



Correlating Driving Behaviour and Characteristics



Vasiliki Agathangelou¹, Dimitrios I. Tselentis¹ and George Yannis^{1*}
¹National Technical University of Athens, Athens, Greece, email: geyannis@central.ntua.gr

Abstract

This research aims to correlate driver's characteristics with its safety performance. In order to achieve this objective, two sets of assessments were used where 12 drivers participated on an expert assessment using on-road driving together with a self-evaluation questionnaire. The analysis of the drivers' behaviour was carried out using the statistical methods of factor analysis and linear regression analysis. Three groups that characterize drivers' perception of careless, aggressive and cautious driving behavior were derived from factor analysis. Moreover, linear regression analysis revealed that driving experience, headways, self-reported driving skill and defensive driving positively affect the overall on-road driving performance score. More precisely, it was ascertained that driving experience leads to statistically significant increase in overall on-road driving performance score.

Objectives

- Correlation between driving behaviour and safety performance.
- Investigation of how several driving behaviour characteristics are influencing traffic safety.
- Developing a mathematical model that reflects the relationship between dependent and independent variables.



Methodology

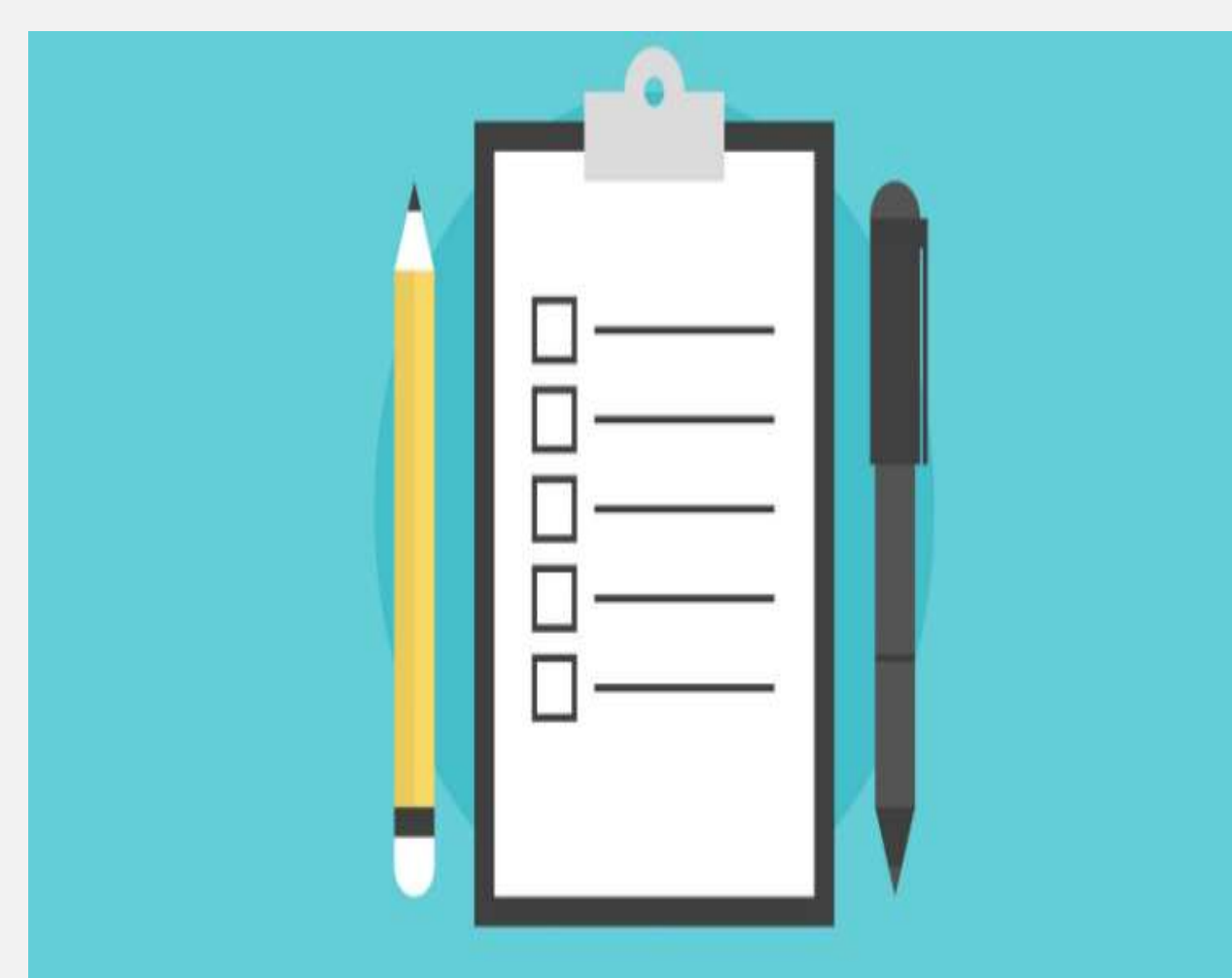
Factor Analysis

Factor analysis is a statistical method that aims to create hidden, unobservable quantities called factors. The factor analysis model is based on the assumption that variables can be grouped on the basis of the correlations between them.

Multiple Linear Regression

When a variable Y is linearly depended on more than one variables X (X₁, X₂, X₃, ..., X_k), 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

Each of the 12 participants drove a trip of:

- 18.4 km
- 27 minutes
- Urban, rural and highway road type

Sixteen (16) driving indicators were assessed as follows:

1. Speed adaptation
2. Braking
3. Accelerating
4. Turning
5. Headways
6. Lateral position
7. Ability to choose the correct lane
8. Lane change
9. Understanding, perception and quality of traffic participation
10. Crossing or junction
11. Anticipation and perception of road signs and traffic signals
12. Joining the traffic stream
13. Visual behaviour and communication
14. Mirror use
15. Use of direction indicator
16. Steering firmness

Each driver was assessed in a scale of 4 (Bad, Insufficient, Sufficient, Good) in each of the above sixteen indicators and in overall on road driving performance score from 0% to 100%.

Questionnaire

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

Results (1/2)

Factor Analysis

- The first factor explains the 36,71% of the variance and includes the total number of accidents were the driver is involved in, how much the driver respects the speed limits on a highway and how frequently is braking, accelerating and turning harshly. This factor concerns careless driving.
- The second factor concerns driving aggressiveness and explains the 16,68% of variance. It reveals the aggressive behaviour using survey questions such as road traffic violations, driving perception of aggressive driving as well as the driver's self-assessment on braking and accelerating on highways.
- The third factor explains the 15,15% of the variance and concerns cautious driving since it includes the self estimated frequency of harsh braking events and headways assessed by the driving assessor.

Variables	Factors			
	1	2	3	4
How many accidents did you have to date as a driver?	.740			
How many road traffic violation did you do during the last 2 years?		.714	-.541	
How much do you respect speed limits while driving on a highway?	-.926			
How aggressive driver do you think you are?		-.667		
How often do you accelerate harshly?	.860			
How often do you brake harshly?	.680		.660	
How often do you turn harshly?	.898			
Braking assessment		-.523		
Accelerating assessment		.589		.625
Headways assessment			-.550	.653

Factor	Initial eigenvalues			Eigenvalues after rotation		
	Total	% Variance	Cummulative %	Total	% Variance	Cummulative %
1	3.745	37.451	37.451	3.671	36.712	36.712
2	1.903	19.032	56.483	1.668	16.678	53.389
3	1.477	14.769	71.253	1.515	15.150	68.539
4	1.089	10.890	82.143	1.360	13.604	82.143
5	.791	7.912	90.055			
6	.496	4.956	95.011			
7	.339	3.391	98.402			
8	.100	1.002	99.404			
9	.052	.524	99.928			
10	.007	.072	100.000			

Results (2/2)

Linear Regression

Overall on road driving performance score = 0.449 + 0.010*(Driving experience_Q) + 0.142*(Headways assessment) + 0.141*(Skillful driver_Q) + 0.108*(Defensive driving assessment)

Overall performance indicator resulting from the assessment under standard driving conditions and rated from 0% to 100%.

Driving experience_Q resulted from the corresponding survey question "How many years do you drive?".

Headways assessment resulted from the assessment of the participant.

Skillful driver_Q resulted from the corresponding survey question "How skillful driver do you think you are?".

Defensive driving assessment resulted from the assessment of the participant.

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.449	.056		8.067	.000
Driving experience_Q	.010	.003	.569	3.250	.014
Headways assessment	.142	.044	.555	3.198	.015
Skillful driver_Q	.141	.049	.554	2.857	.024
Defensive driving assessment	.108	.044	.424	2.444	.045



Conclusions

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

- Driving experience as expressed by the driver's assessed overall performance
- Defensive driving that accounts for the set of behaviors that allow the driver to be alert, recognize and take all the necessary measures to safely avoid possible hazards.
- Headways assessment and self-assessed driving skills

The three main factors arising from factors analysis that represent safety performance are:

- Careless driving accounting for the 36,71% of the total variance
- Driving aggressiveness and explains the 16,68% of total variance
- Cautious driving that represents the 15,15% of total variance

Suggestions for future research

- A larger sample of drivers
- Other statistical analysis methods
- Use of data coming from simulation or naturalistic driving experiments
- Perform the experiment under different traffic conditions, driving environments, time of the day, weather conditions etc.
- Use other recording technologies to monitor real-time on-road driver's behavior

