2020)

 The database analyzed was in .csv format
Drivers' trips are stored per row, the characteristics of which are stored in each column's variables







Descriptive statistics

- The highest and lowest percentage of speeding is found in the urban environment and highways, respectively.
 - This is probably because the speed limits on highway are already high enough
- The largest number of high intensity harsh events takes place in the urban environment mainly due to its characteristics e.g.:
 - \succ high traffic conditions
 - Not clear driving environment
 - verall parameters that lead to a more nervous driving performance







Methodology (1/2)

When a variable Y is linearly depended on more than one variables X (X₁, X₂, X₃,.., X_κ), multiple linear regression is used. The relationship between the dependent and the independent variables is given by the following formula:

 $> y_i = \beta_0 + \beta_1 * x_{1i} + \beta_2 * x_{2i} + \beta_3 * x_{3i} + \beta_k * x_{ki} + \epsilon_i$







Methodology (2/2)

Three linear regression models forecasting the percentage of driving duration of driving above the speed limit were developed: one overall model and two models for each different road type (urban, rural):

- Model 1: Predicting the percentage of speeding overall model
- Model 2: Predicting the percentage of speeding on urban road
- Model 3: Predicting the percentage of speeding on rural road





Results (1/2)

Linear models for speeding for urban and rural roads separately

Independent Variables	Models					
	Overall		Urban		Rural	
	В	t	В	t	В	t
Constant	-0.119	-71.819	-0.215	-183.421	-0.053	-71.287
speed_avg	0.002	110.299	-	-	-	-
harsh _acc	0.006	33.368	-	-	-	-
work_weekend	0.009	10.574	-0.002	-2.013	-0.003	-3.354
smooth_eco	0.189	58.158	-	-	-	-
speed_urban_avg	-	-	0.010	275.838	-	-
harsh _acc_urban	-	-	0.003	10.748	-	-
speed_rural_avg	-	-	-	-	0.002	136.085
harsh _acc _rural	-	-	-	-	0.007	20.873
Adjusted R ²	0.316		0.630		0.310	



Results (2/2)

- As the average speed and the harsh acceleration events increase, the higher the speeding percentage in a trip
- These two factors both indicate an aggressive driving behaviour which is strongly correlated to speed exceedance while driving
- The eco-friendly driving variable is included only in the overall model indicating that the different road environment does not affect eco-driving performance in terms of speeding
- In the overall model the weekdays variable has a positive correlation to speeding, but both in the urban and rural models, weekends indicates increase of speeding





Conclusions

- Average speed, number of harsh acceleration events occurred, have all been determined as statistically significant and positively correlated with the speeding percentage in all different models
- Drivers who tend to accelerate harshly and frequently, also tend to exceed the speed limit in a greater amount of travel time
- It is also found that drivers traveling more in terms of distance and time, usually drive at a higher speed indicating that they are at higher exposure, behavioural risk and speeding percentage





Future Research

- Analysis of different driving behavior parameters identified by the road safety literature as risk factors (e.g. exceeding speed limit, mobile phone distraction)
- Analyses per gender, age, history of accidents, selfassessment, driving experience and more demographic characteristics
- Investigation of driver feedback effect on driving behavior and safety of both drivers and motorcyclists







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