Attitudes of Greek drivers towards mobile phone use while driving

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Abstract

This paper investigates the attitudes and behavior of Greek drivers with specific focus on mobile phone use while driving. The research is based on the data of the pan-European SARTRE 4 survey, which was conducted on a representative sample of Greek drivers in 2011. The analysis of the drivers' behavior was carried out by the statistical methods of factor and cluster analysis. According to the results of factor analysis, Greek drivers' responses in the selected questions were summarized into seven factors, describing road behavior, accident involvement probability, but also their views on issues concerning other drivers' road behavior, enforcement for road safety and mobile phone use while driving. The results of cluster analysis indicated four different groups of Greek drivers: the cautious, the moderate, the conservative and the thoughtless drivers and the characteristics of each group where identified. These results may be useful for the appropriate design of targeted road safety campaigns and other countermeasures.

Keywords: mobile phone, driving, driver behaviour, drivers' attitudes, road safety, factor analysis, cluster analysis.

Résumé

Cet article examine les attitudes et les comportements des conducteurs grecs avec un accent particulier sur l'utilisation du téléphone portable au volant. La recherche est basée sur les données de l'enquête européenne SARTRE 4, qui a été menée sur un échantillon représentatif de conducteurs grecs en 2011. L'analyse du comportement des conducteurs a été effectuée par les méthodes statistiques d'analyse factorielle et de grappe. Selon les résultats de l'analyse factorielle, les réponses des conducteurs grecs à des questions sélectionnées ont été résumées en sept facteurs, décrivant le comportement routier, la probabilité d'implication dans un accident, mais aussi leurs points de vue sur les questions concernant les autres conducteurs, le comportement routier, les contrôles de police et l'utilisation du téléphone mobile pendant la conduite. Les résultats de l'analyse de grappe ont indiqué quatre groupes différents de conducteurs grecs: les prudents, les modérées, les conservateurs et les conducteurs inconscients et les caractéristiques de chaque groupe ont été identifiées. Ces résultats peuvent être utiles pour la conception appropriée des campagnes de sécurité routière ciblés et d'autres contre-mesures.

Mots-clé: téléphone mobile, conduite, comportement du conducteur, attitudes des conducteurs, sécurité routière, analyse factorielle, analyse de grappe.

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1. Introduction

Road accidents are still a burden to society, despite the efforts made so far. Annually, there are 1.3 million fatalities and almost 50 million injuries (WHO, 2013). Greece faces the same problem, but it is notable that there is a reduction of about 42% in the number of fatal accidents in the last decade (EL.STAT., 2013). There is also a 50% reduction in severe accidents.

A factor which is considered to be responsible for almost 25% of accidents is driver's distraction, since the driver has to perform multiple tasks simultaneously (NHTSA, 2006). The introduction of new intelligent technologies and in-vehicle devices as well as the wide use of mobile phones raise the need for further investigating their effects on driver distraction and consequently on road safety.

Mobile phone use is considered to be a demanding cognitive and operational task and it may compromise decision-making while driving (McKnight & McKnight, 1993). According to recent literature (Young et al., 2003; Dragutinovic & Twisk, 2005), distraction caused by mobile phone use consists of four different types (visual, audio, physical and mental). Laberge-Nadeau et al. (2003), link the use of mobile phones with increased risk of road accidents because of the distraction of driver attention. The respective risk of road accident injury of 25-29 year old drivers is almost 2.5 higher than those who drive without distraction (Lam, 2002). On the other hand, international literature shows that drivers adapt and reduce their driving speeds accordingly, in order to compensate for the demanding task of talking to the mobile phone and driving (Haigney et al., 2000; Strayer & Drews, 2001).

Today, the use of a mobile phone while driving is prohibited by road traffic regulations in most European countries. However, few EU countries conduct systematic surveys to investigate car telephone use by drivers. According to European Road Safety Observatory (2009), some observational studies in Europe, USA and Australia indicate that the mobile phone use while driving ranges from 1% to 6% of drivers, but many report occasional use. The attitudes and intentions to use mobile phones while driving have been investigated in literature (AAA Foundation, 2008; White et al, 2010; Walsh et al, 2008; Zhou et al., 2009), but these issues need further research in order to be adequately examined, let alone in a national and representative sample.

Consequently, the aim of the study is to investigate the attitudes and behavior of Greek drivers with focus towards mobile phone use while driving, using the SARTRE 4 pan-European survey data. For that purpose, drivers' responses to selected questions of SARTRE 4 questionnaire are analyzed.

2. Data

The SARTRE 4 survey focuses on road user's attitudes and perceptions towards road traffic risk in Europe (SARTRE 4, 2011). It is based upon a common survey carried out in each participating country and upon a shared analysis of the data. The survey involved a personal interview for the completion of an extensive questionnaire. The project is a sequel to the previous three SARTRE projects, with the inclusion of additional groups (other road users such as pedestrians, public transport users, cyclists and motorized two-wheelers). For more information about the SARTRE 4 project, the reader is advised to visit website of the project at http://www.attitudes-roadsafety.eu/.

During the survey period, 21,280 questionnaires were collected (at least 1,000 for each country), between November 2010 and February 2011, from 19 European countries. In Greece, 602 drivers participated in the survey. This sample is used for this study. The questionnaire included common questions which all respondents had to fill such as age, gender, education and so on (common part denoted as CO), followed by specific questions regarding each road user (e.g. CD for car drivers, MC for motorcyclists). The questions that were selected for the analysis were those which describe adequately the attitudes of drivers towards the mobile phone use while driving. Moreover, other questions related to speeding and driving behavior as well personal attributes such as age, gender and driving experience were selected as well. all cases, the scoring goes from ‘‘positive’’ to ‘‘negative’’ attitudes and from ‘‘safe’’ to ‘‘unsafe’’ behaviors. These questions are illustrated in Table 1:

Table 1. Overview of questions analyzed in the study

Code	Question	Response
SQ2	Gender	1=Male, 2=Female
SQ3a	Age	In years
CO01a	During the last 12 months on average how often did you travel by car as a driver?	1=Nearly daily, 2= One to four times a week, 3=one to three times a month, 4=less than once a month
CO02c	How concerned are you about road accidents?	1=Very, 2=Fairly, 3=Not much, 4=Not at all
CO03	Thinking specifically about the risk of accident, how safe do you think the roads are in our country to travel on?	1=Very, 2=Fairly, 3=Not much, 4=Not at all
CO07b	How much would you be in favor of surveillance of speeding at a single point by automated cameras?	1=Very, 2=Fairly, 3=Not much, 4=Not at all
CO08a	Penalties for speeding offences should be much more severe.	1=Strongly agree, 2= Agree, 3= Neither, 4=Disagree, 5=Strongly disagree
CO08b	Penalties for using a handheld phone while driving should be much more severe.	1=Strongly agree, 2= Agree, 3= Neither, 4=Disagree, 5=Strongly disagree
CD01	How many kilometers/miles would you estimate you have driven in the past 12 months?	In kilometers.
CD02a	In general, how often do you think other car drivers break speed limits on motorways?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD02b	In general, how often do you think other car drivers break speed limits on main roads between towns?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD02c	In general, how often do you think other car drivers break speed limits on country roads?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD02d	In general, how often do you think other car drivers break speed limits in built-up areas?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD04	Over the next month, how likely or not would you be to drive at 20km/h over the speed limit in a residential area?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD05	On a typical journey, how likely is it that you will be checked for speeding?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD06	In the past 3 years, have you been fined, or punished in any other way, for breaking the speed limit driving a car?	1=No, 2=Yes, only fined, 3=Yes, fined and/or other penalty
CD16e	If you feel tired while driving, do you usually talk on the phone to overcome this state?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD17	In the past 12 months while driving, how often did you realize that you were actually too tired to drive?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD18	In the past 12 months, how often did you stop and take a break because you were too tired to drive?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD19	In the past 3 years, how many accidents have you been involved in, as the driver of a car, in which someone, including yourself, was injured and received medical attention?	Number of accidents
CD20	In the past 3 years, how many damage only accidents have you been involved in, as the driver of a car?	Number of accidents
CD23a	When driving a car, how often do you follow the vehicle in front too closely?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD23b	When driving a car, how often do you give way to a pedestrian at pedestrian crossings?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD23c	When driving a car, how often do you drive through a traffic light that is on amber?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD23d	When driving a car, how often do you make/answer a call with handheld phone?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD23e	When driving a car, how often do you make/answer a call with hand free phone?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always
CD24d	How often do you think that making/answering a call with handheld phone is the cause of car drivers being involved in a road accidents?	1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always

3. Analysis methods

3.1. Factor analysis

Firstly it is aimed to identify meaningful groups of variables reflecting drivers' attitudes and behavior with specific focus to those concerning mobile phone and driving. For that purpose, Factor Analysis was performed. This technique aims to understand the structure of a large set of variables and secondly reduce the dataset to a more manageable size while at the same time retaining as much of the original information as possible. It allows the identification of a limited number of factors which reflect the initial large number of questions. In simple words, variables that share variance (are correlated) can be grouped together creating a factor. Factors should in general consist of variables with high loadings (>0.30-0.35). For that reason, factors with low loadings can be eliminated after trials. Orthogonal rotation was selected in order to be sure that the estimated factors are not correlated in order to be used for further analysis. Moreover, each respondent produces a score in each factor. The factor scores are standardized with a mean value equal to 0 and standard deviation equal to 1. All questions presented in Table 1 were considered for the analysis. In order to perform factor analysis with robust results, it is crucial that the size of the sample is adequate. The general rule is that at least 10 – 15 participants (e.g. respondents) per variable should be available.

3.2. Cluster analysis

Next, a two-step cluster analysis was performed in order to group car drivers into meaningful groups. This method of clustering is most appropriate for very large data files and it can produce solutions based on both continuous and categorical variables. The clustering was based upon the factor scores that were calculated previously in the factor analysis. The first step of the two-step procedure is the formation of pre-clusters. The goal of pre-clustering is to reduce the size of the matrix that contains distances between all possible pairs of cases. In the second step, the standard hierarchical clustering algorithm is applied on the pre-clusters. The two-step cluster algorithm requires that all continuous variables are standardized; in this case all the factor scores were standardized with a mean value of 0 and a standard deviation of 1. Each cluster has a centroid, which is the mean factor score for this cluster. Then a t-test is performed in order to assess the significance of the difference of this mean value from zero.

4. Results

4.1. Factor analysis

The factor analysis revealed 7 factors which was the optimal number according to the statistical criteria (please see Papadimitriou et al., 2013). It is aimed to lose as little information (variance as possible). The results showed that almost 64% of the variance is explained. As a result it is meaningful to replace the initial variables with the 7 produced factors. The questions that shared at least some variance are involved in each factor. As a result not all questions share variance but vary independently of others. These factors describe road behavior, accident involvement probability, but also drivers' views on issues concerning other drivers' road behavior, enforcement for road safety and mobile phone use while driving.

The factors are summarized as follows:

- Factor 1: Involves questions CD02a, CD02b, CD02c, CD02d and CO03 and is associated with Greek drivers' opinion about the level of safety of roads in Greece and their perceptions of other drivers' behavior regarding speeding above the limits.
- Factor 2: Involves questions CD04, CD16e, CD23c and CD23d and is associated with drivers' mobile phone use but also with some general behavioral aspects such as driving above the speed limit and driving through amber traffic light.
- Factor 3: Consists of the following questions: CO07b, CO08a, CO08b. This factor is associated with drivers' attitudes towards road safety measures such as penalties for handheld phone use and penalties for speeding offences.
- Factor 4: This factor groups together questions CD05, CD17 and CD19 (past accident involvement with injuries, tired while driving and probability of speed checking by the police).
- Factor 5: Involves questions CD20, CD23d and CD24d (past accidents involvement with only property damage, frequency of mobile phone use while driving and its relation with the risk of an accident).

- Factor 6: Questions CD23a and CD23b are included in this factor and concern driving behavior (following closely the vehicle in front and giving way to pedestrians).
- Factor 7: The last factor involves age and frequency of hand free phone while driving (questions SQ3a and CD23e respectively).

Table 2 provides an overview of the factors showing the factor loadings, that is the shared variance of the variables involved in each factor. A loading of 1 means perfect positive correlation (100% positive shared variance), while a value of -1 means perfect negative correlation (100% negative shared variance) and a value of 0 means no shared variance. In general, variables with loadings higher than 0.3 are taken into consideration. in order to define the factor. The other parameter which defines the factor description is the coding of each variable. For example, factor 1 consists of questions CD02a, CD02b, CD02c, CD02d and CO03, which all have positive loadings (0.781, 0.851, 0.856, 0.762 and 0.471 respectively). The coding of those variables can be observed in Table 1 previously (for CD02a, CD02b, CD02c and CD02d is 1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always, while for CO03 is 1=Very, 2=Fairly, 3=Not much, 4=Not at all. These variables share a positive variance as the loadings are positive and this means that those who think that other drivers drive above the speed limit in various roads more often, are also likely to believe that the roads are not safe. On the other hand, those who think that other drivers do not break the speed limit are satisfied with the level of road safety in Greek roads. The same philosophy applies to all factors.

Table 2. Overview of factors and loadings

Question	Factor						
	1	2	3	4	5	6	7
CD02c	0.856						
CD02b	0.851						
CD02a	0.781						
CD02d	0.762						
CO03	0.471						
CD16e		0.749					
CD23c		0.716					
CD04		0.693					
CD23d		0.562			0.365		
CO08a			0.865				
CO08b			0.813				
CO07b			0.708				
CD19				0.820			
CD17				0.692			
CD05				0.653			
CD20					0.784		
CD24d					-0.374		
CD23b						0.658	
CD23a						0.639	
SQ3a							-0.775
CD23e		0.503					0.535

4.2. Cluster analysis

The clustering of the factors (more specifically of the factor scores) resulted in 4 clusters or groups of drivers. The significance of each factor in each cluster was tested by means of a t-test. The t-test of the factors that is

higher than the critical value of 1.64 for 95% confidence level, shows that the factor score is statistically different from zero, in other words significantly different from the mean factor score (which is 0 as mentioned in chapter 3.1).

The meaning of the sign of the factor score depends on the way that each variable is coded and the sign of the factor loadings. For example, people that belong to cluster 1, have a positive and statistically significant from zero mean score in factor 6 (0.642). Taking also into account that factor 6 consists of variables CD23a and CD23b (coded 1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often, 6=Always), it can be mentioned that Greek drivers who belong to that cluster are more likely to report that they give way to pedestrians but also follow the vehicle in front too closely. A negative value of mean factor score would simply mean the opposite (not giving way to pedestrians, not following the vehicle in front too closely). All mean factor scores in each cluster are interpreted similarly. Table 3 illustrates the clusters centroids.

Table 3. Results of cluster analysis (clusters centroids)

		Centroid			
		Cluster 1	Cluster 2	Cluster 3	Cluster 4
Factor 1	Mean	-0.27	0.582	-0.056	-0.189
	Standard deviation	0.994	0.81	1.039	0.859
Factor 2	Mean	0.175	-0.061	-0.673	1.165
	Standard deviation	0.659	0.879	0.628	1.043
Factor 3	Mean	-0.119	1,291	-0.548	-0.336
	Standard deviation	0.97	0.462	0.576	0.781
Factor 4	Mean	-0.728	-0.002	0.435	0.252
	Standard deviation	0.545	0.699	1.119	0.991
Factor 5	Mean	-0.422	0.006	-0.018	0.694
	Standard deviation	0.633	0.571	0.479	1.899
Factor 6	Mean	0.642	-0.299	-0.175	-0.27
	Standard deviation	0.838	0.903	0.984	0.951
Factor 7	Mean	-0.308	-0.052	-0.018	0.573
	Standard deviation	1.285	0.739	0.879	0.752

More specifically:

- Cluster 1: The "cautious" drivers. 160 drivers (26.7% of the sample) belongs to this cluster. Statistically significant factors for this cluster are factor 4 (negative mean score), 5 (negative mean score), factor 1 (negative mean score), factor 2 (positive mean score) and factor 6 (positive mean score). Older drivers belong to this cluster. Moreover, these drivers rarely drive when they are tired, they are not likely to have been involved in an accident and they believe that the probability of speed check is low. They neither agree or disagree with more severe penalties for mobile phone use or for driving above the speed limit. Regarding mobile phone use, the high positive mean score factor 5, indicates that these drivers believe that mobile phone use increases the risk of accidents. However, they sometimes make or answer a phone call. Lastly, they cluster are more likely to report that they give way to pedestrians but also follow the vehicle in front too closely.
- Cluster 2: The "moderate" drivers. 129 drivers (21.5% of the sample) belongs to this cluster. Statistically significant factors for this cluster are factor 1 (positive mean score) and factor 3 (positive mean score). This cluster involves mainly middle-aged drivers. In general, their driving behavior is moderate since they have average scores in most factors (mobile phone while driving, speed violations, traffic light violations and past accident involvement). However, this group is characterized by the strong belief that the penalties for mobile phone use while driving and penalties for exceeding the speed limit should by no means be more severe. They also disagree with the surveillance of speeding by automated cameras.
- Cluster 3: The "conservative" drivers. 208 drivers (34.7% of the sample) belongs to this cluster. Statistically significant factors for this cluster are factor 2 (negative mean score), factor 3 (negative mean score) and factor 4 (positive mean score). In general, this group of Greek drivers is characterized by more conservative

opinions such as more severe penalties for speeding offences and installation of automated cameras for speeding surveillance. In terms of attitudes towards mobile phone use in driving, drivers in this cluster are less likely to talk on the phone when they feel tired and also less likely to answer or make a phone call. These drivers do not usually drive through amber traffic light, they feel that they will be checked for speeding and consequently they rarely drive above the speed limit, but they have sometimes driven while tired. However, it is interesting that they are more likely to have reported a severe accident involvement in the past.

- Cluster 4: The "risky" drivers. 103 drivers (17.2% of the sample) belongs to this cluster. Statistically significant factors for this cluster are factor 3 (negative mean score), factor 5 (positive mean score), factor 7 (positive mean score). This group consists mainly of young inexperienced drivers with potential risky behavior and an experience of property damage accidents. They are more likely to use the mobile phone while driving (also make phone calls when tired) although they consider mobile phone use as a contributory risk factor. Furthermore, this group often drives through amber traffic light and exceeds the speed limits. It is counterintuitive though, that these drivers support more severe penalties.

5. Discussion and conclusions

So far, the research on mobile phone use is mainly based on real observations or simulations. However, there are only a few studies regarding the attitudes of drivers towards mobile phone use especially having a large national and representative sample. This study aimed to investigate the attitudes and behavior of Greek drivers with specific focus on mobile phone use while driving. It is based on the data of the pan-European SARTRE 4 survey, which was conducted on a representative sample of 600 Greek drivers in 2011. The respondents had to fill a wide range of questions regarding several road safety issues. Specific questions regarding the drivers' behavior, attitudes towards road safety and their attitudes towards mobile phone use were selected in order to be analyzed. Firstly, a factor analysis was performed to identify meaningful groups of variables reflecting drivers' attitudes and behavior with specific focus to those concerning mobile phone and driving. The next step was a two-step cluster analysis in order to group car drivers into meaningful groups according to their attributes.

The results showed 7 factors and 4 clusters of Greek drivers. The produced factors group variables concerning for example driving behavior, past accident involvement, attitudes towards road safety and specific attitudes towards mobile phone use. According to the attributes of the drivers the 4 groups were labeled as "cautious", "moderate", "conservative" and "risky". Overall, the results showed that a large proportion of Greek drivers use the mobile phone while driving even though some of them occasionally. It is interesting that the majority of respondents consider mobile phone use while driving a risk factor.

As expected, respondents who are negative towards mobile phone use are less likely to talk on the phone but they may report occasional mobile phone use. It was also expected that young drivers are more likely to talk on the phone while driving than older drivers. Moreover, those who often use the mobile phone, report other risky behaviors as well, such as exceeding the speed limits or driving through a traffic light that is on amber. Last, Greek drivers are divided to those who strongly disagree with more severe penalties and to those who strongly agree.

The analysis of this sample, showed robust results in general, which agree with international literature. The proposed methodology is also a promising tool in order to analyze especially large questionnaires with a high number of independent variables. As a consequence, it can be expanded to other studies with similar objectives. However, further research is needed in order to understand this issue more deeply. For example, other parameters like driving under the influence of alcohol or other drugs and excessive speeding should be incorporated. It would be also interesting to perform experiments and observations to test whether the stated behavior of drivers differs from the observed behavior in real situations. Furthermore, the same methodology could also be applied to examine the attitudes and behavior of other road users' groups such as motorcyclists and cyclists, or to examine more countries to perform comparisons. Texting while driving is also an important parameter which need further investigation. As a last remark, it can be mentioned that the technological advances in mobile phones (bluetooth, hands-free), could offer a chance to group drivers according to their preferences and analyze the behaviors of each group.

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