Investigating the self-reported behavior of drivers and their attitudes to traffic violations

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ABSTRACT

The theoretical models of driving behavior consider attitudes as an important determinant of driver behavior. Moreover, the association between the self-reported tendency to commit violations and accident involvement is widely recognized. This research investigates drivers' self-reported behavior and attitudes to risky behaviors related to the traffic violations of speeding, drink-driving and cell phone use using cluster analysis. A sample of 601 Greek drivers participating at the SARTRE 4 pan-European survey is utilized. The analysis identified three clusters of drivers. Drivers in Cluster 1 commit traffic violations more often; drivers in Cluster 2 favor traffic violation countermeasures while having moderate views toward compliance with traffic rules; and drivers in Cluster 3 strongly support traffic violation countermeasures and also have strong views toward compliance with traffic rules. Risky behaviors and related attitudes that differentiate the three distinct groups of drivers (clusters) were determined. The findings indicate that differences in attitudes and behaviors may be attributed to factors such as age, gender and area of residence. The research findings also provided some insight about the current level of drivers' attitudes to traffic violations, especially those which negatively affect traffic safety. The pattern of their views on violations may form the basis of risk behavior-related interventions tailored to the identified groups, aiming at informing, educating and raising the awareness of the public.

Keywords: road safety, driving violations, driver attitudes, driver behaviors, survey, demographics

1. INTRODUCTION

Speeding and driving impairment are road safety issues which have been researched extensively while also being priorities of road safety education and enforcement programs. As speed increases, the probability of a crash and the consequences of injury increase as well (Aarts & Van Schagen, 2006). In the United States, about three of every ten crash fatalities are speeding-related (TRB, 2010a). Impairment, particularly due to alcohol use, is also highly represented in fatal crashes. About one-third of all fatal crashes in the U.S. involve an alcohol-impaired driver (TRB, 2010b).

Speeding-related crashes are defined as crashes where a driver is charged with a speeding-related offence or where the officer notes a contributing factor that is speeding-related (racing, driving too fast for the conditions or exceeding the posted speed limit). However, while speeding is an important contributing factor in 30% of crashes in the United States and in a similar percentage in Australia and New Zealand (Lahausse et al., 2010), it is a common and a socially-accepted behavior (TRB, 2010a). It is worth noticing that although drivers generally acknowledge that speeding is dangerous, speeding remains prevalent, in large part because the perceived risk of a speeding-related crash is low relative to the perceived benefits of driving fast (e.g., saving time, enjoyment of speed). Regarding the demographic factors of speeding, younger drivers and males are particularly likely to report speeding behavior and enjoyment of speed. Inexperience, poor judgment, and enjoyment of speed can have a detrimental effect on young drivers' safety. The issue is further complicated by the fact that factors such as the non-use of restraint systems, road type, time of day and particularly alcohol impairment play a contributing role in speeding-related fatalities (TRB, 2010a).

Cell phone use is an important source of drivers' distraction (Drews & Strayer, 2008). Most notably, an increasing trend in driver distraction has been reported with distracted-driving fatalities increasing from 2004 to 2008. Cell phones are often used while driving, particularly by younger age groups, who are more prone to multitasking and resist attempts to alter this pattern (TRB, 2010a, Young & Regan 2007). According to the epidemiological study of Drews and Strayer (2008), an increase in accident risk associated with the use of cell phones, which ranges from fourfold to ninefold. Furthermore, drivers who are engaged in a cell phone conversation are 10 times more likely to fail to stop at a stop sign. Regarding the legalized use of hands-free cell phones and banned use of handheld phones by laws, they note that "there seems to be little doubt that interaction with a handheld cell phone increases the risk of crash involvement", and also that there is "a strong body of evidence that indicates that the difference between handheld and hands-free cell phone conversations is minimal and potentially negligible in terms of accident risks". Recent research indicates that the use of hands-free devices is associated with significant impairment while there is increasing evidence that conversing impairs the visual processing of information, with drivers exhibiting inattention blindness (Drews & Strayer, 2008).

Driver crash involvement can also be understood through investigation of attitudes, goals, and priorities of drivers – factors with important role in determining driver behavior and with a significant influence on driving safety (Moeckli & Lee, 2007).

1.1 Attitudes and behaviors

The SARTRE (Social attitudes to Road Traffic Risk in Europe) pan-European surveys among drivers (SARTRE4, 2012) comprise a series of studies of attitudes conducted across European countries since 1993. The SARTRE surveys allowed for the investigation and comparison between countries of attitudes, self-reported behaviors and support for safety countermeasures. According to Valnaar and Yannis (2006), drivers (respondents in the SARTRE 3 survey) might underestimate the danger of using their mobile phone – either hand-held or hands-free – while driving. A study using the SARTRE 2 database covering most European countries linked the self-assessment dimensions to a set of explanatory variables such as age, gender, region and income. The results indicate that drivers who rate themselves as both more dangerous and faster than others are generally younger men with higher incomes, who break the speed limit more frequently, avoid wearing seat belts and have been involved in more accidents in the past than other drivers. In addition, more experienced and more highly educated drivers assess their driving as less dangerous but admit to driving faster than other drivers (Karlaftis et al, 2002).

The results of the Traffic Safety Culture Index (telephone survey) are particularly revealing of attitudes and behaviors of American drivers in respect to drinking and driving, speeding and cell phone use (AAA, 2012). According to the Traffic Safety Culture Index, speeding on freeways is widespread, although driving 15 mph over the speed limit on residential streets is much less common and is rated as one of the most unacceptable things that a driver can do. Drinking and driving is viewed as a very serious threat; nearly all drivers disapprove of drinking and driving and acknowledge that others also disapprove of it. Furthermore, fourteen percent admit to drinking and driving at least once in the past year and three percent said they had done so in the past month. There is broad support for requiring alcohol-ignition interlocks for drivers convicted of DWI (driving while intoxicated) more than once, and more than 3 in 4 Americans support interlocks for first-time DWI offenders (AAA, 2012). The results of the survey indicate that cell phone use while driving has become widespread. They also reveal that there is somewhat strong social disapproval toward using a handheld cell phone while driving, but nearly half of all drivers believe incorrectly that most others actually approve of it. People are generally accepting of hands-free cell phone use. Nearly 3 in 4 Americans support restricting the use of handheld cell phones while driving, but a small majority (53%) support an outright ban on using any type of cell phone (including hands-free) while driving (AAA, 2012).

The theoretical models of driving behavior that have been developed emphasize different determinants of behavior and provide guidance to efforts to improve traffic safety. When considered together, they suggest a number of factors which are likely to be particularly important determinants of behavior.

Attitudes are a key influence on behavior but the important role of subconscious norms, emotions, habits as well as external conditions has been also recognized (Department for Transport, 2011). The theory of planned behavior is a commonly used framework to describe the underlying process of belief structures - behavioral beliefs, normative beliefs, control beliefs- that influence intentional health-related behaviors. Attitudes, subjective norms and perceived behavioral control which develop from these belief structures, determine intention which, in turn, is a key determinant of behavior (Ward, 2007), (TRB, 2010c), (Forward, 2009), (Horvath et al., 2012). These belief structures may arise from the personality of the individual and the culture of the community emerging from the relationships engendered by the demographic and social structures of the region. This model suggests that safety interventions based on the social-cultural context should modify driver belief

structures in order to naturally support safe decisions by reducing the acceptability of risk (Ward, 2007).

1.2 Traffic Violations

Various human error models and classification schemes can be found in the literature (Austroads, 2011; Stanton & Salmon et al., 2009). According to the dominant, higher-level error classification system developed by Reason (1990, 1997), as referenced in Austroads (2011) and Stanton & Salmon (2009), errors are identified as slips, lapses, mistakes, and violations. Violations are a complex category of error and are categorized behaviors that deviate from accepted procedures, standards and rules. Violations, either deliberate (individuals deliberately breaking rules), or unintentional (individuals unknowingly breaking rules), pose definite risk to others (Reason et al, 1997, as referenced in Stanton & Salmon, 2009). Furthermore, errors (slips and mistakes) as well as violations have been found to decrease with age. Violations can be divided into those related to personal protection e.g., seat belt use, and violations that increase other road users' risk as well, e.g., speeding in an urban area (Delhomme, 1997, as referenced in Karlaftis et al., 2002). Interestingly, most drivers, independently of whether they consider themselves better, the same, or worse than others, believe that they generally commit violations less frequently than other drivers do (Karlaftis et al., 2002).

As referenced in Stanton & Salmon (2009), Parker et al. (1995) have found a clear link between the self-reported tendency to commit violations and accident involvement, even after the effects of exposure, age and gender have been controlled. Although they recognize that the association between violations and accidents is complicated, they stress that from the point of view of those concerned with road safety, the crucial point is that the commission of violations co-varies with accidents (Stanton & Salmon , 2009).

Human behaviors are influenced to some degree by biological factors such as gender and age-related conditions (Foss, 2007) and indeed, studies examining demographic factors relating to dangerous driving show that gender and age are related to risky driving. Younger drivers violate the law more often than older drivers (Groeger & Brown 1989; Parker et al, 1995). Research has also shown that younger drivers and male drivers express a lower level of normative motivation to comply with traffic laws (on the basis of voluntary compliance) than female and older drivers (Yagil, 1998). Furthermore, the perceived danger involved in the commission of a driving violation was found to be much more of a factor among women than among men before the commission of traffic violations (Yagil, 1998).

In their study on errors and violations in a sample of Greek drivers, Kontogiannis et al. (2002) recognize varieties of aberrant driving behavior and violations. Violations (defined as "deliberate circumventions of traffic rules and socially approved codes of behavior" which are "understood in relation to the social and societal context of driving") are categorized as "situational", "aggressive" and "highway–code" violations. Highway-code and aggressive violations differ significantly as a function of age and gender in the sense that younger drivers and males are more likely to report engaging in such violations than are older drivers and females. The tendency to commit highway-code violations proved to be statistically significant and a positive predictor of accident involvement (Kontogiannis et al. 2002).

An earlier study (Kanellaidis et al., 1995) on the attitudes of Greek drivers in relation to speed limits indicated that as the age of the driver increases, so does

reported compliance with speed limits on interurban roads; female drivers comply more with the speed limits. On the other hand, compliance with existing speed limits decreases as the annual number of kilometers driven on interurban roads and as the level of education of the driver increases.

Romano et al. (2012), in their recent study using data from US drivers, have found evidence confirming that males are more likely to be involved in impaired driving and alcohol-related crashes than females, and that they are less likely to be involved in alcohol-free crashes than female drivers. They also found that young drivers are less likely to be involved in alcohol-related crashes than older ones and they are also more likely to be involved in "alcohol-free" crashes than older drivers.

1.3 Objectives of the research

This research investigates drivers' self-reported behavior and attitudes to risky behaviors related to the traffic violations of speeding, drink-driving and cell phone use. The objectives of this research are firstly, to identify the specific violations that differentiate drivers on the basis of their relevant self-reported behaviors and attitudes, especially those most negatively influencing traffic safety and secondly, to identify the characteristics of these varying groups of drivers in terms of age, gender, area of residence and educational level. To achieve this, a cluster statistical analysis was carried out, which used 601 questionnaires collected during the SARTRE 4 European survey (SARTRE4, 2012).

2. METHOD

2.1 The data

This research utilized data from the fourth edition of the SARTRE pan-European survey (Social attitudes to Road Traffic Risk in Europe) carried out between November 2010 and February 2011 in 19 European countries. In each country, at least 600 car drivers were interviewed, on the basis of simple random sampling at the national level. The survey involved a personal interview for the filling of an extensive questionnaire, common in all countries.

The dataset used in this paper contains the responses of 601 Greek car drivers to questions regarding attitudes and self-reported behavior covering speeding, drink-driving and cell-phone use while driving. Thirteen questions were included in this analysis, to which respondents provided ratings on 4, 5 and 6-point scales.

2.2 The cluster analysis

Two-step cluster analysis was applied, using an SPSS statistical package (SPSS 17.0), to identify groups of individuals (drivers) that are similar to each other but different from other groups on the basis of their self-reported behavior and attitudes. Two-step clustering is preferred for large datasets and handles categorical as well as continuous variables (Everitt et al, 2011). The first step of the two-step procedure is formation of pre-clusters. In the second step SPSS uses the agglomerative hierarchical clustering algorithm on the pre-clusters. Log-likelihood is the distance measure used in both (pre-cluster and cluster) steps, since data are categorical. The Bayesian information criterion (BIC) is the clustering criterion for automatic determination of number of clusters. In the auto-clustering procedure both BIC and distance changes are used to find the number of clusters.

3. RESULTS

For the three clusters that were identified, Table 1 shows the number of drivers (cases) in each cluster, the frequency of drivers in a cluster expressed as a percentage of the total number of drivers assigned to clusters and the number of drivers in a given cluster, expressed as a percentage of the total number of drivers. It is evident that there are no skewed splits among the clusters and also there are no excluded cases.

Table 1
Distribution of drivers in clusters

		N (Number of cases)	Percentage (%) of Combined	Percentage (%) of Total
Cluster	1	181	30.1%	30.1%
	2	221	36.8%	36.8%
	3	199	33.1%	33.1%
	Combined	601	100.0%	100.0%
	Total	601		100.0%

The identified clusters of drivers are distinguishable on the basis of their attitudes and self-reported behaviors regarding the particular violations reflected in their responses to the relevant questions. Drivers in Cluster 1 commit traffic violations more often; drivers in Cluster 2 favor traffic violation countermeasures while having moderate views toward compliance with traffic rules; and drivers in Cluster 3 strongly support traffic violation countermeasures and compliance with traffic rules. The three clusters are presented in the following sub-sections along with the survey questions and answers as well as the characteristics of drivers in each cluster.

Tables 2-4 show for each cluster the number and the percentage of cases (drivers) with a particular value for statistically significant variables distinguishing the clusters. Figures 1, 2 and 3 depict the importance of each statistically significant variable in determining cluster 1, cluster 2 and cluster 3, respectively. Each Figure shows chi-square values (on the X axis) per variable making up the particular cluster (list of variables on the Y axis). Bonferroni method of multiple comparison was utilized, setting the desired overall significance level as alpha=0.05.

3.1 Cluster 1

The variables most important in differentiating Cluster 1 (consisting of 181 drivers) are the likelihood of drivers driving at 20km/h over the speed limit in a residential area, drivers' perceptions regarding their friends' speeding behavior, self-reported frequency of driving after the consumption of even a small amount of alcohol, friends' behavior regarding drink-driving and the self-reported frequency of driving under the influence of alcohol over the legal limit. Other variables that differentiate the drivers in Cluster 1 refer to their attitude towards the use of speed limiting devices fitted to cars and the self-reported frequency of handheld phone use while driving (Figure 1).

Speeding

A large majority of the drivers in Cluster 1 (over 75%) state that they would "sometimes", "often", "very often" and "always" be likely to drive at 20km/h over the speed limit in a residential area over the following month (CD04), i.e. to a higher degree than drivers in the other clusters (Table 2). A large majority (78%) agrees "fairly" or "very much" that most of their friends would demonstrate similar behavior (CD03E) (Table 2), which again is to a higher degree than drivers in the other clusters.

Drinking and driving

Although a large majority (78%) report that they have "never" or "rarely" driven after having drunk even a small amount of alcohol (CD10), they express this view to a lesser extent than drivers in the other two clusters (Table 2). Similarly, although a large majority of 85% report that they have "never" or "rarely" driven after the consumption of alcohol over the legal limit (CD11), they express this view to a lesser extent than drivers in the other two clusters. Almost half of them (46.2%) agree "fairly" or "very much" that their friends would drink and drive (CD09D) (Table 2), an opinion which they express to a higher degree than drivers in Cluster 2 and Cluster 3.

Speed limiting devices

Furthermore, more than one third (37%) of them are "not much" or "not at all" in favor of speed limiting devices fitted to cars (CO06A) (Table 2) and express this negative attitude to a higher degree than drivers in the other clusters.

Handheld phone

Almost half of them (48%) report that they "often", "very often" or "always" make or answer a call with a handheld phone (CD23D) , which is to a higher degree than drivers in the other two clusters (Table 2).

Automated cameras

Almost 43% are "not much" or "not at all" in favor of speeding surveillance by automated cameras (CO07B) (Table 2), an attitude which they express to a higher degree than drivers in the other clusters. Noticeably, drivers in Cluster 1 do not favor speeding surveillance at all to a higher degree (19%) than the other clusters.

Fines for speeding

A clear majority (77%) reported that they had received no fine at all (CD06), representing the lowest percentage among the three clusters.

Alcolock

A clear majority of 73% are "very" or "fairly" in favor of the use of an alcolock (CO06C), i.e. they are generally positive but to a lesser extent than Cluster 3 and equally as positive as Cluster 2 (Table 2).

Hands-free phone

Almost one third (34%) of drivers in Cluster 1 admit that they "often", "very often" or "always" make or answer calls with a hands-free phone (CD23E), which is to a higher degree than drivers in the other clusters (Table 2).

Insert Figure 1

Table 2
Cluster 1 profile

	Never		Rarely		Sometimes		Often		Very often		Always	
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)
QCD04. Over the next month, how likely or not would you be to drive at 20km/h over the speed limit in a residential area?												
	2	1.1	39	21.5	48	26.5	58	32.0	28	15.5	6	3.3
QCD23D. When driving a car how often do you make/answer a call with handheld phone												
	12	6.6	25	13.8	56	30.9	42	23.2	27	14.9	19	10.5
QCD23E. When driving a car how often do you make/answer a call with hand free phone?												
	31	17.1	48	26.5	40	22	38	21	17	9.4	7	3.9
	Never		Rarely		Sometimes		Often		Very often			
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)		
QCD10. Over the last month, how often have you driven a car after having drunk even a small amount of alcohol?												
	54	29.8	58	32.0	50	27.6	16	8.8	3	1.7		
QCD11. Over the last month, how often did you drive a car, when you may have been over the legal limit for drinking and driving?												
	116	64.1	39	21.5	21	11.6	4	2.2	1	0.6		
	Very		Fairly		Not much		Not at all					
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)				
QCO06A. How much would you be in favour of using speed limiting devices fitted to cars that prevented drivers exceeding the speed limit?												
	17	9.4	98	54.1	39	21.5	27	14.9				
QCO06C. How much would you be in favour of using an "alcolock" that prevented the car to start if the driver exceeds the legal alcohol limit ?	66	36.5	67	37.0	24	13.3	24	13.3				
QCO07B. How much would you be in favour of surveillance of speeding at a single point by automated cameras?												
	20	11.0	82	45.3	44	24.3	35	19.3				
QCD03E. How much do you agree with the statement "Most of your friends would drive 20km/h over the speed limit in a residential area"?	49	27.1	93	51.4	36	19.9	3	1.7				
QCD09D. How much do you agree with the statement "Most of your friends would drink and drive a car"?												
	4	2.2	79	43.6	90	49.7	8	4.4				

3.2 Cluster 2

Variables which mainly contribute to differentiating drivers of Cluster 2 (consisting of 221 drivers), are drivers' attitudes towards the use of alcolocks, speed limiting devices fitted to cars and speeding surveillance by automated cameras (Table 3). Other variables which differentiate the drivers in Cluster 2 are drivers' perceptions regarding their friends' speeding behavior and the likelihood of drivers driving at 20km/h over the speed limit in a residential area. Interestingly, the variable referring to drivers' perceptions of "how often making/answering a call with a handheld phone would be an accident causal factor" differentiate only the drivers in this cluster (Figure 2).

Speeding and drink-driving countermeasures

The majority of drivers in Cluster 2 (68%) are "fairly" in favor and a large majority (79%) "fairly" and "very much" in favor of the use of alcolocks (CO06C) (Table 3), which is to a higher degree than drivers in Cluster 1 and to a lesser extent than drivers in Cluster 3. A clear majority of drivers in this cluster (81%) are "very much" and "fairly" in favor of the use of speed limiting devices (CO06A) (Table 3). More than half of them (58%) are "fairly" and "very much" in favor of speeding surveillance by automated cameras (CO07B) (Table 3). They seem to support speeding and drinking countermeasures to a lesser extent than drivers in Cluster 3 and to a higher degree than drivers in Cluster 1.

Speeding

A large majority of drivers in Cluster 2 (76%) agree "not much" and "not at all" with the statement that most of their friends would drive 20km/h over the speed limit

in a residential area (CD03E) (Table 3); interestingly, more drivers in Cluster 3 than in Cluster 2 agree "fairly" or "very much" that most of their friends would drive 20km/h over the speed limit. The clear majority (71%) report that they would "never" or "rarely" drive at 20km/h over the speed limit in a residential area (CD04) (Table 3); that is to a higher degree than Cluster 1 and to a lesser extent than drivers in Cluster 3.

Accident causal factor – use of handheld phone

The variable representing drivers' perceptions of how often making/answering a call with a handheld phone would be an accident causal factor only differentiates Cluster 2 (CD24D), where the behavior is perceived as being "never", "rarely" or "sometimes" a cause of car drivers being involved in road accidents by the majority (61%). Drivers in Cluster 2 perceive it as being "often", "very often" or "always" an accident causal factor to a lesser extent than drivers in the other clusters.

Drinking and driving (friends' behavior)

A large majority (91%) of them perceive that most of their friends would drink and drive "not at all" and "not much" (CD09D) (Table 3), an attitude which they express to a higher degree than drivers in Cluster 3.

Fines for speeding

The large majority (99%) of drivers in this cluster reported that they had received no fines for speeding (CD06).

Handheld phone

Fewer than half of them (48%) report that when driving a car they "never" or "rarely" make or answer a call with a handheld phone (CD23D) (Table 3). This percentage is higher than that of Cluster 1 (21%) and lower than that of Cluster 3 (70%). They report some use of a handheld phone to a higher degree than Cluster 3 and to a lesser extent than Cluster1.

Hands-free phone

A clear majority (77%) of them report that they "never" or "rarely" make or answer a call with a hands-free phone (CD23E), that is, to a higher degree than Cluster 1 (21%) and to a lesser extent than Cluster 3.

Insert Figure 2

Table 3
Cluster 2 profile

	Never		Rarely		Sometimes		Often		Very often		Always	
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)
QCD04. Over the next month, how likely or not would you be to drive at 20km/h over the speed limit in a residential area?												
	53	24.0	112	50.7	45	20.4	9	4.1	2	0.9	0	0.0
QCD23D. When driving a car how often do you make/answer a call with handheld phone												
	26	11.8	79	35.7	69	31.2	23	10.4	22	10.0	2	0.9
QCD23E. When driving a car how often do you make/answer a call with hand free phone?												
	73	33	76	34.4	45	20.3	9	4.1	15	6.8	3	1.4

	Never		Rarely		Sometimes		Often		Very often	
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)
QCD10. Over the last month, how often have you driven a car after having drunk even a small amount of alcohol?										
	154	69.7	52	23.5	14	6.3	1	0.5	0	0.0
QCD11. Over the last month, how often did you drive a car, when you may have been over the legal limit for drinking and driving?										
	207	93.7	13	5.9	1	0.5	0	0.0	0	0.0

	Very		Fairly		Not much		Not at all	
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)
QCO06A. How much would you be in favour of using speed limiting devices fitted to cars that prevented drivers exceeding the speed limit?								
	8	3.6	170	76.9	40	18.1	3	1.4
QCO06C. How much would you be in favour of using an "alcolock" that prevented the car to start if the driver exceeds the legal alcohol limit ?	25	11.3	152	68.8	43	19.5	1	0.5
QCO07B. How much would you be in favour of surveillance of speeding at a single point by automated cameras?								
	18	8.1	111	50.2	81	36.7	11	5.0
QCD03E. How much do you agree with the statement "Most of your friends would drive 20km/h over the speed limit in a residential area"?	1	0.5	50	22.6	135	61.1	35	15.8
QCD09D. How much do you agree with the statement "Most of your friends would drink and drive a car"?								
	1	0.5	20	9.0	121	54.8	79	35.7

3.3 Cluster 3

The variables that are most important in differentiating Cluster 3 (consisting of 199 drivers) are drivers' attitudes towards speed limiting devices fitted to cars, alcolocks and speed surveillance by automated cameras. Other variables that differentiate the drivers in Cluster 3 are the "likelihood of drivers driving at 20km/h over the speed limit in a residential area" and the self-reported frequency of handheld phone use while driving. Cluster 3 report safe driving behaviors and express safety-oriented attitudes to a higher degree than the other clusters. Interestingly, the perceived frequency of drinking and driving as an accident causal factor differentiates only Cluster 3 (Figure 3).

Speed limiting devices and alcolocks

A clear majority (75%) of drivers in this cluster are "very much" in favor of speed limiting devices fitted to cars (CO06A) (Table 4) and the large majority (98%) are "very much" and "fairly" in favor. The corresponding percentages of drivers with favorable views towards the use of alcolocks (CO06C) are similar or even higher are (88% being "very much" in favor and 100% "very much" or "fairly" in favor) (Table 4).

Speeding surveillance

A large majority of the drivers in this cluster (88%) are "very much" or "fairly" in favor of speeding surveillance by automated cameras (CO07B) while 67% are very much in favor (Table 4), which is a higher percentage than drivers in the other clusters.

Speeding behavior

A large majority of them (85%) report that they would “never” or “rarely” drive at 20km/h over the speed limit in a residential area (CD04) (Table 4), with more than half of them (56%) stating that they would “never” do so to a much higher degree than by drivers in the other clusters.

Handheld phone

A clear majority of 70% report that they “never” or “rarely” make or answer a call with a handheld phone (CD23D), representing the highest of the corresponding percentages in the three clusters (Table 4).

Drinking and driving

A large majority of drivers in this cluster (84%) report that they have “never” driven a car after having drunk even a small amount of alcohol over the last month (CD10) (Table 4), which is to a higher degree than drivers in the other clusters (Cluster1), while 87% of them perceive that most of their friends would drink and drive “not at all” or “not much” (CD09D), yet they have this view to a lesser degree than drivers in Cluster 2. The large majority of the drivers in this cluster (96%) report that they had “never” driven a car after consuming alcohol over the legal limit over the last month (CD11) (Table 4).

Hands-free phone

The majority (73%) report that when driving a car they “never” or “rarely” make or answer a call with a hands-free phone (CD23E) . Similarly, they report no hands-free phone use to a higher degree than drivers in the other clusters.

Speeding-friends

More than one-third of them (38%) agree “fairly” or “very much” with the statement that their friends would drive 20km/h over the speed limit in a residential area (CD03E) (Table 4), believe this to a higher degree than drivers in Cluster 2.

Cause of an accident - drinking and driving

A large majority (80%) of drivers in Cluster 3 think that drinking and driving is “very often” and “always” the cause of a car driver being involved in a road accident (CD24B). It is noted that this is a differentiating variable only for this cluster, this view being expressed by drivers in Cluster 3 to a higher degree than the other clusters.

Insert Figure 3

Table 4
Cluster 3 profile

	Never		Rarely		Sometimes		Often		Very often		Always	
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)
QCD04. Over the next month, how likely or not would you be to drive at 20km/h over the speed limit in a residential area?												
	111	55.8	57	28.6	21	10.6	7	3.5	3	1.5	0	0.0
QCD23D. When driving a car how often do you make/answer a call with handheld phone												
	72	36.2	65	32.7	44	22.1	11	5.5	4	2.0	3	1.5
QCD23E. When driving a car how often do you make/answer a call with hand free phone?												
	104	52.3	42	21.1	24	12.1	11	5.5	6	3	12	6

	Never		Rarely		Sometimes		Often		Very often	
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)
QCD10. Over the last month, how often have you driven a car after having drunk even a small amount of alcohol?										
	167	83.9	24	12.1	7	3.5	0	0.0	1	0.5
QCD11. Over the last month, how often did you drive a car, when you may have been over the legal limit for drinking and driving?										
	191	96.0	7	3.5	0	0.0	0	0.0	1	0.5

	Very		Fairly		Not much		Not at all	
	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)	Frequency	Percent(%)
QCO06A. How much would you be in favour of using speed limiting devices fitted to cars that prevented drivers exceeding the speed limit?								
	150	75.4	46	23.1	3	1.5	0	0.0
QCO06C. How much would you be in favour of using an "alcolock" that prevented the car to start if the driver exceeds the legal alcohol limit ?	175	87.9	24	12.1	0	0.0	0	0.0
QCO07B. How much would you be in favour of surveillance of speeding at a single point by automated cameras?								
	134	67.3	42	21.1	18	9.0	5	2.5
QCD03E. How much do you agree with the statement "Most of your friends would drive 20km/h over the speed limit in a residential area"?	12	6.0	64	32.2	67	33.7	56	28.1
QCD09D. How much do you agree with the statement "Most of your friends would drink and drive a car"?								
	9	4.5	18	9.0	81	40.7	91	45.7

3.4 Respondents' characteristics

Gender

A clear majority of drivers in Cluster 1 are male. In Cluster 2, male drivers predominate (56.5%), while in Cluster 3, the majority are female drivers. In Cluster 1, the proportion of male drivers (67.4%) is higher than in Cluster 3 (48.2%) when the proportions are compared at 95% confidence level (Table 5).

Age

The large majority of Cluster 1 participants are drivers younger than 55 (93.9%). In Clusters 2 and 3, drivers under 55 predominate, with percentages three and four times those of the 55+ group, respectively. At 95% confidence levels, the proportion of drivers younger than 55 in Cluster 1 (93.9%) is higher than the corresponding proportion in Cluster 2 (80.1%) and Cluster 3 (74.4%) (Table 5).

It is worth noting that in Cluster 1, the proportion of drivers aged 17-24 (12.2%) is higher than in Cluster 2 (7.2%) and Cluster 3 (4.5%). The percentages of drivers aged 55-64 and 65+ in Cluster 3 are higher than in Cluster 1, while in Cluster 3 the percentage of drivers over 65 (12.6%) is higher than in Cluster2 (Table 5).

It follows that Cluster 1 clearly consists of drivers younger than 55 (93.9%), while the percentage of young drivers (17-24) (12.2%) is higher than in the other clusters. Clusters 2 and 3 have different percentages of young (17-24) and older drivers (65+): in Cluster 2 the percentage of young drivers is relatively high in comparison to Cluster 3, while in Cluster 3 the percentage of older drivers (65+) is higher than in Cluster 2.

Area of residence

In all clusters, the majority of respondents live in urban and suburban areas. At 95% confidence level, the percentage of drivers in Cluster 1 living in rural areas and small towns is higher than the corresponding percentages in Cluster 2 (Table 5).

Education level

In all clusters, the majority of respondents have completed primary and secondary education, with the corresponding percentages being 66.3% of Cluster 1, 70.6% of Cluster 2 and 71.9% of Cluster 3 (Table 5).

Table5
Clusters description: Percentage with specific demographic characteristics and corresponding confidence intervals (a=0.05).

		Cluster 1			**Cluster 2**			**Cluster 3**		
		Percentage	Confidence interval		Percentage	Confidence interval		Percentage	Confidence interval	
Gender	Males	67.4	60.6	74.2	56.6	50.0	63.1	48.2	41.3	55.2
	Females	32.6	25.8	39.4	43.4	36.9	50.0	51.8	44.8	58.7
Age	17-24	12.2	7.4	16.9	7.2	3.8	10.7	4.5	1.6	7.4
	25-34	27.1	20.6	33.5	23.1	17.5	28.6	19.6	14.1	25.1
	35-44	36.5	29.5	43.5	29.9	23.8	35.9	31.2	24.7	37.6
	45-54	18.2	12.6	23.9	19.9	14.6	25.2	19.1	13.6	24.6
	55-64	4.4	1.4	7.4	13.1	8.7	17.6	13.1	8.4	17.7
	65+	1.7	-0.2	3.5	6.8	3.5	10.1	12.6	8.0	17.2
Area of residence	Rural & small towns	42.5	35.3	49.7	29.0	23.0	34.9	29.6	23.3	36.0
	Urban & suburban	57.5	50.3	64.7	71.0	65.1	77.0	70.4	64.0	76.7
Educational level	Primary & Secondary	66.3	59.4	73.2	70.6	64.6	76.6	71.9	65.6	78.1
	Further	33.7	26.8	40.6	29.4	23.4	35.4	28.1	21.9	34.4

3.5 Comparative analysis of clusters

This research investigated drivers' self-reported behavior and attitudes to risky behaviors related to the traffic violations of speeding, drink-driving and cell phone use and the existing relationships with drivers' age, gender and area of residence. Using cluster analysis three clusters were identified. Drivers in Cluster 1 commit traffic violations more often; drivers in Cluster 2 favor traffic violation countermeasures while having moderate views toward compliance with traffic rules; and drivers in Cluster 3 strongly support traffic violation countermeasures and compliance with traffic rules.

The main variables that differentiate Cluster 1 refer to speeding (likelihood to engage in speeding and perceived speeding behavior of their friends) and drink-driving behavior (self-reported and perceived behavior of friends). It is worth noticing that among these variables are drivers' perceptions regarding their friend's relevant behaviors. Other variables statistically significant in differentiating the drivers in this cluster refer to drivers' support of speed limiting devices and the use of handheld phone while driving.

Specifically, the majority of drivers in Cluster 1 (who commit traffic violations more often), report speeding, drink and driving related behaviors and phone use while driving to a higher degree than the other clusters. Although the majority reported that they had received no fine for breaking the speed limit, a higher proportion of Cluster 1 drivers had received a fine than drivers in the other clusters. Their majority report that they "never" or "rarely" drive after having consumed even a small amount of alcohol

and a clear majority report that they "never" or "rarely" drive after the consumption of alcohol over the legal limit), but this is to a lesser extent than the drivers in the other clusters. They generally believe that their friends would exhibit speeding behavior, and to a higher degree than the other clusters. Although fewer than half of them believe that their friends would drink and drive, they believe this to a higher degree than the other clusters. Drivers who commit traffic violations more often have a less positive attitude to speeding countermeasures (speeding surveillance and speed limiting devices). Half of them admit "often", "very often" or "always" using a handheld phone and one third of them, a hands-free phone. Their self-reported use of a cell phone while driving is to higher degree than the other clusters.

The variables which mainly differentiate drivers in Cluster 2 refer to their support of traffic violation countermeasures, that is, the use of alcolocks, speed limiting devices fitted to cars and speeding surveillance by automated cameras. Other variables refer to speeding behavior and their perceptions regarding their friends' speeding and drink-driving behavior. Interestingly, drivers' perceptions of how often making/answering a call with a handheld phone would be an accident causal factor differentiates only drivers in this cluster.

The majority of drivers in Cluster 2 (who favor traffic violation countermeasures while having moderate views toward compliance with traffic rules) are generally positive to road safety countermeasures (alcolocks, speed limiting devices and speeding surveillance), yet express moderate support compared to drivers in Cluster 3, who strongly support compliance with traffic rules. They also express less critical attitudes towards their friends' behavior regarding speeding as well as drinking and driving than drivers who strongly support compliance with traffic rules (Cluster 3). Almost one in four reports speeding "sometimes" while almost all of them had received no fines for speeding. Their self-reported use of handheld phones is lower than drivers who commit traffic violations more often (Cluster 1)and higher than drivers who strongly support compliance with traffic rules (Cluster 3). About half of them - (52%) - report "sometimes", "often", "very often" and "always" using a handheld phone, while one in four also report "sometimes", "often", "very often" or "always" using a hands-free phone while driving. Their overall self-reported phone use while driving is lower than the drivers who commit traffic violations more often but higher than the drivers who strongly support compliance with traffic rules. Yet, "making/answering a call with handheld phone would be an accident causal factor" differentiates only this cluster, and they have this opinion to a less extent than drivers in the other clusters: almost one in three believe (36%) that making/answering a call with a handheld phone would "often" or "very often" be an accident causal factor.

The variables that are most important in differentiating Cluster 3 refer to their support of traffic violation countermeasures (speed limiting devices fitted to cars, alcolocks and speed surveillance by automated cameras). It is worth noticing, that drivers in Cluster 3 report safe driving behaviors and express safety-oriented attitudes to a higher degree than the other clusters. Other variables that differentiate the drivers in Cluster 3 refer to speeding behavior and handheld phone use while driving. It is noted that the perceived frequency of drinking and driving as an accident causal factor differentiates only the drivers in Cluster 3. The large majority of the drivers in Cluster 3 (who strongly support traffic violation countermeasures, also have strong views toward compliance with traffic rules) are very positive to speeding and drink-driving countermeasures and have more favorable views towards countermeasures than the drivers in the other clusters. A clear majority report that they "never" drive after having drunk even a small amount or when over the legal limit. The majority do not believe that their friends would exhibit speeding and drink-driving behavior but,

interestingly they express this belief to a lesser extent than drivers with moderate views toward compliance with traffic rules (Cluster 2). The majority report no use of the cell phone (hands-free and handheld) while driving to higher degree than the other clusters. Drink-driving being a cause of a car driver's involvement in a road accident differentiates only this cluster, with a clear majority having this view.

The majority of drivers in all clusters are younger than 55, with the highest percentage in Cluster1 (drivers who commit traffic violations more often). At 95% confidence level, the proportion of drivers younger than 55 in Cluster 1 is higher than in the cluster consisting of drivers with moderate views toward compliance with traffic rules (Cluster 2) and the cluster of drivers who strongly support compliance with traffic rules (Cluster 3). It is noted that, compared to the other clusters, drivers who commit traffic violations more often have the highest percentage of drivers between the ages of 17 and 24. Furthermore, the group of drivers with moderate views has a higher percentage of young drivers (17-24) than the group of drivers with strong views, which in turn, has a higher percentage of older drivers (65+).

A clear majority of drivers who commit traffic violations more often (Cluster 1) and the majority of drivers who favor traffic violation countermeasures while having moderate views toward compliance with traffic rules (Cluster 2) are male drivers. The majority of drivers who strongly support traffic violation countermeasures and have strong views toward compliance with traffic rules (Cluster 3) is female. The majority of respondents in all three clusters live in urban areas and suburban areas. Interestingly, the percentage of drivers who commit traffic violations more often living in rural areas and small towns is higher when compared to the other clusters. The majority of respondents in all groups have completed primary and secondary education.

4. DISCUSSION

Previous research has indicated that those attitudes and beliefs specific to individual behaviors appear to be the strongest predictors of risky driving; in particular, different driving behaviors (e.g., speeding, aggressive driving, drink-driving, etc.) seem to have different predictors (Fernandes et al., 2006).

The present research investigated drivers' self-reported behaviors and their attitudes to driving violations and perceived acceptance of violation countermeasures using a clustering procedure. The research identified risky behaviors and related attitudes that differentiate three distinct groups of drivers (clusters): drivers who commit traffic violations more often; those who favor traffic violation countermeasures while having moderate views toward compliance with traffic rules; and those drivers who strongly support traffic violation countermeasures and who also have strong views toward compliance with traffic rules. Furthermore, the demographic characteristics of age, gender, the area of residence and educational level of drivers in the clusters were determined.

The main variables that differentiate the drivers in cluster 1 -who commit traffic violations more often- refer to speeding and drink-driving behavior, while among the variables of a lower ranking are drivers' perceptions regarding their friend's relevant behaviors. The variables which mainly differentiate the drivers in cluster 2 -who favor traffic violation countermeasures while having moderate views toward compliance with traffic rules- refer to their support of traffic violation countermeasures, that is, the use of alcolocks, speed limiting devices fitted to cars and speeding surveillance by automated cameras. Other variables refer to speeding behavior and their perceptions

regarding their friends' speeding and drink-driving behavior. Interestingly, drivers' perceptions of how often making/answering a call with a handheld phone would be an accident causal factor differentiates only drivers in this cluster. The variables that are most important in differentiating drivers in cluster 3 -who strongly support traffic violation countermeasures and who also have strong views toward compliance with traffic rules- refer to their support of traffic violation countermeasures (speed limiting devices fitted to cars, alcolocks and speed surveillance by automated cameras).

The majority of the drivers in all the clusters are drivers younger than 55, with the highest percentage in the cluster of drivers who commit traffic violations more often. Compared to the other clusters, drivers who commit traffic violations more often have the highest percentage of drivers between the ages of 17 and 24. Furthermore, the group of drivers who strongly support traffic violation countermeasures and compliance with traffic rules has a higher percentage of older drivers (65+) than the other groups. The group of drivers who favor traffic violation countermeasures and have moderate views toward compliance with traffic rules (cluster 2) has a higher percentage of young drivers (17-24) than the group of drivers who strongly support traffic violation countermeasures and compliance with traffic rules (cluster 3). A clear majority of drivers who commit traffic violations more often are male. The majority of drivers with moderate views are male while the majority of drivers who strongly support traffic violation countermeasures and have strong views toward compliance with traffic rules are female. The majority of drivers in all three clusters live in urban and suburban areas. It was also found that the percentage of drivers who commit traffic violations more often living in rural areas and small towns is higher than in the other groups. The majority of drivers in all clusters have completed primary and secondary education. The findings indicate that differences in attitudes and behaviors may be attributed to factors such as age, gender and area of residence, being generally in line with other research in this area and implying varying traffic safety subcultures among the driver population (TRB, 2010c). The present research used data concerning self-reported behavior, likely behavior and normative beliefs regarding different risky behaviors. It does not examine an extensive range of factors, such as behavioral beliefs, beliefs about the outcomes of the behavior, perceived risk or perceived control, personality factors or traits (Forward, 2009), (Horwath et al., 2011) which may motivate drivers' engagement in the particular behaviors (i.e. speeding, drinking and driving mobile phone use).

Limitations of the research, which are common in research on self reported-data, concern validity and probable inaccuracy of recall or report. It is worth noticing however, that as discussed in previous studies, violations are deliberate acts and thus they may be easier to recall than other types of errors (Kontogiannis et al. 2002). Research has shown (Fernandes et al., 2007) significant correlation between self-reported speeding intentions and observed driving speed.

The need to address unsafe behaviors by encouraging public recognition and understanding of prevailing cultural and attitudinal settings and accepted views that compromise road safety improvements as well as increasing public support for implementation of measures to improve safety has been recognized as a major challenge of the safe system approach (Howard & Sweatman, 2007). The present research provided some insights regarding the community's current level of attitudes as well as perceptions of social norms (Eby and Bingham, 2007), and might provide the background for specific education campaigns tailored to the intended audience (Allen et al., 2007) which might aim at the perceived legitimacy of actions/interventions, such as implementation of enforcement programs or introduction of legislation (McKenna, 2007).

The research findings might be regarded as a contribution to the identification of distinct attitudes of drivers towards specific unsafe behaviors, especially those which negatively affect traffic safety. This information may lead to the design and implementation of safety interventions targeting relevant driver populations and support in defining relevant priorities. The pattern of drivers' views of violations may form the basis of risk behavior-related interventions tailored to the identified groups, aiming at informing, educating and raising the awareness of the public.

6. REFERENCES

AAA Foundation for Traffic Safety, 2012. Traffic Safety Culture Index. Retrieved from http://www.aaafts.org/pdf/2011TSCindex.pdf

Aarts L., Van Schagen I., 2006. Driving speed and the risk of road crashes: A review. Accident Analysis & Prevention, 38, 215-224.

Allen, P., Mercer, G. William, 2007. The role of public surveys in measuring program effectiveness and improving road safety. In *Improving Traffic Safety Culture in the United States. The Journey Forward*, AAA Foundation for Traffic Safety, Washington, D.C..
Retrieved from http://www.aaafoundation.org/pdf/safetyculturereport.pdf

Austroads 2011. The Nature of Errors Made by Drivers. Austroads Publication No. AP-R378/11. ISBN 978-1-921709-68-5.

Department for Transport, 2011. Behavioural insights Toolkit. Social research and Evaluation Division, Department for Transport. Retrieved from: http://assets.dft.gov.uk/publications/behavioural-insights-toolkit/toolkit.pdf

Drews, F., Strayer, D., 2008. Cellular Phones and Driver Distraction. In *Driver Distraction: Theory, Effects and Mitigation*, CRC Press. (Edited by Regan M., A., Lee, J., D., Young, K., L.).

Eby, D.W., Bingham, C.R., 2007. Customised driver feedback and traffic-safety culture. In *Improving Traffic Safety Culture in the United States. The Journey Forward*, AAA Foundation for Traffic Safety, Washington, D.C..
Retrieved from http://www.aaafoundation.org/pdf/safetyculturereport.pdf

Everitt, S. B., Landau, S., Leese, M., Stahl, D., 2011. Cluster Analysis, 5th Edition, Wiley. ISBN-13:978-0-470-74991-3.

Fernandes, R., Soames, Job, R.F., Hatfield, J., 2007. A challenge to the assumed generalizability of prediction and countermeasure for risky driving: Different factors predict different risky driving behaviors. *Journal of Safety Research, 38*, 59-70.

Forward, S., E., 2009. An assessment of what motivates road violations. Transportation Part F 12, 225-234.

Foss, R., 2007. Addressing behavioral elements in traffic safety: A recommended approach. In *Improving Traffic Safety Culture in the United States. The Journey Forward*, AAA Foundation for Traffic Safety, Washington, D.C..
Retrieved from http://www.aaafoundation.org/pdf/safetyculturereport.pdf

Horvath, C., Lewis, I., Watson, B., 2012. The belief which motivate young male and female drivers to speed: A comparison of low and high intenders. *Accident Analysis and Prevention, 45*, 334-341

Howard, E. Sweatman, P., 2007. Road safety culture development for substantial road trauma reduction: Can the experience of the state of Victoria, Australia, be applied to achieve road safety improvement in North America?. In *Improving Traffic Safety Culture in the United States. The Journey Forward*, AAA Foundation for Traffic Safety, Washington, D.C..

Retrieved from http://www.aaafoundation.org/pdf/safetyculturereport.pdf

Kanellaidis, G., Golias, J., Zarifopoulos, K., 1995. A survey of drivers' attitudes toward speed imit violations. *Journal of Safety Research. 26*, 1, 31-40.

Karlaftis, M.G., Kotzampassakis, I., Kanellaidis, G., 2003. An empirical investigation of European drivers' self-assessment. *Journal of Safety Research, 34*, 207-213.

Kontogiannis, T., Kossiavelou, Z., Marmaras, N., 2002. Self-reports of aberrant behavior on the roads: errors and violations in a sample of Greek drivers. *Accident Analysis and Prevention 34*, 381-399.

Lahausse, J., A., van Nes, N., Fildes, B., Keall, M., D., 2010. Attitudes towards current and lowered speed limits in Australia. *Accident Analysis and Prevention 42*, 2108-2116.

McKenna, F., P., 2007. The perceived legitimacy of intervention: A key feature for road safety. In *Improving Traffic Safety Culture in the United States. The Journey Forward*, AAA Foundation for Traffic Safety, Washington, D.C..
Retrieved from http://www.aaafoundation.org/pdf/safetyculturereport.pdf

Moeckli, J., Lee, J.D., 2007. The making of driving cultures. In *Improving Traffic Safety Culture in the United States. The Journey Forward*, AAA Foundation for Traffic Safety, Washington, D.C..
Retrieved from http://www.aaafoundation.org/pdf/safetyculturereport.pdf

Parker, D., Reason, J. T., Manstead, S. R., Stradling, S., G., 1995. Driving errors, driving violations and accident involvement. Ergonomics 38 (5), 1036-1048.

Romano, E., O., Peck, C., R., Voas, R., B., 2012. Traffic environment and demographic factors affecting impaired driving and crashes. *Journal of Safety Research, 43*, 75-82.

Social Attitudes towards Road Traffic Risk in Europe, SARTRE 4, 2011. http://www.attitudes-roadsafety.eu/. (May 18, 2011).

Stanton, N., A., Salmon, P., M., 2009. Human error taxonomies applied to driving: A generic driver error taxonomy and its implications for intelligent transport systems. *Safety Science*, 47, 227-237.

Transportation Research Board (TRB), 2010a. White Papers for the *web Stakeholder Workshop for "Toward Zero Deaths: A National Strategy on Highway Safety*", August 25-26, Washington, D.C. [White paper on Safer Drivers (White paper No.3)].

Transportation Research Board (TRB), 2010b. White Papers for the *web Stakeholder Workshop for "Toward Zero Deaths: A National Strategy on Highway Safety*", August 25-26, Washington, D.C. [White paper on Safer Vehicles (White paper No.4)].

Transportation Research Board (TRB), 2010c. White Papers for the *web Stakeholder Workshop for "Toward Zero Deaths: A National Strategy on Highway Safety*", August 25-26, Washington, D.C. [White paper on Traffic Safety Culture (White paper No.2)].

Valnaar, W., Yannis, G., 2006. Perception of road accident causes. *Accident Analysis and Prevention, 38*, 155-161.

Ward, N.J. 2007, The culture of traffic safety in rural America. In *Improving Traffic Safety Culture in the United States. The Journey Forward*, AAA Foundation for Traffic Safety, Washington, D.C..
Retrieved from http://www.aaafoundation.org/pdf/safetyculturereport.pdf

Yagil, D., 1998. Gender and age-related differences in attitudes toward traffic laws and traffic violations. *Transportation Research Part F, 1*, 123-135.

Young, K. & Regan, M. (2007). Driver distraction: A review of the literature. In: I.J. Faulks, M. Regan, M. Stevenson, J. Brown, A. Porter & J.D. Irwin (Eds.). Distracted driving. Sydney, NSW: Australasian College of Road Safety. Pages 379-4.

LIST OF FIGURES

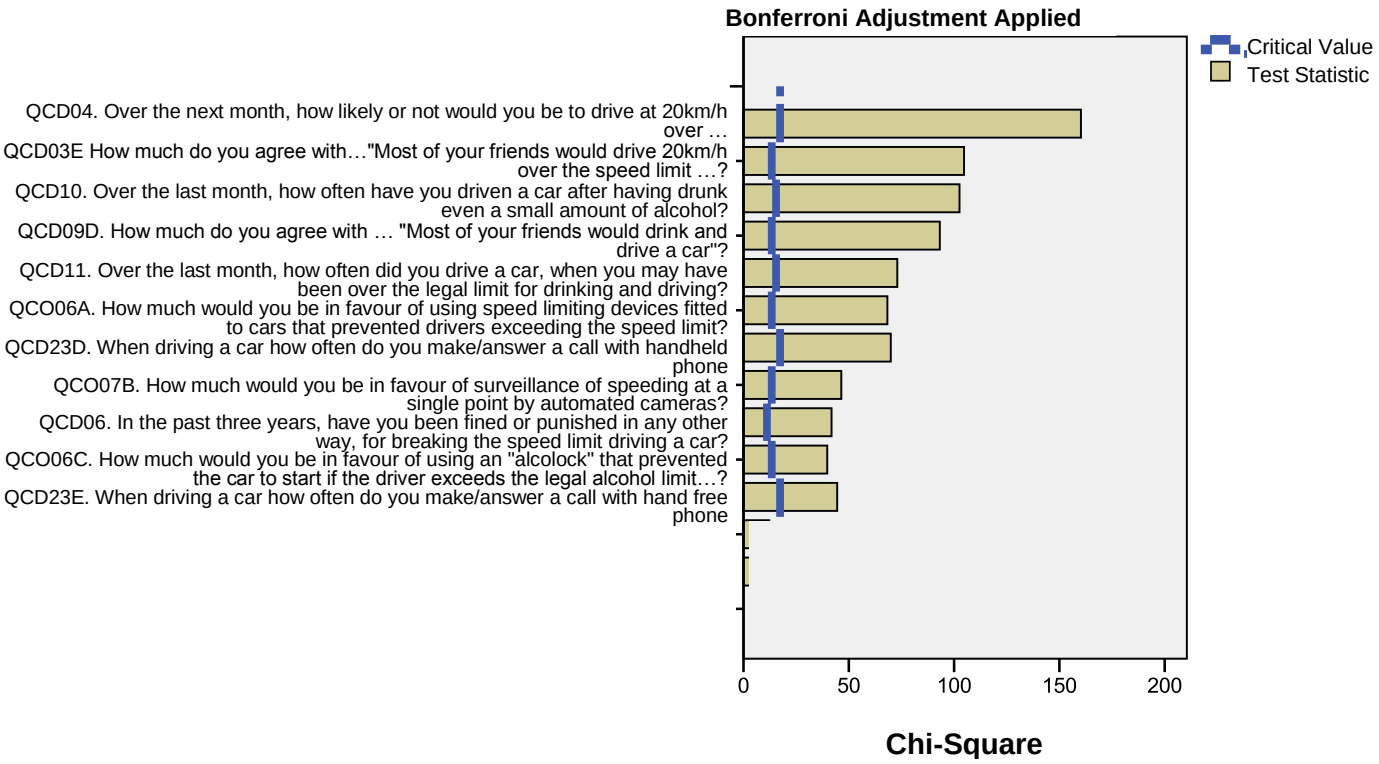


Figure 1. Two-step Cluster 1 variablewise importance plot.

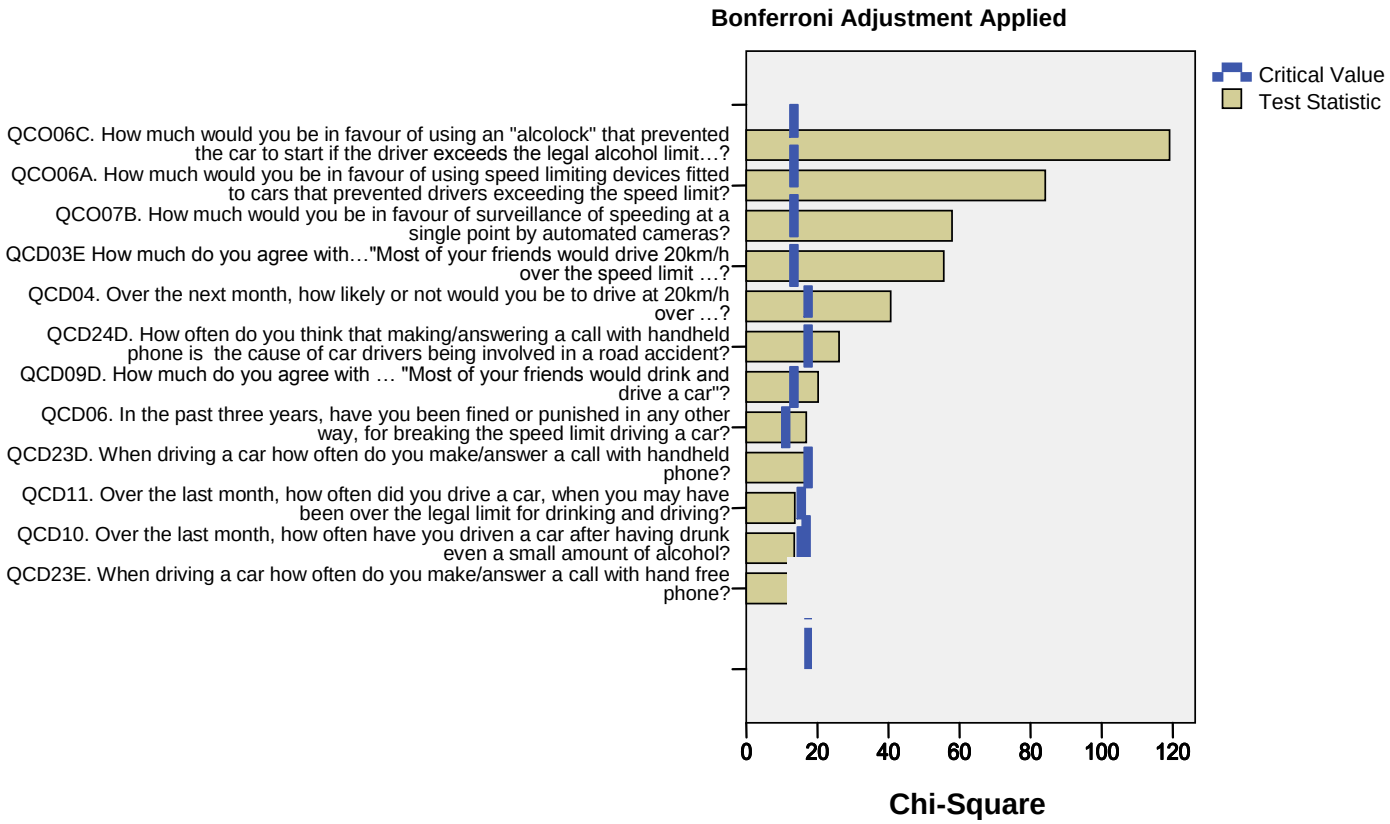


Figure 2. Two-step Cluster 2 variablewise importance plot.

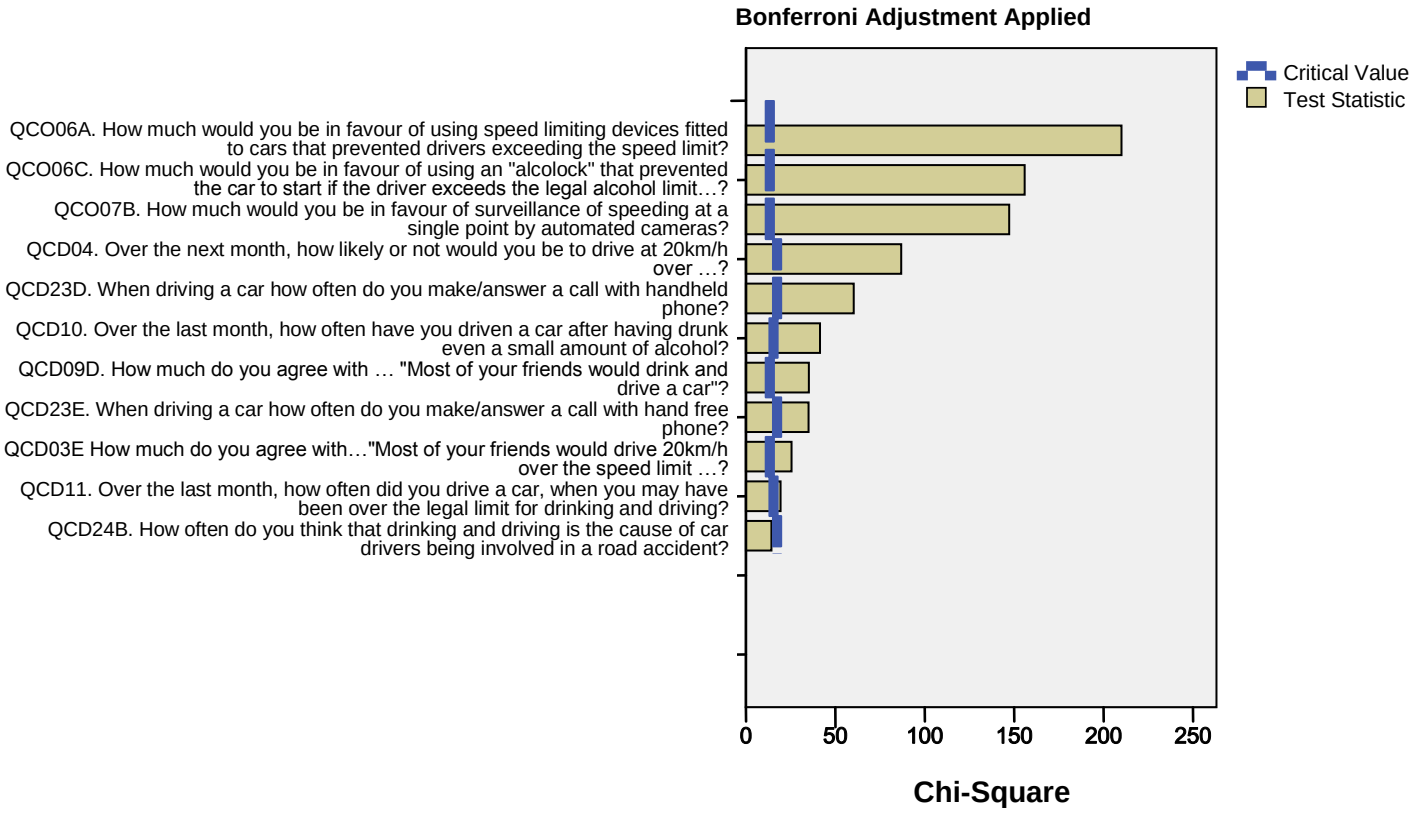
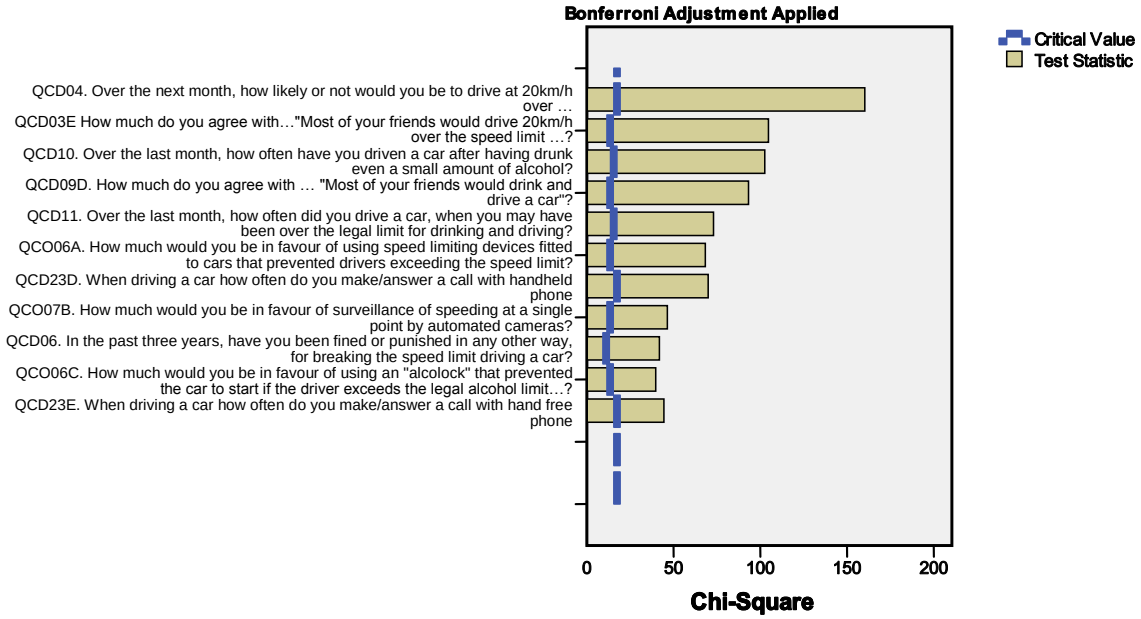


Figure 3. Two-step Cluster 3 variablewise importance plot.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Critical Value
Test Statistic
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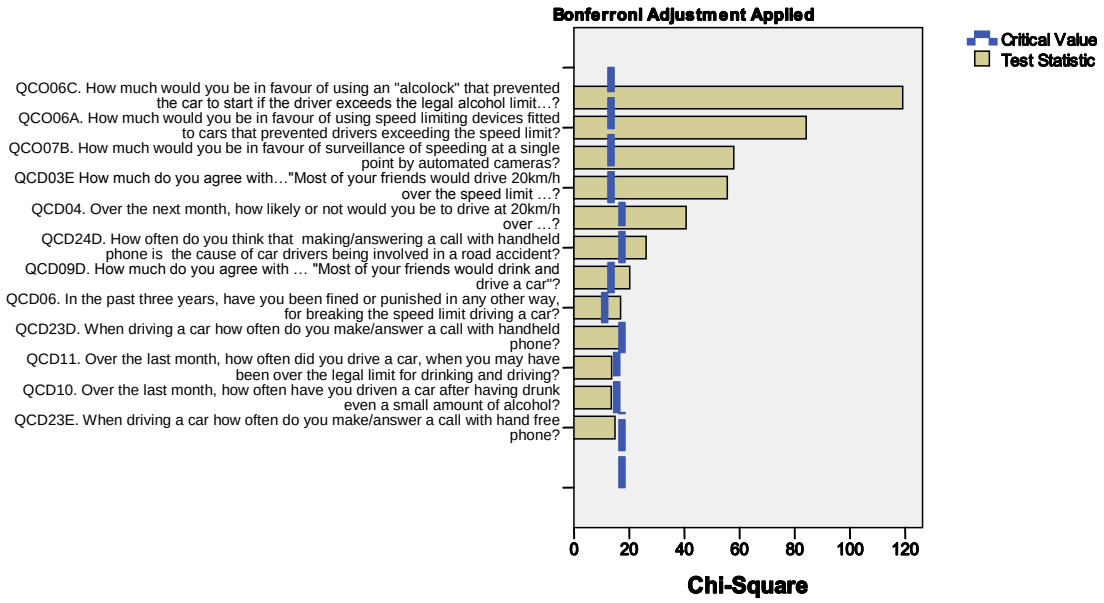
QCD03E How much do you agree with…"Most of your friends would drive 20km/h over the speed limit …?
QCD10. Over the last month, how often have you driven a car after having drunk even a small amount of alcohol?
QCD09D. How much do you agree with … "Most of your friends would drink and drive a car"?
QCD11. Over the last month, how often did you drive a car, when you may have been over the legal limit for drinking and driving?
QCO06A. How much would you be in favour of using speed limiting devices fitted to cars that prevented drivers exceeding the speed limit?
QCD23D. When driving a car how often do you make/answer a call with handheld phone
QCO07B. How much would you be in favour of surveillance of speeding at a single point by automated cameras?
QCD06. In the past three years, have you been fined or punished in any other way, for breaking the speed limit driving a car?
QCO06C. How much would you be in favour of using an "alcolock" that prevented the car to start if the driver exceeds the legal alcohol limit…?
QCD23E. When driving a car how often do you make/answer a call with hand free phone
0
50
100
150
200
Chi-Square

Figure 1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Critical Value
Test Statistic
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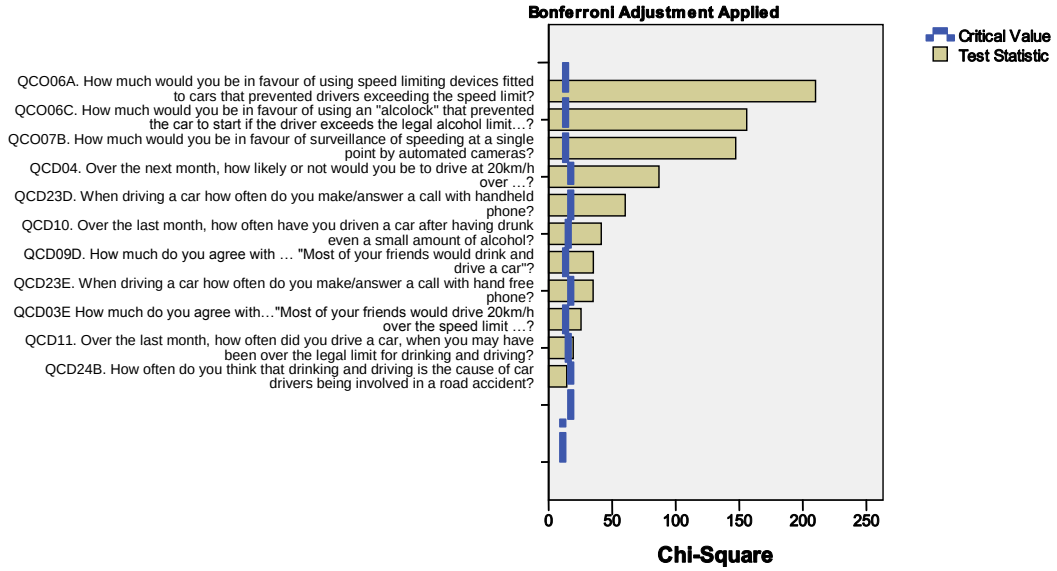
QCO06A. How much would you be in favour of using speed limiting devices fitted to cars that prevented drivers exceeding the speed limit?
QCO07B. How much would you be in favour of surveillance of speeding at a single point by automated cameras?
QCD03E How much do you agree with…"Most of your friends would drive 20km/h over the speed limit …?
QCD04. Over the next month, how likely or not would you be to drive at 20km/h over …?
QCD24D. How often do you think that making/answering a call with handheld phone is the cause of car drivers being involved in a road accident?
QCD09D. How much do you agree with … "Most of your friends would drink and drive a car"?
QCD06. In the past three years, have you been fined or punished in any other way, for breaking the speed limit driving a car?
QCD23D. When driving a car how often do you make/answer a call with handheld phone?
QCD11. Over the last month, how often did you drive a car, when you may have been over the legal limit for drinking and driving?
QCD10. Over the last month, how often have you driven a car after having drunk even a small amount of alcohol?
QCD23E. When driving a car how often do you make/answer a call with hand free phone?
0
20
40
60
80
100
120
Chi-Square

Figure 2.


Bonferroni Adjustment Applied
Critical Value
Test Statistic
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QCO06C. How much would you be in favour of using an "alcolock" that prevented the car to start if the driver exceeds the legal alcohol limit…?
QCO07B. How much would you be in favour of surveillance of speeding at a single point by automated cameras?
QCD04. Over the next month, how likely or not would you be to drive at 20km/h over …?
QCD23D. When driving a car how often do you make/answer a call with handheld phone?
QCD10. Over the last month, how often have you driven a car after having drunk even a small amount of alcohol?
QCD09D. How much do you agree with … "Most of your friends would drink and drive a car"?
QCD23E. When driving a car how often do you make/answer a call with hand free phone?
QCD03E How much do you agree with…"Most of your friends would drive 20km/h over the speed limit …?
QCD11. Over the last month, how often did you drive a car, when you may have been over the legal limit for drinking and driving?
QCD24B. How often do you think that drinking and driving is the cause of car drivers being involved in a road accident?
0
50
100
150
200
250
Chi-Square

Figure 3.

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