



## Association of Stated and Revealed Driving Behaviour Using an On-Board-Diagnostics System



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### Abstract

The aim of this research is the correlation of stated and revealed driver's behavior with the use of vehicle on-board diagnostics (OBD) data. On that purpose, a large data set from a driving behavior experiment was exploited, which recorded abnormal behavior of 17 drivers. These data concerned harsh acceleration and braking, average traffic speed and mileage travelled, which were recorded per second during a period of three months. Drivers' stated behavior was investigated through a corresponding questionnaire. For the data analysis, a mathematical statistical model was developed using linear regression. The results demonstrated a strong correlation between harsh brakings and accelerations on one hand and the number of accidents, the annual income and the declared frequency of harsh braking on the other.

### Objectives

- Find the correlation between stated and revealed driver's behavior.
- Investigation of how driving characteristics interact with each other.
- Compare driver's perception and reality through data collected from OBD devices and questionnaires.



### Methodology

#### Multiple Linear Regression

When a variable Y is linearly depended on more than one variables X (X<sub>1</sub>, X<sub>2</sub>, X<sub>3</sub>, ..., X<sub>k</sub>), multiple linear regression is used. The relationship between the dependent and the independent variables is given by the following formula:

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



### Data

#### Experiment

Seventeen drivers participated in the naturalistic driving experiment using OBD devices recording for each trip:

- Distance travelled
- Time of the day
- Speed
- Harsh acceleration (HA) events (duration, magnitude etc.)
- Harsh braking (HB) events (duration, magnitude etc.)
- Harsh cornering (HC) events (duration, magnitude etc.)
- Fuel consumption
- Seat belt use

#### Questionnaire

- A survey consisting of 78 questions including:
  - Accident history
  - Driving experience
  - Driving offences
  - Driving perception
  - Demographics

#### Summary Statistics

- 9 out of 17 drivers are freelancers and 1 is a student.
- Approximately 50% belongs to the high income category.
- Stated HA frequency is close to respective revealed one.
- High income drivers perform more HA events per 100 km than the rest of the sample and their stated number of HB is higher than the revealed.
- Drivers with the lowest number of HA appear to have the lower number of road traffic violations.
- There is no correlation between the number of accidents and the number of HA per 100km.
- There is no correlation between the frequency of driving under the influence of alcohol and the number of HA or HB per 100km

### Results (1/2)

#### Linear Regression

The dependent variables and representative of the reported driver behavior selected from the measurements shown by the specific component are listed below:

- Number of harsh brake events per 100 km.
- Number of harsh accelerations events per 100 km.
- Number of harsh brake events with a driving speed between 50 and 90 km/h at the beginning of the event
- The number of harsh accelerations events with an acceleration value between 0.22g and 0.26g (m/s<sup>2</sup> at the peak of the event).

	Model 1		Model 2		Model 3		Model 4	
	$\beta_i$	$\epsilon_i$	$\beta_i$	$\epsilon_i$	$\beta_i$	$\epsilon_i$	$\beta_i$	$\epsilon_i$
Dependent variables								
Annual income < 10,000 euros	-33.296	1.171	-50.742	1.392	-7.694	1.135	-19.3	1.288
2 accidents to date	44.115	1.156	57.078	1.357	13.856	1.626	16.824	1.280
"I often brake harshly" (questionnaire)							10.628	1.001
1 traffic violation fine	31.718	1	38.564	1.276	8.001	1.254	12.753	1
"I sometimes brake harshly" (questionnaire)			-24.289	1	-2.752	1		
3 trips per day	40.961	1.097						

### Results (2/2)

#### Linear Regression

- Statistical analysis confirms that high income drivers perform more HA events per 100 km than the rest and that their stated number of HB is higher than the revealed.
- On the other hand, models revealed that the higher the number of driving fines, the lower the possibility of a driver to perform a harsh event.
- Number of accidents to date also appears to play a very important role as an explanatory variable in all developed models
- It is confirmed that driving under the influence of alcohol does not affect the number of harsh accelerations or brakes.



### Conclusions

The most important explanatory variables of safe driving behaviour recognition are:

- Elasticity revealed that the most important factors for predicting driving behaviour are the number of accidents to date as well as the annual income.
- It was shown that most careful drivers perform higher number of harsh events.
- Lower income drivers appear to drive less cautiously since they perform lower number of harsh events and drive over the speed limit less than those in the high income category.
- The number of trips per day seems to affect only in one of the 4 models developed.
- The stated frequency of driving under the influence of alcohol and violating traffic code was not found to be significant in any of the models.

### Suggestions for future research

- Use of a larger sample of drivers
- An experiment could be conducted in cooperation with psychologists since revealed driving behavior may alter based on the psychological situation of the driver.
- The influence of other parameters should be investigated such as different traffic conditions, driving environments, time of the day, weather conditions etc.
- Driving distraction parameters should be also examined.
- A questionnaire to be administered also after the conduction of the experiment to assess if the participant feels that his behaviour is changed.

