Greek driver attitudes towards aggressive driving

Angeliki Stefatou[1], Apostolos Ziakopoulos[2*], Athanasios Theofilatos[3], Tor-Olav Nævestad[4], Torkel Bjornskau[5], Alexandra Laiou[6], George Yannis[7]

[1,2,6,7] National Technical University of Athens, 5 Heroon Polytechniou Str., GR-15773 Athens, Greece
agg.stefatou@hotmail.com, apziak@central.ntua.gr, alaiou@central.ntua.gr, geyannis@central.ntua.gr
*(corresponding author)
[3] Loughborough University, Ashby Road, Loughborough LE11 3TU, United Kingdom
A.I.Theofilatos@lboro.ac.uk,
[4,5] Institute of Transport Economics, Gaustadalléen 21, 0349 Oslo, Norway
ton@toi.no, tbj@toi.no

Abstract

This paper explores the characteristics of driver aggressiveness in Greece through perceptions on their own behavior and the behavior of other drivers. Within the framework of the project SafeCulture, a dedicated survey was conducted and the answers of 302 car drivers and 201 two-wheeler drivers on 5 questions regarding speed, 6 questions regarding overtaking behavior and aggressiveness and 3 questions regarding alcohol consumption were analysed. Factor analysis methods were utilized to produce continuous secondary factor variables for speed, aggressiveness and alcohol consumption. Binary logistic regression models correlated these factors with driver involvement in road crashes during the last two years. Two Greek regions were considered: capital city Athens and the island of Rhodes. Results indicate that drivers do not perceive traditional crash factors as causes for their crash involvement. Specifically, drivers stated that neither speeding nor driver inexperience or lack of education was considered as a crash involvement factor. The only contributing factors perceived by drivers was found to be those involving driver overtaking behavior and aggressiveness. The results will help provide insights on the aggressiveness of drivers and improve behavior and safety.

Keywords: *Road safety; driver aggressiveness; overtaking behavior; factor analysis; questionnaire data; driving experience*

Περίληψη

Η παρούσα εργασία ερευνά τα χαρακτηριστικά της επιθετικότητας των οδηγών στην Ελλάδα μέσω των αντιλήψεων για τη δική τους συμπεριφορά και τη συμπεριφορά άλλων οδηγών. Στο πλαίσιο του έργου SafeCulture διεξήχθη μια ειδική έρευνα και αναλύθηκαν οι απαντήσεις 302 οδηγών αυτοκινήτων και 201 δικυκλιστών μέσω 5 ερωτήσεων σχετικές με την ταχύτητα, 6 ερωτήσεων σχετικές με την προσπέραση και επιθετικότητα και 3 ερωτήσεων σχετικές με την κατανάλωση αλκοόλ. Μέσω της μεθόδου παραγοντικής ανάλυσης παρήχθησαν συνεχείς δευτερογενείς μεταβλητές-παράγοντεσγια την ταχύτητα, την επιθετικότητα και την κατανάλωση αλκοόλ. Κατόπιν χρησιμοποιήθηκαν πρότυπα δυαδικής λογιστικής παλινδρόμησης προκειμένου να συσχετιστούν αυτοί οι παράγοντες με την εμπλοκή του οδηγού σε οδικά ατυχήματα τα τελευταία δύο χρόνια. Εξετάστηκαν δύο ελληνικές περιοχές: η Αθήνας και η Ρόδος. Τα αποτελέσματα δείχνουν ότι οι οδηγοί δεν αντιλαμβάνονται τους παραδοσιακούς παράγοντες ατυχημάτων ως αιτίες για τη συμμετοχή τους σε οδικό ατύχημα. Συγκεκριμένα, οι οδηγοί δήλωσαν ότι ούτε η ταχύτητα ούτε η απειρία του οδηγού ή η έλλειψη εκπαίδευσης θεωρήθηκε παράγοντας εμπλοκής σε οδικό ατύχημα. Οι μοναδικοί παράγοντες που θεωρούν οι οδηγοί ότι επηρεάζουν την εμπλοκή τους ήταν αυτοί που αφορούσαν στη συμπεριφορά των οδηγών και στην επιθετικότητά τους. Τα αποτελέσματα θα βοηθήσουν στην κατανόηση της επιθετικότητας των οδηγών και θα βελτιώσουν τη συμπεριφορά και την ασφάλεια.

Λέξεις-κλειδιά: *οδική ασφάλεια, οδηγική επιθετικότητα, συμπεριφορά προσπέρασης, παραγοντική ανάλυση, δεδομένα ερωτηματολογίων, οδηγική εμπειρία*

1. Introduction

1.1 Present road safety state

Road transport is intimately linked to the value of human life, as it is an integral part of modern society and human activities. However, the modern lifestyle that leads to an ever-increasing demand for travel results in daily human casualties and serious injuries to road crashes. The huge social and economic costs of road crashes make it a priority for each country. It is estimated that after heart disease and cancer road crashes are the third leading cause of deaths, as they are losing about 1.25 million people worldwide every year. What is more, road crashes have platooned during the previous decade (WHO, 2018), revealing much untapped potential for road safety improvement.

It was therefore necessary to improve road safety at both national and local levels. These concerted efforts in the European Union have resulted in a drastic reduction in road crashes in the last few years, which is in the range of 51.7% for the period 2002-2015 (European Commission, 2017); Greece however is still ranked last in the EU in terms of road deaths. Furthermore, research has consistently shown that 94% of crashes are still due to human error (Singh, 2015). There is therefore considerable promise in investigating the various aspects of human factors in driving and road safety.

1.2 Study objective

Consequently, the main objective of the present paper is to investigate the characteristics of aggressive driving in Greece. More specifically, the characteristics of aggressive drivers were analysed and it was examined which of them can better describe overall driver aggressiveness. In order to achieve the aim of the paper, a large questionnaire from the SafeCulture project survey in Greece was utilized. The questionnaire respondents included participants from two Greek regions, namely Athens, which is the capital city, and the island of Rhodes. A total of 503 drivers, consisting of 302 private car drivers and 201 two-wheeler drivers were asked to answer a wide range of questions from which they were selected on issues related to compliance with traffic rules, speed limits and traffic control.

Initially, factor analysis methods are utilized in order to produce continuous secondary factor variables for speed, aggressiveness and alcohol consumption. Afterwards, these factors as well as other driving characteristics are considered by utilizing binary logistic regression in order to correlate them with driver involvement in road crashes during the last two years.

2. Literature Review

2.1 Individual driver aggressiveness

This section includes relevant past research papers on driver aggressiveness that provides insights to the present research objective.

It is first informative to include one more generic definition of aggressive driver, as stated by relevant research (CTC et al., 2009; Lee et al., 2010):

"Definitions of aggressive driving most commonly cited in the literature are the following:

1. NCHRP: “Operating a motor vehicle in a selfish, pushy, or impatient manner, often unsafely, that directly affects other drivers.”
2. NHTSA: “Driving actions that markedly exceed the norms of safe driving behavior and that directly affect other road users by placing them in unnecessary danger” or (from a law enforcement perspective) “when individuals commit a combination of moving traffic offenses so as to endanger other persons or property.”
3. AAA: “Any unsafe driving behavior that is performed deliberately and with ill intention or disregard for safety.” "

Vanlaar et al. (2008) conducted a survey through a public opinion poll on 1201 Canadian drivers. The following behaviors were examined: Crossing the road while the traffic light is red as well as using excessive speed to cross the traffic signal, speeding over the speed limit, using unnecessary language and gestures against other drivers, using car horns unnecessarily and overall risky driving. Data analysis included employing generalized linear regression and logistic regression models. These models showed that a significant proportion of drivers admits that driver aggressiveness is a noteworthy issue (indicatively, 30% of respondents admit to swearing under their breath). Consistently with the literature, young male drivers were found to be more aggressive with a history of traffic fines and violations. In closing, the authors highlight the need of better understanding which specific behaviors participants associate with the generic term “aggressive driving.”

In an effort to provide quantitative evaluation of the impacts of aggressive driving on road safety, Habtemichael & de Picado Santos (2014) conducted microscopic traffic simulations using the VISSIM software and Surrogate Safety Assessment Models. The study examined crash risk and crash injury severity as well as the perceived advantages of aggressive driving as contrasted to normal driving. The authors utilized the conflict involvement parameter to determine crash risk, which results indicated is in the range of 3.10-5.90 compared to baseline driving, regardless of congestion of the road environment. An additional important result of that study is that conflicts involving aggressive drivers are estimated to be 7-61% more severe compared to normal drivers, while the perceived advantages of aggressive driving were found to be negligible, about 1-2%.

A widely cited study by Constantinou et al. (2008) focused on younger-novice drivers and the interactions of their personality, driver behavior and respective offences. 352 participants were involved in the Driving Behavior Quesionnaire survey which separates driving behavior into four factors: errors, lapses, violations and mistakes. Structural Equation Models were employed, and results showed that personality had significant correlations with aberrant driving behavior. However, age was not found to be correlated with personality, contrary to expectation. The authors conclude that personality is an indirect predictor ('distal factor') of road crashes, but they claimed it is an important predictor nonetheless. The trait of young, male drivers being more aggressive was confirmed once again.

2.2 Cultural driver aggressiveness

A critical part of aggressiveness lies in what can be termed as 'driving culture' or 'road safety culture'. Culture hints to a more abstract, collective mentality of a nation or similar group of people that can be applicable to road safety in a risk factor context, while it has not actively been targeted by road safety stakeholders as a potential measure (Edwards et al., 2014; Ward et al., 2010). It can be observed that driving culture can vary wildly in regions that are more distanced from each other, as most other cultural traits do as well.

This driving and maritime safety culture discrepancy between two very different countries (Greece and Norway) has been the explicit research field of the SafeCulture project and has been extensively showcased in several publications (Nævestad et al., 2017; 2018a; 2018b; 2019). The details of the SafeCulture project are provided in these studies, and the data utilized are presented in section 3 of the current paper. Some interesting collective findings that are pertinent to the present research can be summarised as follows.

When comparing private and professional drivers between the two countries, it was found that aggressive violations are more similar among private and professional drivers within the national samples than to groups across the two national samples (as opposed to seatbelt use). This finding validated the presence of differences in road safety cultures across the two countries. Furthermore, it was shown that road safety culture can be used to predict aggressive violations, at least partially. In addition, the presence and nature of organizational factors such as demanding working conditions and organizational security culture was found to be important as well, especially in the professional driver groups.

Overall, the literature suggests that aggressive driving is defined by three different characteristics: intention, emotion and behavior (e.g. Berdoulat et al., 2013). These can be broken down more specifically into against third parties, negative feelings during driving and risk-taking while driving. Moreover, aggressive drivers express their aggression differently. Indicative aggressive driving behaviors are: minimization of spatial headways, speeding, offensive language and gestures, car horn use and risky driving maneuvers. Aggressive drivers, which are usually young males, were shown to be at a higher risk of crash involvement with additional risks of increased crash injury severity. Therefore it can be inferred that further research on aggressive driving is needed to better design policies to counter the increase road safety risks it incurs.

3. Data

As mentioned previously, this study utilizes data from the SafeCulture project. The main objectives of the project are to examine the influence of culture on transport safety on behavior in private and professional road and sea transport, and to clarify implications for safety intervention strategies. The main project target groups for road transport in the SafeCulture project were private car and motorcycle drivers, and professional heavy goods vehicle (HGV) and bus drivers. The current research utilizes only the private car and motorcycle driver data.

The questionnaire survey conducted within the SafeCulture framework focused on two Greek regions, namely Athens, which is the capital city, and the island of Rhodes. The questionnaires include sample characteristics (gender, driving license ownership, driving frequency, country of origin/residence, educational level). The main part, investigating road safety behavior, consisted of questions regarding road crash involvement, attitudes on unsafe driving behavior, perception of the behaviors of other road users, perception of uneasiness as a road user, alcohol consumption when driving, self-reported police checks, self-reported unsafe behavior and support towards road safety policy measures. Final sample size consisted of 503 drivers in total: 302 car drivers (201 in Athens and 101 in Rhodes) and 201 motorcycle drivers (136 in Athens and 65 in Rhodes)

Respondents were 56% male and 44% female, and belonged predominantly to the 36-45 and 46-55 age groups, followed by >56 years old. Very few participants <26 years were included in the study. Respondents had varying education levels: 33% had university education, 29% had technical higher education, 33% had high school education, 4% had junior high school education level and the remaining 1% had primary school education or lower. The majority of respondents (78%) were not involved in any road crash during the previous 2 years before the time of the survey. The majority of males also had considerably higher driving experience than females (>20 years).

The core of the present research is the answers on various questions regarding aggressive driving behavior. These comprised 5 questions regarding speed, 6 questions regarding overtaking behavior and aggressiveness and 3 questions regarding alcohol consumption, and are shown analytically on Table 1 in Section 5.

4. Methods of analysis

4.1 Factor Analysis for Grouping Variables

Initially, it was aimed to investigate whether meaningful groups of variables reflecting car driver attitudes and behavior exist. This was carried out through the means of Factor Analysis will help understand the structure of this large set of variables (38) and secondly, to reduce this dataset to a more easily managed one without losing much information. These variables were tested on how much variance they share and they were grouped into appropriately labelled components.

The optimal number of factors to retain can usually be decided by applying a combination of more than one criterion. For instance, the visual observation of the Scree plot and the total percentage of variance explained could be used. The Scree test plots the components on the X axis and the corresponding eigenvalues on the Y axis. As the number of components increases, the eigenvalues are reduced. Scree test suggests that all further components after the number for which the reduction becomes too small should be dropped out of the analysis. The percentage of variance explained can be used in order to keep only those components which account the majority of variance. It is noted that component scores are saved in order to be used for further analysis after performing PCA.

An adequate sample size is critical to perform PCA. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used, with values above 0.5 are considered to be very satisfactory. It is also noted that rotation and more specifically, orthogonal rotation (Varimax), was selected to improve interpretability of the components. The components scores were calculated according to the Anderson-Rubin method to ensure that component scores are uncorrelated and also to ensure orthogonality of the estimated components. They have a mean of 0 and a standard deviation of 1.

4.2 Binary Logistic Regression

When the dependent variable is binary in nature (taking values 0-1), the binary logistic regression model is appropriate and has been used extensively in the literature (e.g. Bellos et al., 2019).

The 'utility function' is $U = \beta_o + \beta_i * x_{i,}$ (Eq. 1)
then the probability P is: $P = e^U/(e^U + 1)$ (Eq. 2)

The goodness-of-fit of the model can be assessed through the likelihood ratio test. The likelihood-ratio test statistic equals:
$-2\log (L_o/L_f) = -2 [\log(L_o)-\log(L_f)] = -2 (L_o-L_f)$ (Eq. 3)

Where L_o is the null model (constant only) and L_f is the full model.

In order to perform the logistic regression, the backward LR (log-likelihood ratio) method is a straightforward method, according to which the all the independent variables are put in the model and one by one is eliminated provided that the change in the -2Log-likelihood is not significant for 1 degree of freedom at 95%.

The exponential of the coefficients, exp(B), expresses the odds ratio. More specifically, concerning positive coefficients, for each additional unit increase in the factor score, the odds of having been involved in a crash is increased by $100\%*(\exp(B_i)-1)$. For negative coefficients, one unit increase, decreases the odds of a past crash involvement by $100\%*(\exp(B_i)-1)$.

5. Results and Discussion

Firstly, the factor analysis revealed the optimum solution according to pre-defined criteria to be 3 factors, namely "speed", "overtaking" and "alcohol". As stated previously, the KMO values are above or very close to 0.7 indicating a very satisfactory sample size. This enabled the quantification of the more qualitative answers and their merging to three individual metrics that are the factors, which are more easily usable from the subsequent analysis.

Secondly, binary logistic regression analysis was conducted. The dependent binary variable for this analysis was the involvement of respondent in road crashes up to two years prior to the time of the study (the binary outcome was 0 for 'no' and 1 for 'yes'). For the purposes of the analysis, driving experience was aggregated into three categories (0-10 years, 11-20 years and more than 20 years), with the last being reference category. The last category was selected as reference because it comprised the highest number of observations in the sample (45.37% of

the total sample). Similarly, education level was aggregated into a binary variable (0 for up to high school education, 1 for university education), the first being reference category. Naturally, location was a binary variable from study design (0 for Athens, 1 for Rhodes), the latter being reference category. Both analyses were conducted using IBM SPSS Statistics (version 23). Tables 1 and 2 summarize the findings of the factor and binary logistic regression analysis respectively.

Table 1: Results of Factor Analysis

Question Group	Question Description	KMO	Extraction	Component
Speed	When driving in Greece, I expect that other drivers do not respect speed limits on highways	0.841	0.698	0.835
	When driving in Greece, I expect that other drivers do not respect speed limits in urban areas		0.659	0.812
	When driving in Greece in my local municipality, I expect that other drivers do not respect speed limits on highways		0.611	0.788
	When driving in Greece in my local municipality, I expect that other drivers do not respect speed limits in urban areas		0.622	0.781
	How many of your regular driving friends you believe do not respect speed limits in urban areas?		0.491	0.701
Overtaking	For every 10 trips: how often do you accelerate after stopping at a traffic light to overtake vehicles next to you?	0.731	0.520	0.798
	For every 10 trips: how often do you overtake a slow driver from the internal (right) lane?		0.636	0.762
	For every 10 trips: how often do you overtake in 2-lane roads when there is no congestion?		0.581	0.721
	When driving in Greece, I expect that other drivers overtake a slow driver from the internal (right) lane		0.313	0.645
	How many of your regular driving friends you believe overtake a slow driver from the internal (right) lane		0.346	0.588
	When driving in Greece in my local municipality, I expect that other drivers overtake a slow driver from the internal (right) lane		0.416	0.559
Alcohol	When driving in Greece, I expect that other drivers drive while suspecting they are above allowed alcohol limits	0.680	0.608	0.823
	How many of your regular driving friends you believe drive while suspecting they are above allowed alcohol limits?		0.665	0.815
	When driving in Greece in my local municipality, I expect that other drivers drive while suspecting they are above allowed alcohol limits		0.677	0.780

As for the overall model metrics, the -2Log-likelihood was minimized at 477,059, providing the reported model as the optimal of all model specifications. Cox & Snell R^2 was estimated at 0.319 and Nagelkerke R^2 was estimated at 0.425. The Hosmer-Lemeshow test was found significant at 4.577 with a significance of 0.802 at a 95% significance level with 8 degrees of freedom. A much better model fit was found after utilizing the exponential of the factor of

speed. This possibly hints a relation to the well-established speeding power model (Elvik, 2013; Elvik et al., 2019), in the sense that speed is best correlated with road crashes in a power form.

Table 2: Results of Binary Logistic Analysis

Binary: During the last two years, have you been involved in a road crash? (0:no | 1:yes)	**Coefficient (B)**	**S.E.**	**Wald**	**df**	**Sig**	**OR [exp(B)]**
exp(Factor: Speed)	-0.203	0.075	7.224	1	0.007	0.817
Factor: Overtaking	0.331	0.144	5.310	1	0.021	1.393
Location [Athens]	-0.555	0.216	6.614	1	0.010	0.574
Driving experience [20 years] (baseline)	-	-	14.099	2	0.001	-
Driving experience [11-20 years]	-0.870	0.245	12.613	1	0.000	0.419
Driving experience [0-10 years]	-0.445	0.218	4.158	1	0.041	0.641
Education level [higher education]	-0.409	0.202	4.089	1	0.043	0.664

Results directly related to the original question and research aim of the paper were obtained from the analysis. Firstly, it is evident that a large proportion of drivers do not fully understand the dangers of aggressive driving and cannot connect this road behavior to the number of crashes it causes. There is, therefore, a poor realization of the consequences of aggressive behavior and the crashes it causes amongst drivers. It is important to stress once again that the results of the current paper, although unexpected compared to some findings of the international literature, present the general perception of Greek drivers in cities and islands. Furthermore, the literature proposes that aggressive drivers express their aggression differently. Indicative features of aggressive driving can be overtaking and speeding, and characteristics of the driver, the location of residence, the driving experience and the level of training.

According to the respondents, overtaking is recognized as an important factor in a crash interference. In our study, it was observed that the factor overtaking is positively correlated with past crash involvement. This is a phenomenon that may be attributed to changing lanes without control or warning, incorrect calculation of available time-space or lack of visibility as the driver is forced to move more often to the opposite traffic. Assessing the responses relative to speeding, it is clear that the majority of respondents ignore and do not fully understand the correlation of speed with road crashes or believe that another factor is primarily to blame instead of speed.

Location is another factor, which significantly affects crash involvement. There is a perception that the probability of a crash occurring is greater on Rhodes than on the city of Athens. This can probably be explained from to the increased tourist traffic on the islands during the summer months, resulting in an increase in the likelihood of crashes. According to the responses, there is a perception that driving experience is another important parameter of a crash. It is believed that drivers who drive more than a year are more likely to be involved in a crash. The above perception could be attributed to the fact that they are older drivers and are therefore distinguished by either lack of reflexes or overestimating the potential of new drivers. Another important point is exposure – drivers that spend considerable more time on the road, while gathering experience, have increased exposure to road crash risk compared to novices.

It is noted that the level of education of the driver is recognized by the sample as a factor related to crash involvement. According to the model, it is more likely that people with higher education level (University degrees etc.) than people with lower secondary education level will be involved in a crash (negative beta coefficient). Lack of education therefore does not seem to be perceived as a risk of being involved in a road crash. This can be interpreted by drivers viewing general education as unrelated to crash occurrence.

Lastly, the influence of alcohol during the driving has not been statistically significant in any of the statistical models. This may indicate an over-estimation of drivers' capabilities based on their judgment and may be partly due to a lack of public awareness of the influence of alcohol on driving. There is also the possibility that drivers are afraid of self-reporting, or of underestimating the hazardous habits of others in their location.

6. Conclusions

This study endeavours to investigate the characteristics of driver aggressiveness in Greece via their perceptions on their own behavior and the behavior of other drivers. For that purpose, the answers of 302 car drivers and 201 two-wheeler drivers on a questionnaire survey were analysed using a two-step approach: firstly a factor analysis on groups of questions considering speed, overtaking behavior and alcohol, and secondly a binary logistic analysis for crash involvement during the past two years, in which the calculated three factors served as input.

Findings include that drivers perceive some elements of aggressiveness as more contributing to crash involvement than others, mainly the factor involving overtaking behaviour. The capital city of Athens was found to be perceived as a more risky location than the island of Rhodes. Results indicated poor perception of drivers of some factors that are known to cause crash involvement as well. Predominantly, the direct impacts of speed (and speeding) appear to be underestimated, driver experience was found to increase crash involvement likelihood in the past two years (probably through increased exposure), while the impacts of higher education are also disregarded in the perception of drivers. Alcohol was not found to be statistically significant, disregarding a lack of perception of its negative effects on road safety on behalf of drivers.

These results indicate a dire need for informing the public through awareness raising and campaigning in order to bridge scientific knowledge with practice and apply the valuable research results into real-world crash reduction.

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