

# Examining the influence of traffic enforcement on the development of traffic safety culture

Alexandra Laiou<sup>1</sup>, Nikolaos Veneris<sup>1</sup>, Elena Provatari<sup>1</sup> and George Yannis<sup>1</sup>

<sup>1</sup>Department of Transportation Planning and Engineering, National Technical University of Athens, Athens, Greece

alaiou@central.ntua.gr, nickven999@gmail.com, e\_provatari@mail.ntua.gr, geyannis@central.ntua.gr

## Abstract

This paper aims to investigate the impact of traffic safety culture elements on the probability of road crash involvement, focusing on traffic enforcement aspects. Focus is on car drivers and motorcyclists in touristic and non-touristic areas in Greece. A questionnaire survey was conducted among car drivers and motorcycle riders in Athens and the on island of Rhodes. The survey included questions on background variables, national and local traffic safety culture (referring to the road user behaviours that respondents expect from other drivers in their own country or municipality), paternalism, experience of road safety enforcement, road risk attribution and previous involvement in road crashes. Five binary logistic regression models were developed in an effort to find differentiations and common road safety culture elements between car drivers and motorcycle riders, but also drivers in Athens and drivers in Rhodes, in relation to road crash risk. Results indicate that drivers probably understand the importance of more intensive traffic enforcement as a means of traffic crash reduction; the development of a common traffic safety culture in the island of Rhodes in contrast to Athens and the importance of factors such as driving frequency, age and experience on traffic crash probability.

**Keywords:** Road safety, traffic crash involvement, traffic safety culture, traffic enforcement.

## 1 Introduction

The devastating social and economic cost of road crashes can be proven by the fact that about 1.35 million are killed annually around the world (W.H.O, 2018). Greece scores the 6<sup>th</sup> worst performance in the European Union as far as road fatalities per million inhabitants are concerned (CARE – Eurostat, 2022). Nævestad et al. (2012), highlight the importance of traffic safety culture studies as a means of improving road safety level. Accordingly, Morimoto et al. (2022) point out the necessity of constructing a Safe System tailored to the traffic safety culture of each country, utilizing comparisons

and ratings based on common road safety metrics, in order to implement road safety measures at a national level.

Traffic safety culture studies between 3 Norwegian and 2 Greek provinces have been conducted (Nævestad et al., 2021), showing that a common safety culture between the Norwegian provinces is developed, while in the Greek provinces there is a statistically significant differentiation. Apart from that, the importance of traffic safety culture as a behavioral pattern indicator is highlighted while the correlation between it and traffic crash involvement is proved. With that in mind, a similar research (Nævestad et al., 2022) has shown that risky behavior endorsement can increase road crash probability.

As far as traffic enforcement is concerned based on the ESRA study (Meesmann et al., 2022) the enforcement level declared by the drivers is adversely proportional to traffic violations. Moreover, the drivers' opinions on traffic enforcement, as well as the opinions about their or other drivers' risky behaviors, could be an important predictor of traffic violation probability (Tan et al., 2022). Finally, the relation between the level of enforcement and road crash number varies significantly from region to region in Greece (Yannis et al., 2007).

The main objective of this paper is to investigate the impact of traffic safety culture elements on the probability of road crash involvement, focusing on traffic enforcement aspects. Focus is on car drivers and motorcyclists in touristic and non-touristic areas in Greece.

Methodology includes the development of five binary logistic regression models, using the road crash involvement as the dependent variable. The sample includes 503 private car drivers and motorcycle riders who live in Athens and Rhodes areas. Drivers and riders answered various questions included in a drivers' behavior questionnaire. Those questions were then examined and subsequently, those that are similar to the goals of this paper, were selected for further analysis.

## **2 Methodology**

### **2.1 Data collection**

Data used in this paper were initially collected within a research project titled "Safety culture in private and professional transport: examining its influence on behaviours and implications for interventions" undertaken by the Norwegian Institute of Transportation Economics (TØI) and the National Technical University of Athens (NTUA). One of the main goals of the project was the comparison of transport safety culture between Norwegian and Greek drivers.

A questionnaire survey was conducted among private car drivers and motorcycle riders sampled in two different areas, namely Athens (N=321) and the island of Rhodes (N=182) in Greece. The survey included questions on background variables like age, experience as a driver, gender, kilometers driven with a car or motorcycle in the last two years, frequency of driving and type of vehicle. Additional questions concerned measuring national and local traffic safety culture (referring to the road user behaviours that respondents expect from other drivers in their own country or municipality), pater-

nalism, experience of road safety enforcement, road risk attribution and previous involvement in road crashes. Questions selected for the analysis described in this paper and alternative answers are listed below:

- **General:** gender, age (< 26, 26-35, 36-45, 46-55, 56+), for how long have you had your driver's license? (0-5 years, 6-10 years, 11-15 years, 16-20 years, 20+ years), What is your highest education? (primary school, high school, lyceum, professional school / technological university, university), area (Athens, Rhodes), type of vehicle (car, motorcycle)
- **Expected driving behaviour (country level / municipality level):** When driving in my country/municipality, I expect from other drivers to respect and follow traffic rules (none/very few, less than half, about half, more than half, nearly all/all)
- **Expected driving behaviour (peers):** How many of your friends who regularly drive a car do you think they respect and follow traffic rules (none/very few, less than half, about half, more than half, nearly all/all)
- **Acceptance of traffic enforcement:** The fact that crashes still happen in traffic, shows that the authorities should control road users' behaviour to a greater extent than they do today (totally disagree, disagree somewhat, neither agree or disagree, agree somewhat, totally agree), The authorities should make it more difficult for people to engage in risky behaviour in traffic (totally disagree, disagree somewhat, neither agree or disagree, agree somewhat, totally agree),
- **Traffic enforcement experience:** In the course of the two last years, approximately how often have you seen a police inspection along the road? (never, hardly ever, 5 times or fewer, 10 times or fewer, 20 times or fewer, more than 20 times)
- **Road risk attribution:** In your opinion, is lacking police enforcement of traffic rules an important cause of traffic crashes in Greece? (unimportant, of little importance, neither important /nor unimportant, somewhat important, very important)
- **Involvement in road crashes:** During the last two years, have you been involved in a traffic crash while driving? (No, Yes)

## 2.2 Descriptive statistics

More than 2/3 of the sample comprises men, while the majority of the questioned drivers are aged between 26 and 45 years old. Apart from that, most of the drivers and riders (69%) have had their driving license for more than 10 years, while about 9 out of 10 drivers drive every day.

Some quantitative findings include that only 33 to 42% of the drivers expect other drivers to obey traffic rules, regardless of the reference level (friends, municipality or country). The current insufficient level of enforcement in Greece is also indicated by the fact that 55% of the drivers have seen less than 5 police checks over the period of the last 2 years. Finally, the drivers' majority deem the lack of enforcement as a very important cause of traffic crashes.

### 2.3 Statistical analysis

For the analysis of the data, five binary logistic regression models were developed:

- An overall model for drivers of private cars and motorcycles in Athens and Rhodes
- One model for drivers of private cars and motorcycles in Athens
- One model for drivers of private cars and motorcycles in Rhodes
- One model for drivers of private cars in Athens and Rhodes
- One model for drivers of motorcycles in Athens and Rhodes

In all models the dependent variable was the involvement in a traffic crash. The selection of the independent variables inserted in each of the above models is the result of many trials with several different independent variable combinations, out of which the models with the best statistical fitment were extracted. Statistical checks require an independent value significance level of less than 0.05, a Hosmer-Lemeshow value significance greater than 5% and an  $R^2$  value as close to 1 as possible.

## 3 Results

### **Model 1: Drivers of private cars and motorcycles in Athens and Rhodes**

Results show that those who expect less than half of their friends to follow traffic rules are 39.3% less probable to being involved in a crash. This, maybe, shows that they consider others' behavior dangerous for themselves too and, as such, they make safer decisions. It is also important to notice that those who declare that the lack of enforcement is not an important cause of traffic crashes are 2.5 times more probable to being involved in a traffic crash. This could be attributed to the fact that these drivers do not prefer stricter enforcement, because they obtain risky behaviors. Finally, driving frequency and age are also important. Those who drive every day are more probable to crash involvement, due to their greater exposure to everyday risk. Drivers over 55 years old are also at greater risk compared to younger drivers.

### **Model 2: Drivers of private cars and motorcycles in Athens**

In Athens, drivers' behavior in the municipality plays a statistically significant role when it comes to traffic crash involvement. In particular, those who expect less than half of the drivers in their municipality to follow traffic rules, are 64% less probable to being involved in a crash (similarly to Model 1). Moreover, gender plays a statistically significant role, as women are less probable to being involved in a crash by 42.9% compared to men.

### **Model 3: Drivers of private cars and motorcycles in Rhodes**

Contrary to the drivers in Athens, those who expect less than half of the drivers in their municipality to follow traffic rules are 6.5 times more likely to being involved in a crash. This is likely attributed to the fact that in a small and secluded society, like the island of Rhodes, local social circle has a strong influence on behavior, causing drivers to follow social trends (in this case not following traffic rules) in order to avoid standing out or being considered irregular.

### **Model 4: Drivers of private cars in Athens and Rhodes**

Declared police enforcement frequency is statistically important among car drivers,

as those who have reported infrequent checks are 49.2% less probable to being involved in a crash. A likely explanation is that lack of enforcement forces drivers to adopt safer behaviors, as they feel exposed in a low-level enforced driving environment.

#### **Model 5: Drivers of motorcycles in Athens and Rhodes**

Experience – and not age group – is a statistically significant variable among motorcycle riders. That been said, it is observed that riders with less than 5 years of experience are the least likely to being involved in a traffic crash. A possible contributing factor could be that motorcycle riding requires more skill than car driving and, thus, less experienced riders tend to be more careful on the road.

## **4 Discussion**

The main objective of this paper is to investigate the impact of traffic safety culture elements on the probability of road crash involvement, focusing on traffic enforcement aspects. The study was focused on car drivers and motorcycle riders as well as on drivers in touristic and non-touristic areas.

The main conclusions of this paper are included in this chapter, taking common elements and differentiations between the models into consideration. Starting from the common elements, there are two common statistically significant variables across all models. These were driving frequency, which is proportional to the traffic crash probability and lack of enforcement being considered an important cause of crashes. The latter shows that drivers who perceive that there is a lack of enforcement adopt less dangerous behaviors due to the insecurity caused by the above finding. They also understand that traffic enforcement is a key factor towards making roads safer, demanding its intensification.

Concerning age and experience, it is found that older drivers (55+ age group) or, in the case of motorcycle riders more experienced ones (20+ years of experience) are more prone to being involved in a crash, compared to all the other groups. This might show that age or experience comes at the cost of obtaining riskier driving habits.

Friends' behavior is only statistically significant when it comes to smaller social groups, like drivers in Rhodes and motorcycle riders. This might show that bigger social groups, like car drivers or drivers in Athens, are not greatly influenced by their peers.

As discussed, driver-declared behavior of other drivers in their municipality has a positive impact on drivers in Athens, yet a negative one on drivers in Rhodes. Thus, a common safety culture among drivers in a secluded touristic area is likely developed.

On the other hand, driver-declared enforcement frequency is only significant when it comes to car drivers, indicating that they are worried about low enforcement level and, because of that, they take fewer risks. Finally, gender is only significant among drivers in Athens, signifying that women drive safer than men.

The following proposals, which are based upon the discussed conclusions, aim to generally improve road safety level in Greece. Particularly, an increase of the enforcement level could be useful, provided that it is focused upon the main crash causes, such as speeding, alcohol violations and seatbelt / helmet usage. Establishing local road safety observatories in areas with low road safety levels such as the Greek islands, could

also prove very useful. Those observatories could gather and analyze specific crash data from these areas and provide solutions which are tailored to their unique needs.

Future research proposals include expanding the specific study into areas that have a discrete traffic safety culture, so that comparison studies can become available. A research expansion among different islands (i.e. in the Mediterranean) would also enlighten some interesting safety culture aspects. Frequent research repetition and an expansion among different European countries could as well provide a firm European traffic safety culture database. Finally, the inclusion of additional survey questions or different analysis methods could further enlighten traffic safety culture.

## 5 References

1. Eurostat (2022) [https://transport.ec.europa.eu/background/2021-road-safety-statistics-what-behind-figures\\_en](https://transport.ec.europa.eu/background/2021-road-safety-statistics-what-behind-figures_en) (Accessed on 31/3/2023).
2. Meesmann, U., Wardenier, N., Torfs, K., Pires, C., Delannoy, S. & Van den Berghe, W. (2022). A global look at road safety. Synthesis from the ESRA2 survey in 48 countries. ESRA project (E-Survey of Road users' Attitudes). Brussel, Belgium: Vias institute.
3. Morimoto A., Wang A. & Kitano N. (2022). A conceptual framework for road traffic safety considering differences in traffic culture through international comparison ATSS Research 46, p. 3–13.
4. Nævestad T.O., Laiou A., Rosenbloom T., Elvik R. & Yannis G. (2022). The role of values in road safety culture: Examining the valuation of freedom to take risk, risk taking and crash involvement in three countries. *Transportation Research Part F: Psychology and Behaviour* 84, p. 375–392.
5. Nævestad T.O., Bjørnskau T., Laiou A., Phillips R.O. & Yannis G. (2021). Clash of cultures in Greek traffic? What happens when a Southern European road safety culture is mixed with a Northern European road safety culture? 10th International Congress on Transportation Research - ICTR2021, Rhodes, Greece, 2-3 Sept.
6. Nævestad T.O. & Bjørnskau T. (2012). How can the safety culture perspective be applied to road traffic? *Transp. Rev.* 32 (2), p. 139–154.
7. Tan C., Shi Y., Bai L., Tang K., Suzuki K. & Nakamura H. (2022). Modeling effects of driver safety attitudes on traffic violations in China using the theory of planned behavior. *ATSS Research* 46, p. 63–72.
8. TØI (2019). Trafikksikkerhetskultur i Norge og Hellas. TØI rapport 1685/2019.
9. World Health Organization (W.H.O.) <https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries> (Accessed on 31/3/2023)
10. Yannis G., Papadimitriou E. & Antoniou C. (2007). Multilevel modelling for the regional effect of enforcement on road crashes. *Crash Analysis and Prevention* 39, p. 818–825.