# SAFETY CULTURE AMONG PRIVATE AND PROFESSIONAL DRIVERS: NORWAY AND GREECE

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**Abstract:**
*The aims of this study are to examine: 1) safety behaviours related to accidents among private (passenger car) and professional (HGV, bus) drivers in Norway and Greece, and 2) factors influencing these behaviours. Results indicate that safety behaviours related to accidents are more similar among private and professional drivers within the national samples, than across the national samples. Moreover, drivers' safety behaviours are influenced by the behaviours that these groups ascribe to other drivers in their countries, indicating the existence of different national transport safety cultures, which may shed light on the different accident records in the two countries.*

**Keywords**: Safety culture, safety behaviours, private and professional drivers, Norway, Greece

## 1. INTRODUCTION

### *1.1 Background and Aims*

It is widely recognized that safety culture is important for safety in organizational safety, and the concept is applied to an ever-increasing range of sectors and industries, including professional and private transport (Wills, et al. 2005; Davey et al. 2006; AAA 2007;). Research also suggested that in order to fully understand its effects on safety in transport, we should study not only safety culture particular to organisations, but that particular to nations, regions and sectors (Nævestad & Bjørnskau 2012). Transport safety culture (TSC) is defined as shared norms prescribing certain transport safety behaviours, shared expectations regarding the behaviours of others and shared values signifying what's important (e.g. safety, mobility, respect, politeness). The safety culture perspective is quite new to the transport sector, and more research is needed for it to be as crucial in transport as it is in hazardous industries. It is decisive to establish the importance of TSC in influencing transport safety behaviour and safety outcomes, and to clarify how this knowledge can be used to enhance transport safety.

It is not unreasonable to hypothesize that differences between national TSC may shed light on national differences in fatality rates. Several factors that could influence TSC are national (e.g. traffic rules, police enforcement, road user interaction). For these reasons, it could be expected to find different national TSCs. On the other hand, it could be hypothesized that professional drivers are less influenced by national TSC, as they often are members of organisations, which are obliged to facilitate safe transport. Organisational safety culture may reduce the negative impact of national safety culture (Nævestad et al 2017, 2018). Moreover, professional drivers in the EU are also subject to a common EU-directive on periodic training, aiming to improve traffic safety and ensure equal conditions for competition (although national implementation may vary). By comparing different groups within the same countries, it will be possible to examine the importance of national culture for transport safety behaviours and accident involvement. If behaviours are more similar among private and professional drivers within the national samples,

than among professional drivers across the national samples, it may be hypothesized that this to some extent could be due to the influence of national TSC. The influence of other variables known to be related to private/ professional drivers' safety behaviours is also examined, e.g. age, experience (Elvik et al 2009).

Therefore,within a research project titled "Safety culture in private and professional transport: examining its influence on behaviours and implications for interventions", an empirical study wasconducted in Norway and Greece to examine whether and how membership in different socio-cultural units (nations, sectors, countries, organisations) influences transport safety behaviour and accidents in private and professional road transport. The project was funded by the Norwegian Research Council, and undertaken by the Institute of Transport Economics – TØI (Norway) and the National Technical University of Athens - NTUA (Greece). The present paper compares private car and professional HGV and bus drivers in Norway and Greece. The aims of the study are to examine 1) safety behaviours related to personal injuries and accidents among private (private car) and professional (HGV, bus) drivers in Norway and Greece, and 2) factors influencing these behaviours.Norway and Greece were selected to be compared since the road safety status in the two countries differ significantly. The road fatality rate of Norway is one of the lowest in the EU, while Greece has one of the worst transport safety records of all EU-27 countries (Yannis & Papadimitriou, 2012).

### *1.2 Previous Research*

*Cross-cultural studies of safety behaviours.* The driver behaviour questionnaire (DBQ), (Reason et al 1990)is one of the most widely used scales for measuring driver behavior. There are some cross-cultural studies of safety behaviours related to accidents among private drivers (e.g. Özkan et al 2006; Warner et al 2011).Özkan et al (2006) compares DBQ items in six countries: Finland, Great Britain, Greece, Iran, The Netherlands, and Turkey. Warner et al (2011) compare safety behaviours among private drivers in Finland, Sweden, Turkey, and Greece. Their results indicate more aggressive violations in Greece and Turkey compared to Sweden and Finland, and these are related to accidents. Studies in the Safe Culture project also indicate significant differences between Norwegian and Greek bus and HGV drivers (Nævestad et al 2017;2018).
*Nationality and national TSC.* Previous research indicates considerable national differences between European drivers' accident risk and attitudes towards road safety (SARTRE 2012).Studies of national differences between DBQ items (Warner et al, 2011; Özkan et al 2006) often hypothesize that the results indicate differences in national culture. These studies do, however, not specify the (cultural) mechanisms generating these different national behaviours. It maybe hypothesized that national TSC may come about as a result of mild social pressure, specified as descriptive norms(Nævestad et al 2014). These refer to individuals' perceptions of what other people actually do, which may influence behaviour by providing information about what is normal (Cialdini et al., 1990).
*Age, gender, experience.* In current transport safety research, it is well established that key variables related to driver characteristics (age, gender, experience) explain a certain amount of variation in transport operators' safety behaviours (Elvik et al. 2009). Previous research has found that older drivers and females are more inclined to be involved in lapses, while errors do not seem to be related to any specific demographic groups (Parker et al 1998). Finally, violations (which seem to be the behaviour most strongly related to accidents) seem to be more prevalent among young drivers and male drivers.

## 2. METHODS

### *2.1 Recruitment of Respondents*

The Norwegian professional driver respondents were recruited in 2016-2017 through the Norwegian researchers' contact with Norwegian transport companies and unions. Web links to the questionnaires were distributed along with an introductory text explaining the purpose of the survey and stressing that the surveys were confidential. The Norwegian private driver respondents were recruited through the Preference Database of the Norwegian Postal Service, consisting of 430,000 people in 2016, who had consented to receive information or advertising through the moving or holiday service of the Postal Service. E-mails with web-links to the survey were submitted to 45,483 people in three Norwegian counties including the capital Oslo, based on differences in accident risk and attitudes. Of the 45,452 people who received the e-mail, 6,727 people (14,8%) opened the e-mail, and 645 (9.6%) completed the survey. In an attempt to increase response rates, Norwegian respondents were informed that they could participate in a draw for a present card of 2000 NOK, if they wanted to. The Greek respondents were recruited through a marketing research company in Greece, under the scientific supervision of NTUA. Recruitment of drivers in Greece was also difficult, therefore, it was decided to approach candidates in person and further explain the scope of the survey. This helped eliminate their doubts and fears about confidentiality, and the use of the information they would provide. The private drivers in Greece were sampled in the capital Athens and the island of Rhodes. This sampling is based on an assumption that the TSC on an island could be different from the capital, as an island is a geographically enclosed area, and as Rhodes has many tourist drivers.

### *2.2 Survey Themes*

*Demographic variables.* The survey includes questions on age, experience as a driver, gender, nationality, kilometres driven with professional or private car in the last two years etc. For private drivers, questions were also included on education, their place of living (e.g. rural, urban) how long they have had their driver's license, how often they drive, the type of car they own etc. The survey also included work-related variables for the HGV and bus drivers, e.g. type of vehicle, work pressure, wage arrangements and management focusing on certain safety behaviours (speeding, seat belt use). An organisational culture index, consisting of 10 questions from the GAIN-scale on organisational safety culture was used (GAIN, 2001).

*Safety behaviours:* The survey includes nine questions including questions taken from the DBQ and based on the results of previous research (Warner et al, 2011), or questions on behavior that is related to accidents in previous research (Nævestad et al 2015). In this study, the DBQ questions were those on which Scandinavian and Southern European drivers scored significantly different, were related to accident involvement (Warner et al 2011), and were appropriate for professional drivers of heavy vehicles. Five of the behavior items in the survey match these criteria. Previous factor analyses of these indicate a two-factor solution (Nævestad et al 2017,2018): aggressive violations and over-speeding. A factor analysis confirmed the two-factor solution for the private and professional drivers in the sample, but it was not possible to verify the results of it due to spatial limitations). Here, the focus is on aggressive violations, as previous research indicates that these variables are related to accident involvement (Nævestad et al 2017,2018). An aggressive violations index, comprised of three items, based on the previous factor analysis: 1) Become angered by a certain type of driver and indicate your hostility by whatever means you can, 2) Sound your horn to indicate your annoyance to another road user, 3) Pull out of a junction so far that the driver with right of way has to stop and let you out. The DBQ answer alternatives have been changed from relative to absolute alternatives (e.g. Question: "For

every ten trips, how often do you …?", Alternative answers: "Never", "Once or twice", "Three or four times", "Five or six times", "Seven or eight times", "More than eight times but not always", "Always"). The reason is that previous research shows that different demographic groups tend to interpret questions and formulations differently (i.e. what does "often" mean?)

*National TSC index.* As noted, national TSC is measured as descriptive norms , reflecting perceptions of what other drivers in the country do. Thus, the survey includes 9 questions on expectations to other road users, reflecting those used for respondents' own behaviour. Based on previous studies, we assume a two-factor solution on the national TSC index, and we only include the factor which has been found to be important in previous research (Nævestad et al 2017, 2018). This is based on seven items regarding other drivers' aggressive violations and over-speeding, reflecting the behaviour items, other drivers' driving under the influence and seat belt use. Five answer alternatives ranged between 1 (none-very few) and 5 (almost all/all).

*Safety outcomes.* 4 questions based on previous work on fatigue (Nævestad and Bjørnskau, 2014; Nordbakke, 2004), on safety assessment (Størkersen et al, 2011) and also newly developed questions were included. Accidents is the most important outcome measure.

## 3. RESULTS

### *3.1 Description of the Sample*

The study sample includes 596 private car drivers and 216 professional drivers from Norway and 287 private car drivers and 200 professional drivers from Greece. In Tables 3.1 to 3.2 the main characteristics of the survey sample are presented. The study includes 82 people who were not born in either Norway or Greece, we do not include these, as we assume that nationality is a key variable.

*Table 3.1: Distribution of drivers per city/county and sector*

| Group | County/sector | Number | Share | Share of males |
|---|---|---|---|---|
| Private Norway | Oslo | 461 | 35% | 59% |
| | Aust-Agder | 91 | 7% | 64% |
| | Finnmark | 44 | 3% | 50% |
| Private Greece | Athens | 200 | 15% | 62% |
| | Rhodes | 87 | 7% | 65% |
| Professional Norway | Bus | 115 | 9% | 93% |
| | HGV | 101 | 8% | 97% |
| Professional Greece | Bus | 101 | 8% | 100% |
| | HGV | 99 | 8% | 99% |
| Total | | 1299 | 100% | 72% |

Table 3.1 indicates, as expected, that the share of male drivers is between 90 and 100% in the groups of professional drivers from both countries.

### *3.2 Mean Scores on the Aggressive Violations and National TSC Indexes*

*Table 3.2 Aggressive violations index*

| Nationality | Mean | N | Std.D |
|---|---|---|---|
| Norwegian-private | 4.3 | 596 | 1.54 |
| Norwegian professional | 4.7 | 216 | 2.35 |
| Greek Private | 5.7 | 287 | 3.42 |
| Greek professional | 5.8 | 200 | 2.90 |

| | | | |
|---|---|---|---|
| Norwegian total | 4.4 | 812 | 1.8 |
| Greek total | 5.7 | 487 | 3.2 |
| Total | 4.9 | 1299 | 2.51 |

We conducted a Tukey post-hoc test to examine whether the differences between the mean scores were significantly different. We did not find significant differences between the private and professional drivers within each country, but we did for each group across countries (at the 1%-level). Results are in accordance with our hypothesis: safety behaviours are more similar within national samples. Table 3.3 shows results on the national TSC index for the different groups.

*Table 3.3 National Transport Safety Culture index*

| Nationality | Mean | N | Std.D |
|---|---|---|---|
| Norwegian-private | 10.7 | 596 | 3.58 |
| Norwegian professional | 14.0 | 216 | 5.51 |
| Greek Private | 18.6 | 287 | 7.05 |
| Greek professional | 18.6 | 200 | 7.22 |
| Norwegian total | 11.6 | 812 | 4.42 |
| Greek total | 18.6 | 487 | 7.11 |
| Total | 14.2 | 1299 | 6.53 |

*3.3 Regression Analyses*

A total of 214 respondents had been involved in an accident in the course of the last two years. This applies to 10% of the private Norwegian drivers, 17% of the private Greek drivers, 16% of the professional Norwegian drivers and 36% of the Greek professional drivers. Table 3.4 shows a logistic regression analysis of the variables influencing accident involvement.

*Table 3.4Logistic regression. Dependent variable: "Accidents (No=0, Yes=1)" Beta values.*

| Variables | Step1 | Step2 | Step 3 | Step 4 | Step 5 | Step 6 |
|---|---|---|---|---|---|---|
| Gender (Female=0, Male=1) | **.423**** | **.452**** | **.321*** | .245 | .194 | .057 |
| Age group | | -.066 | -.065 | -.037 | -.043 | -.057 |
| 1000 kilometre driven | | | **.002***** | **.002***** | **.002**** | .001 |
| Aggressive violations | | | | **.086***** | **.050*** | **.051*** |
| Nationality (Greek=0, Norw.=1) | | | | | **-.847***** | **-.453**** |
| Subgroup (profes. Greek=0, Other=1) | | | | | | **-.914***** |
| Nagelkerke R | .008 | .009 | .019 | .032 | .068 | .085 |

* p < 0.1** p < 0.05*** p < 0.01***

First, we see that gender contributes significantly to accident involvement, reflecting the fact that a significantly higher proportion of the males (18%) had been involved in accidents in the last 2 years, compared to 12.5% of the females. Thus, it seems that males are more likely to be involved in accidents. This initial relationship seems, however, to be a result of the professional drivers in the sample, who largely are male and who have driven five times longer distances in average in the last two years than private drivers (avg. 122,000km vs.23,000km), and who, thus, have more accidents. Thus, we see that the significance level of gender is reduced when we include kilometer driven. When behaviour is included, gender ceases to contribute significantly. In Step 4, we include aggressive violations index, and we see that this contributes significantly to accident involvement, although its contribution is smaller than the other contributing variables.

This could be due to the fact that this index has more values (min: 3, max: 21) than the other significant variables in Step 6, which only have two values. Interestingly, we see that nationality contributes significantly and negatively in Step 5, reflecting the lower proportion of accidents among Norwegian respondents, with a lower frequency of aggressive violations. The contribution of nationality is almost reduced to the half when the subgroup "professional Greek" respondents (bus, HGV) is included, probably as it was found that these have the highest proportion of accidents, compared to the other groups. In Step 6, the contribution of aggressive violations is only significant, at the 10% level, indicating that the higher accident risk of professional Greek drivers also is due to other factors than their behaviours. This is an issue for future research. The Nagelkerke R value is.082. Thus, the model explains 8% of the variation in respondents' accident involvement.

Table 3.5 shows the results of a hierarchical, linear regression analysis, where independent variables are included in successive steps to examine the variables predicting respondents' aggressive violations. The Table presents the standardized beta coefficients. The contributions of the different independent variables on the dependent variables can therefore be compared directly. The scores on the dependent variable vary between 3 and 21.

*Table 3.5 Linear regression. Depen. var.:"Aggressive violations", Standardized beta coefficients*

| Variables | Step1 | Step2 | Step 3 | Step 4 | Step 5 | Step 6 |
|---|---|---|---|---|---|---|
| Gender (Male: 1, Female: 2) | **-.115*** | **-.137*** | **-.110*** | **-.093*** | **-.103*** | **-.094*** |
| Age Group | | **-.137*** | **-.130*** | **-.101*** | **-.094*** | **-.094*** |
| Nationality (Nor.=1: Greek=2) | | | **.241*** | **.077** | **.055*** | .021 |
| National TSC | | | | **.320*** | **.292*** | **.288*** |
| Rhodes (Other=1, Rhodes=2) | | | | | **.103*** | **.122*** |
| Professional Greece (Oth.=1,Pr.Gr.=2) | | | | | | .055 |
| Adj. R2 | .012 | .030 | .087 | .160 | .168 | .169 |

* p < 0.1** p < 0.05*** p < 0.01***

Table 3.5 indicates that all the variables except nationality and professional drivers in Greece contribute significantly in Step 6. The negative contribution of gender indicates that male scores significantly higher on the aggressive violations index in both countries. This also applies, when we control for the other variables in the model in Step 6. Likewise, we see that increasing age is related to less aggressive behaviours. The contribution of nationality is reduced considerably when national TSC is included in the model, indicating that the initial contribution of nationality in Step 3 largely was due to national TSC. National TSC is the variable with the strongest contribution in the model, indicating that respondents who expect more aggressive violations and risky behaviours from drivers from their own country, are engaged in more aggressive violations themselves. In Table 3.3 and 3.4, it was found that this applies to the Greek respondents. Looking more closely at the subgroups, a considerably higher score on the aggressive violations index among private drivers from Rhodes was found. These drivers scored 7.1 points on this index, compared to 4.8 points for the rest of the other groups. The average score for Athens drivers was 5.1 points. Rhodes is the variable with the second strongest contribution in the model. We made a professional Greek driver variable as this group also had a high average score on aggressive

violations, but this variable does not contribute significantly. The adjusted $R^2$ value increases from 0,033 in Step 3 to 0,156 in Step 4, when national TSC is included, demonstrating the high importance of national TSC as a predictor of aggressive violations. The adjusted $R^2$ value of .169 indicates that the model explains 17% of the variation in the aggressive violations.

## 4. CONCLUDING DISCUSSION

Our results support the findings of previous research(e.g. Warner et al 2011), it was found that Greek drivers are more inclined to commit aggressive violations than Norwegian drivers. It was hypothesized that if traffic safety behaviours were more similar among private and professional drivers within the national samples, than among drivers across the national samples, this could be due to the influence of national TSC. The results are in accordance with this hypothesis, despite the professional drivers' similar periodic training and organisational membership. It is argued that this seems to indicate the existence of different national TSC in the two countries. A result that further supports this assertion is that it was found that national TSC, measured as descriptive norms, is the variable which has the strongest influence on respondents' safety behaviours. In accordance with results concerning safety behaviours, systematic differences between the national groups on the national TSC index.

A potential critique that can be raised against identification of the descriptive norms mechanism is that it also may influence behaviour through the false consensus bias, in which individuals overestimate the prevalence of risky behaviour among their peers to justify their own behavior (Nævestad et al 2014). It is difficult to assess the importance of this. However, different driver groups in Greece (private and professional) have similar scores when describing the safety behaviours of other drivers in their country. This does not apply in the Norwegian sample, but the difference between the Norwegian private and professional is nevertheless smaller than between any of the Norwegian groups and the Greek groups. This seems to indicate that what is measured as national TSC to some extent reflects the safety behaviours that the different national groups ascribe to other drivers in their country and not just a false consensus bias to justify their own behaviour.

The results indicate that aggressive violations, which were found to be related to national TSC, are related to accident involvement. Thus, it is not unreasonable to hypothesize that differences between national TSC may shed light on national differences in fatality rates. It has only been possible to examine some aspects related to this, but our results indicate that the descriptive norms mechanism could provide a possible analytical perspective as to how national TSC influences transport safety behaviours. Future research should look more into how national TSC comes about. It may, for instance, be hypothesized that TSC comes about through interaction (and sanctions) in traffic, as this seems to be a likely arena to learn about the "normal behaviour" of other drivers. This line of reasoning could explain one of the results that it was not possible to discuss in depth: drivers in Rhodes differed significantly from the other groups with respect to their safety behaviours and their reported national TSC. The latter deviated from the national pattern, with 7 points higher score than Athens. This indicates a unique regional TSC in Rhodes, which should be followed up in future research. It as also found that the professional Greek drivers had a safety behaviour and a proportion of accident involvement which differed from the other groups. Future research should examine whether the higher incidence of aggressive violations and accidents among Greek professional drivers could be due to work related variables like time pressure, commission pay, framework conditions etc. Previous research has found

relationships between DBQ items, organisational safety culture, time pressure and stress (Davey et al.'s 2006; Wills et al 2006).

The TSC perspective may facilitate new types of interventions, which could target the identified descriptive norms mechanism. There are already successful examples of such interventions (Nævestad et al 2014). Several studies conclude in favour of focusing on descriptive norms in traffic safety interventions (cf. Nævestad et al 2014).

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