

The regional differences between countries in traffic safety: A cross-cultural study and Turkish Case

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To Gülgin and our child

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ABSTRACT

Road traffic accidents are a large problem everywhere in the world. However, regional differences in traffic safety between countries are considerable. For example, traffic safety records are much worse in Southern Europe and the Middle East than in Northern and Western Europe. Despite the large regional differences in traffic safety, factors contributing to different accident risk figures in different countries and regions have remained largely unstudied. The general aim of this study was to investigate regional differences in traffic safety between Southern European/Middle Eastern (i.e., Greece, Iran, Turkey) and Northern/Western European (i.e., Finland, Great Britain, The Netherlands) countries and to identify factors related to these differences. We conducted seven sub-studies in which I applied a traffic culture framework, including a multi-level approach, to traffic safety. We used aggregated level data (national statistics), surveys among drivers, and data on traffic accidents and fatalities in the analyses. In the first study, we investigated the influence of macro level factors (i.e., economic, societal, and cultural) on traffic safety across countries. The results showed that a high GNP per capita and conservatism correlated with a low number of traffic fatalities, whereas a high degree of uncertainty avoidance, neuroticism, and egalitarianism correlated with a high number of traffic fatalities. In the second, third, and fourth studies, we examined whether the conceptualisation of road user characteristics (i.e., driver behaviour and performance) varied across traffic cultures and how these factors determined overall safety, and the differences between countries in traffic safety. The results showed that the factorial agreement for driver behaviour (i.e., aggressive driving) and performance (i.e., safety skills) was unsatisfactory in Greece, Iran, and Turkey, where the lack of social tolerance and interpersonal aggressive violations seem to be important characteristics of driving. In addition, we found that driver behaviour (i.e., aggressive violations and errors) mediated the relationship between culture/country and accidents. Besides, drivers from “dangerous” Southern European countries and Iran scored higher on aggressive violations and errors than did drivers from “safe” Northern European countries. However, “speeding” appeared to be a “pan-cultural” problem in traffic. Similarly, aggressive driving seems largely depend on road users’ interactions and drivers’ interpretation (i.e., cognitive biases) of the behaviour of others in every country involved in the study. Moreover, in all countries, a risky general driving style was mostly related to being young and male. The results of the fifth and sixth studies showed that among young Turkish drivers, gender stereotypes (i.e., masculinity and femininity) greatly influence driver behaviour and performance. Feminine drivers were safety-oriented whereas

masculine drivers were skill-oriented and risky drivers. Since everyday driving tasks involve not only erroneous (i.e., risky or dangerous driving) or correct performance (i.e., normal habitual driving), but also “positive” driver behaviours, we developed a reliable scale for measuring “positive” driver behaviours among Turkish drivers in the seventh study. Consequently, I revised Reason’s model [Reason, J. T., 1990. Human error. Cambridge University Press: New York] of aberrant driver behaviour to represent a general driving style, including all possible intentional behaviours in traffic while evaluating the differences between countries in traffic safety. The results emphasise the importance of economic, societal and cultural factors, general driving style and skills, which are related to exposure, cognitive biases as well as age, sex, and gender, in differences between countries in traffic safety.

Keywords: Economy, culture, personality, young drivers, sex, gender, cognitive biases, driver behaviour and performance, and traffic accidents.

List of Publications

This thesis is based on the following articles, which are referred to in the text by their Roman numerals (I-VII).

- I Özkan, T., & Lajunen, T. (submitted). The role of personality, culture, and economy in unintentional injuries: An aggregated level analysis. (manuscript)
- II Özkan, T., Lajunen, T., Chliaoutakis, J., Parker, D., & Summala, H. (2006). Cross-cultural differences in driving behaviours: A comparison of six countries. *Transportation Research An International Journal Part F: Traffic Psychology and Behaviour*, 9, 227-242.
- III Özkan, T., Lajunen, T., Chliaoutakis, J., Parker, D., & Summala, H. (2006). Cross-cultural differences in driving skills: A comparison of six countries. *Accident Analysis and Prevention*, 38, 1011-1018.
- IV Özkan, T., Lajunen, T., Parker, D., Sümer, N. & Summala, H. (submitted). Cross-cultural differences and symmetric relationship between self and others in aggressive driving among British, Dutch, Finnish, and Turkish drivers. (manuscript)
- V Özkan, T., & Lajunen, T. (2005). Why are there sex differences in risky driving? The relationship between sex and gender-role on aggressive driving, traffic offences, and accident involvement among young Turkish drivers. *Aggressive Behavior*, 31 (6), 547-558.
- VI Özkan, T., Lajunen, T. (2006). What causes the differences in driving between young men and women? The effects of gender roles and sex on young drivers' driving behaviour and self-assessment of skills. *Transportation Research An International Journal Part F: Traffic Psychology and Behaviour*, 9, 269-277.
- VII Özkan, T., & Lajunen, T. (2005). A new addition to DBQ: Positive Driver Behaviours Scale. *Transportation Research An International Journal Part F: Traffic Psychology and Behaviour*, 8, 355-368.

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1. INTRODUCTION

Road traffic deaths accounted for 23% of all injury deaths worldwide in 2002. It has also been estimated that nearly 1.2 million people, male-to-female ratio being 2.34 to 1, are killed and 20-50 million people are injured or disabled each year in road traffic accidents. An average of about 3,300 road users, in other words, are killed and about a 100,000 are injured and/or disabled each day in traffic (see World Health Organization, WHO, 2001, 2004). In addition to human suffering, the total cost of road accidents, including the economic value of lost quality of life, has ranged from 0.5% to 5.7% of a country's Gross National Product (GNP) of countries (Elvik, 2000) and globally US\$ 518 billion per year (WHO, 2004).

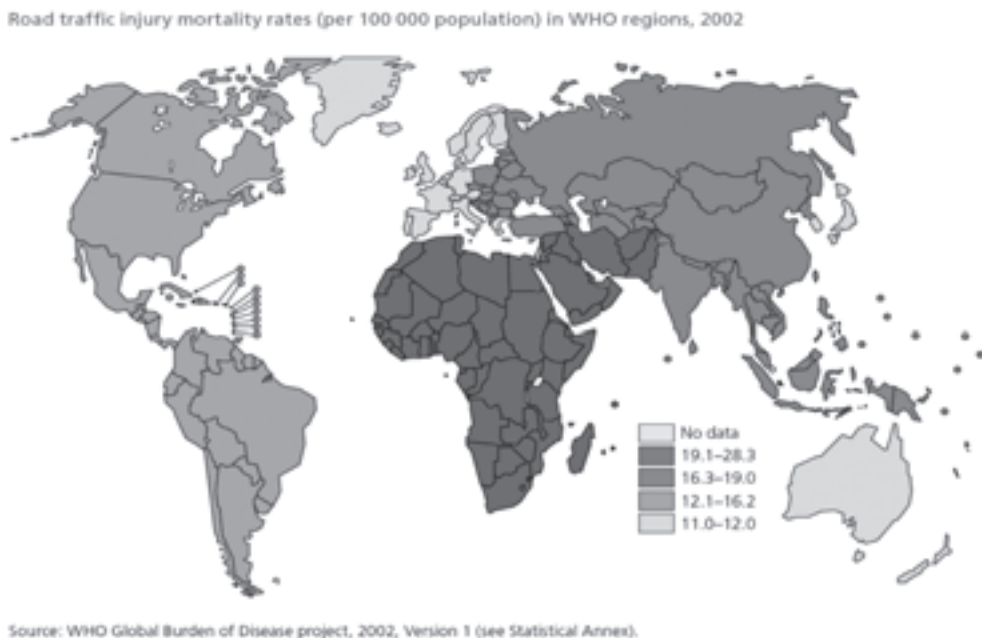


Figure 1. World map in road traffic injury mortality rates.

As presented in Figure 1 (WHO, 2004), road traffic accidents is a widespread problem. However, there are considerable regional differences between countries. In 2002, for example, the WHO Western Pacific Region and South-East Asia Region accounted for more than half of the absolute number of road traffic fatalities that occur annually in the world. The WHO African Region (including Middle East) had the highest fatality rate, with 28.3 per 100,000 population, which was closely followed by the low-income and middle-income countries of the WHO Eastern Mediterranean Region with 26.4 fatalities per 100,000 population (see Table A.2, WHO, 2004). The vast differences among countries in traffic fatalities are, in other words, remarkable in the world in general and in Europe and its close neighbours (e.g., Middle East) in particular.

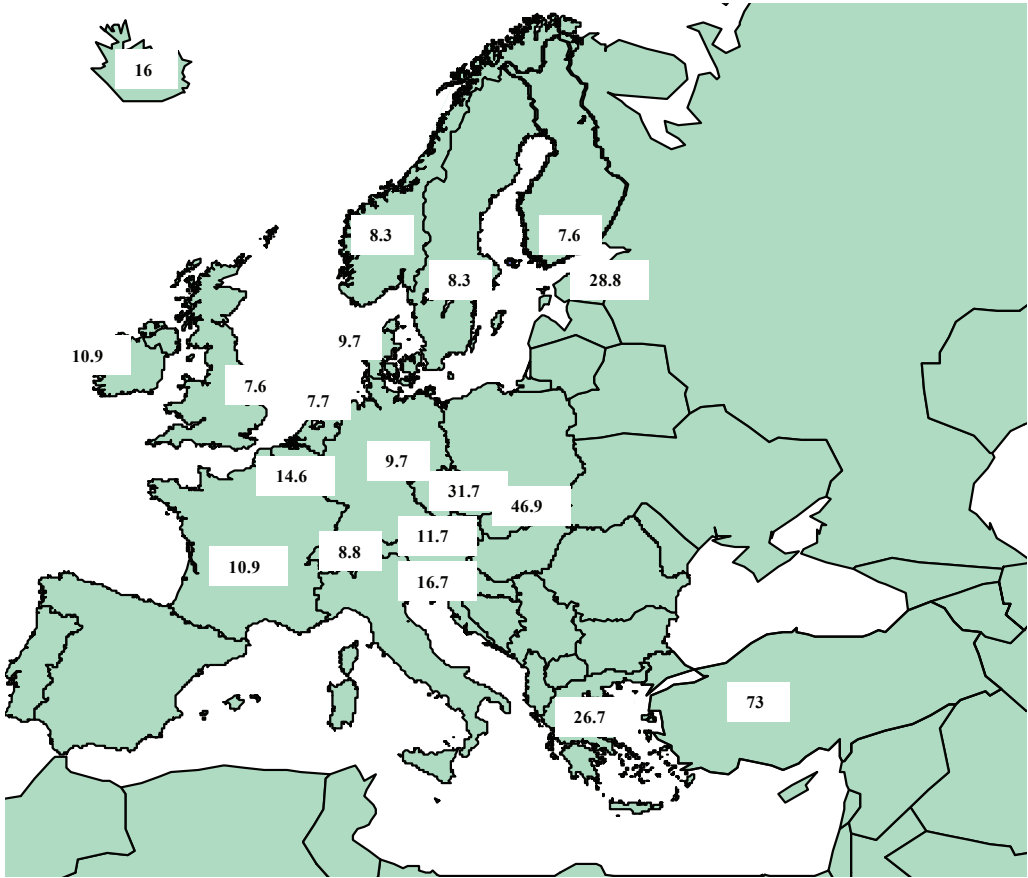


Figure 2. Road fatalities in some European countries per 1 billion vehicle-kilometres on all roads in selected years.

In the EU, about 40,800 people were killed in traffic accidents in 2000 and further 11,600 in the Accession Countries (ETSC, 2003). As presented in Figure 1 and 2, Eastern/Southern (Mediterranean) Europe (e.g., Greece, Turkey) has the highest accident rates compared to Northern/Western Europe. In 2003, for instance, 7.6 Finns and Britons, and 7.7 Dutch per 1 billion vehicle-kilometre were killed in traffic accidents whereas the corresponding figures for Greeks and Turks were 26.7 and 73 in 2001, respectively (IRTAD, 2003, 2005). The traffic fatalities were reported to be much higher in Middle Eastern countries (i.e., Iran) than in European countries (i.e., Turkey) (e.g., Raoufi, 2003). Despite this inequality between regions in general and between Southern European/Middle Eastern and Northern/Western European countries in particular, traffic researchers have paid little attention to factors behind accident risk figures that differ between countries.

Countries represent different “external” factors to a traffic system like economy, demography, climate, public awareness as well as cultural and national characteristics (Jaeger & Lassarre, 2000). These factors interact with “internal” factors of a traffic

system such as engineering (roadway and traffic engineering and automotive engineering) and road users (driver behaviour and driver performance), which, in turn, causes accidents (Evans, 2004; Jaeger & Lassarre, 2000). An accident is, in other words, either an independent or a combined outcome of human factors, vehicle related factors, and road environment. They are embedded in a complex socio-technical system (e.g., Svedung & Rasmussen, 1998) including “external” factors (Jaeger & Lassarre, 2000). It should be noted that, however, human factors have been estimated to be a sole or dominant contributory factor in approximately 90% of road traffic accidents (e.g., Evans, 2004; Lewin, 1982; Rumar, 1985). The remarkable improvements (e.g., in-vehicle technologies) in engineering have also placed more emphasis on studies of human factors in driving. These improvements do lead to safer road traffic when accompanied by behavioural interventions for changing road user behaviours (Lajunen, 1997). The challenge of traffic psychology is, therefore, to get a better insight into the factors, especially human factors, behind considerable regional differences between countries in traffic safety as well as traffic systems or cultures and, consequently, to develop effective counter measures.

1.1. Framework of the study: Traffic culture

Leviäkangas (1998) labelled all of the factors, which directly and/or indirectly influence a country’s level of traffic safety, as “traffic culture”. According to Leviäkangas, traffic culture is the sum of all factors that affect skills, attitude and behaviour of drivers as well as vehicles and infrastructure. However, the term traffic culture has not been conceptualised comprehensively and investigated empirically. The present study used “traffic culture” as a framework of reference and aimed at studying the goals, mechanisms, and the basic structure of traffic culture. Besides, some components of traffic culture were empirically examined across countries in the present study.

It is well known that the sum of all practices overwhelmingly aim at achieving the goals of safety, that is decreasing the number of accidents and near accidents, as well as at promoting mobility, that is reaching the destination in terms of the amount of travel and trip time in traffic (e.g., Elvik & Vaa, 2005; Evans, 2004). It should be noted that, however, mobility and safety are often, but not always, in conflict. The primary goal of a traffic system in a country is mobility, which should be achieved by minimizing the risk of the unwanted by-product, accidents (e.g., Evans, 2004; Hirsch, 2003).

To achieve both safety and mobility, or safe mobility, engineering factors (roads and vehicles) and road user behaviour and performance must be taken into account. As a matter of fact, road engineering can improve road infrastructures by, for example, replacing intersections with overpasses or underground pedestrian crossings and to increase both safety and mobility. Speed control, a kind of enforcement, on the other

hand, can drastically increase safety or reduce casualties whereas it reduces mobility. In contrast, night vision system will increase mobility whereas their effect on safety is uncertain (Evans, 2004).

It can be assumed that traffic culture in a country or in a region is formed and maintained mostly by formal and informal rules, norms, and values, which are, in other words, *the centre* of the mechanism of traffic culture. While formal rules are mostly applied and enforced by authorities including education, road users mostly share informal rules, norms, and values as a result of exposure and interaction with other road users. They define the acceptable and necessary road user behaviours and performance and choices of engineering practices. Traffic culture is also a result of both the larger cultural heritage and the present state of environment including economy and political climate (Leviäkangas, 1998). Similar to culture of a country (e.g., Hofstede, 2001), ecological factors (e.g., economy, geography), societal and cultural factors seem to lead to the development and pattern maintenance of institutions or political bodies (e.g., legislation, engineering, and educational systems). Once these institutions are established, the societal norms and values and formal and informal rules will be reinforced and the boundaries of road user behaviours will be determined. Jaeger and Lassarre (2000) showed in their model that, for example, system environment factors, or external factors (climate, economy, demography, and road safety regulations), were linked to the internal factors (vehicles, drivers, and road infrastructure) of transport system. The internal factors of the transport system determine driver's exposure and behaviour (i.e., average speed), which, in turn, affect the number of accidents and fatalities. Thus, traffic culture of a country has been formed and continued with the functions of the large number of factors and practices at the multi-levels or layers (e.g., see Andersson & Menckel, 1995; Becker, 1998; Cohen, Miller, Sheppard, Gordon, Gantz, & Atnafou, 2003; McLeroy, Bibeau, Steckler, & Glanz, 1988; TAG model by Jaeger & Lassarre, 2000; AcciMap by Svedung & Rasmussen, 1998).

As presented in Figure 3, a country's level of safety in traffic is mostly determined by how and to what extent external factors influence either directly or indirectly internal factors, which, in turn, affect exposure and accident risk. It is highly likely that factors like geography or climate, which remain relatively constant over the decades and resist to be changed (Evans, 2004), would have a more direct effect on engineering (e.g., roads and vehicles) compared to road users. It is likely, on the other hand, that climate (e.g., snow) could reduce drivers' exposure and behaviour, in particular speed (Jaeger & Lassarre, 2000), which in turn, might increase the number of accidents but lower the risk of severe injuries (Evans, 2004; Jaeger & Lassarre, 2000). However, external factors could not be restricted to only system or environment related factors, in other words, they can be other variables presented at the eco-cultural-socio-political level in the present study (Jaeger & Lassarre, 2000) (see Figure 3).

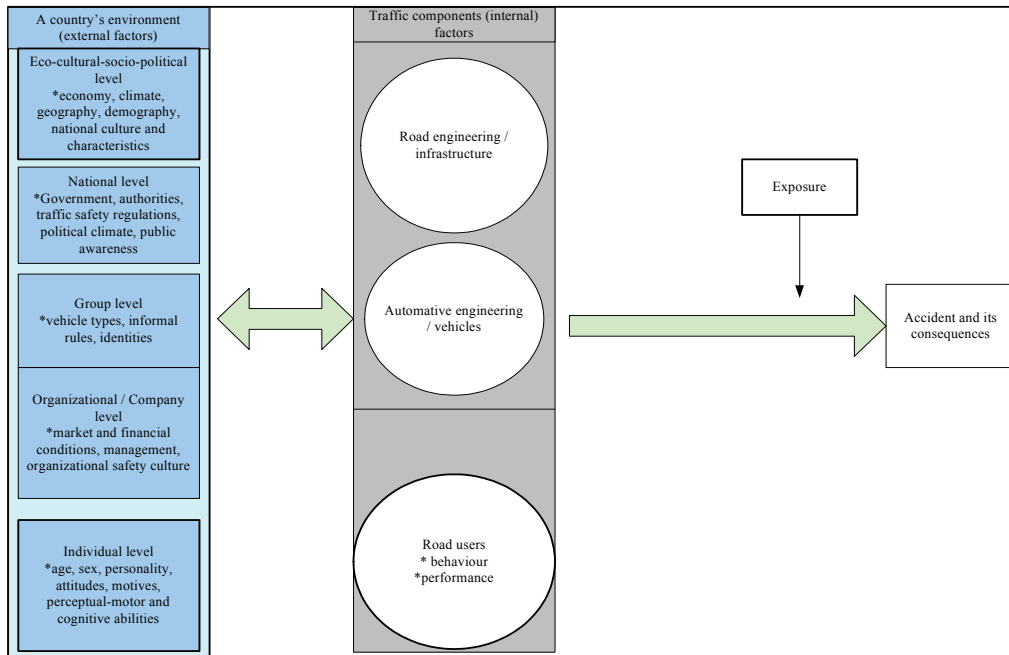


Figure 3. Chart of a country's traffic culture (adapted from multi-layer concept by Andersson & Menckel, 1995; Becker, 1998; Cohen et al., 2003; McLeroy et al., 1988; TAG model by Jaeger & Lassarre, 2000; AcciMap by Svedung & Rasmussen, 1998)

As presented in Figure 3, many other external factors interactively operate on different levels. The same drivers, for example, can engage in different driver behaviours and display different performance and pose different accident risk in two different countries (Finland and Russia) with roughly the same climate but different traffic safety regulations and practices (Leviäkangas, 1998) and public awareness and government policies (Svedung & Rasmussen, 1998). In the same country even in the same city, drivers from different driver groups (e.g., a truck driver versus a private car user or a young versus an old driver) might follow informal rules of their own group rather than formal rules in driving and, therefore, develop a different general driving style and pose different levels of accident risks (e.g., Sümer & Özkan, 2002). Organizational culture factors i.e., management or company policy (Svedung & Rasmussen, 1998), on the other hand, might be more important than formal traffic code and informal group code for professional drivers. In other words, drivers from the same driver group but from different companies, driving even in the same route and vehicles, might have different driver behaviours and performance and accident risk (e.g., Öz, Özkan, & Lajunen, 2006). In contrast, it is likely that professional drivers driving for different organizations (e.g., government, army) could use the same 'privileges' for lifting up enforcement or penalties in the case of unsafe driving (e.g., Zhang, Huang, Roetting, Wang, & Wei, 2006; Xie & Parker, 2002). Furthermore, when all other conditions and situations

are constant, *ceteris paribus*, each individual driver might have a different general driving style and accident liability. Since driving is to some extent a “self-paced” task and drivers determine their risk by their own choices, (Näätänen & Summala, 1976), individual factors like “extra motives”, personality, sex, age influence an individual driver’s behaviours and performance and accident risk (Elander, West, & French, 1993). In brief, traffic culture of a country can be redefined as the sum of all external factors (eco-cultural-socio-political, national, group, organizational, and individual factors) and practices (e.g., education, enforcement, engineering, emergency services) for the goals of mobility and safety to cope with internal factors (road users, roads, and vehicles) of traffic.

It can be assumed, therefore, that accident risk and differences between countries in traffic safety are results of different traffic cultures. In particular, road engineering/infrastructure and automotive engineering/vehicles and factors related to road users overwhelmingly affect the accident risk and/or a country’s traffic safety. Nevertheless, Evans (2004) concluded that the differences in road infrastructure and vehicles could not primarily explain the differences between high-rate and low-rate countries as to traffic fatalities. He rather claimed “how drivers behave is overwhelmingly the most important factor determining overall safety” (Evans, 2004). Therefore, the present study focused on driver behaviours and performance and aimed at explaining the differences between countries in traffic safety. At this point, it is worth pointing out that without investigations taking into account external and internal factors and using multi-level analysis will not be sufficient alone in designing effective, efficient, and sustainable countermeasures for reducing regional differences in traffic safety. Thus, the role of predominant external factors (e.g., economy and cultural values and characteristics) in regional differences between countries as to traffic safety should first be clarified. However, engineering demands of everyday traffic and other external and internal factors, in spite of their importance and relevance, will not be investigated in the present study.

1.2. Predominant external factors (i.e., system environment) in traffic safety

The predominant system environment (Jaeger & Lassarre, 2000) or factors on the level of eco-cultural-socio-politics called exogenous variables in traffic literature (Page, 2001; Poppe, 1995) include the usual ecological components of a traffic culture like economic, demographic (e.g., population), ecologic (e.g., latitude) (Hofstede, 2001; Jaeger & Lassarre, 2000), and broader cultural factors (Leviäkangas, 1998). These factor are highly correlating with each other (see Hofstede, 2001) and cannot be modified by safety policies in short term period and mostly have indirect and rarely direct effects on the level of mobility and safety by interacting with engineering and road users of everyday traffic in a country. To sum up, economic and societal and cultural factors appear to be the most important variables in traffic safety (Gaudry & Lassarre, 2000).

Economy

In several studies, a country's economic situation has appeared to be the most important exogenous aggregated level factor related to traffic and driver's exposure in general and traffic accidents in particular (e.g., Jacobs & Cutting, 1986; Lamn, Choueri, & Kloeckner, 1985). A high-income country, for example, can invest to its road infrastructure, maintenance of infrastructure, as well as to traffic safety work, vehicles and driver education whereas a low-income country or country in economic depression can pay less attention to traffic safety. On the other hand, the composition of the driver population may change from a dominant majority of professional drivers to private car drivers in the period of economic boom (e.g., China; Zhang et al., 2006). Along with economic development, the male-dominant traffic society may turn into a more female-male balanced one, i.e. the proportion of male and female driving license holders changes, resulting in a higher number of female drivers (United Nations, 1997). The number of young, inexperienced drivers is, however, relatively high in high-income countries. Page (2001) indicated that, for instance, an increase of 10% in the young population, *ceteris paribus*, leads to an increase of 8.3% in fatalities. During an economic boom, young adults have more money to spend for their leisure time activities like driving. Chambron (2000) showed that a 10% increase in the number of kilometres driven would result in a 6.5% rise in personal injury accidents and almost a proportionate increase in fatal accidents. It seems that the quantity (e.g., the amount of driving) and quality (e.g., why, when, where, with whom and in what kind of weather and road conditions the driving takes place) of driving, exposure, (Laapotti, 2003) and the risk of traffic accidents could increase for young, male, and private car users during economic boom. It should be noted that, however, the results of the previous studies about the relationships between driver groups (e.g., female versus male drivers), exposure, risky driving, and accident involvement have been mixed (e.g., see Hyman, 1968; Maycock, Lockwood, & Lester, 1991).

New (and safer) car sales (Pelzman, 1975) and car ownership rate are also relatively high in high-income countries. According to the well-known Smeed's law (Smeed, 1949), traffic casualties are related to the cube root of car ownership. It was evidenced (with data) in 20 different countries that the death rate per vehicle fell when ownership increased. In addition, Smeed's law showed valid for a variety of countries (e.g., in Great Britain from 1909 to 1973) over time and for the data of 62 countries (Adams, 1987; 1995). According to Adams (1995), Smeed's law raises the conclusion that "accident statistics do not measure safety or danger; as traffic increases, the death toll is contained, and sometimes reduced, "by behaviour" (emphasis added, APA) that avoids danger rather than removing it."

In low-income countries or during economic depression, the composition of the driver population and reduced total exposure (i.e., general driving behaviour) can lead

to a decrease in the total number of fatalities. It was found out that economic depression and especially high unemployment rate were negatively related to number of road fatalities (Eyer, 1977; Hakim, Shefer, Hakkert & Hocherman, 1991; Wagenaar, 1984; Wilde, 1991). It is likely that, however, unemployment could be related to the low rate of car ownership, which, in turn, might be associated with high death rate per vehicle, as the opposite to Smeed's law. In addition, economic uncertainty might have the effect of reducing the attention of the road users and policy makers on safety concerns (e.g., Chambron, 2000). The relationship between economic situation and traffic safety has also been quite poorly understood. For example, Reinfurt, Stewart and Weaver (1991) studied the effect of unemployment on road fatalities, suicides and homicides, and found no evidence that including unemployment rate in the model would improve forecasting of level of motor vehicle fatalities, suicides, and homicides in the U.S.

Economic system, on the other hand, influences the price mechanism (e.g., price of fuel), household consumption and vacation practices (e.g., holiday travel), modes of personal travel (e.g., home to work trips), and industrial activity for the transport of goods (Jaeger & Lassarre, 2000). It was found that factors like the high occurrence of home-to-work trips and holiday travels, greater number of commercial vehicles per unit of work, wine consumption and low price of fuel explained the growth in both total mileage and accident risk. In SARTRE 1 study conducted in October 1991 and June 1992 targeting major road safety concerns, it was found that the differentiation between drivers of the 15 European countries as to their attitudes and behaviours toward major road safety concerns (i.e., alcohol, speed, seat belts) is also partly structured along economic prosperity of the country (i.e., "safe" or "high-income" West/North vs. "dangerous" and "low-income" South) (SARTRE, 1998).

Major road safety concerns called endogenous variables (Page, 2001), which are modifiable components (e.g., traffic policies and regulations) of a traffic system and have direct effects on a country's traffic safety, are closely related to traffic accidents or fatalities (Gaudry & Lassarre, 2000; Lassarre, 1986; Scott, 1986). In contrast to high average speed and alcohol consumption (Chambron, 2000), for example, the higher seat belt usage rate may result in a lower number of severe injuries and/or fatalities occurring in a country. International research also has consistently proved the effectiveness of seat belt use in preventing and reducing fatalities and severe injuries during road vehicle accidents (e.g., Evans, 1986; IRTAD, 1995; National Highway Traffic Safety Administration, 2003). Evans (1986) indicated that if all the front seat occupants in U.S. used lap/shoulder belts without changing any other behaviour, then there would be a 41% reduction in fatalities in that population. Societal and broader cultural factors are also related to accident risk and fatalities via major road safety concerns.

Culture dimensions and values

Societal and broader cultural factors (e.g., values and cultural characteristics) are connected with formal and informal rules, values and norms. Traffic culture and environment reflecting this culture constitute the borders of individual drivers' behaviour. Helman (1994, p. 210-211) described, for example, most of Southern European cultures (e.g., Italian, Portuguese, Greek) as "permissive" cultures based on their acceptance of drinking and drunkenness as a 'normal' part of everyday life. According to the SARTRE 1 study (SARTRE, 1998), driving under influence of alcohol is much more acceptable and common in Southern Europe than in Northern Europe. Similarly, seat belt use is much less common in Southern and Eastern Europe than in North and West. Besides, Southern European drivers are less in favour of speed limits and speed detection devices compared to Northern European drivers. According to SARTRE 2 (conducted in October 1996 and April 1997) among 19 European countries (SARTRE, 1998), major road safety concerns have improved and the difference between Southern and Northern European drivers seems to be decreasing in the meantime (except Italy and Greece and partly Spain and Portugal). According to SARTRE 3 (SARTRE, 2003) conducted in November 2002 and December 2003, among 23 European countries, nevertheless, some drivers especially those in Southern European countries still do not conform to safety regulations. They, for example, think that wearing a seatbelt is not necessary if they drive carefully. It can be assumed that similar differences can be found in the extent of tolerance for the behaviours of other road users and aggressive driving. However, the results of SARTRE 2 and 3 showed that speed excess is socially accepted (or 'enjoyed') in many other countries (e.g., France, The Netherlands, and Sweden) and the speed problem exists in every country. Besides, drivers think that their own driving is less dangerous than other drivers' driving in almost every country (SARTRE, 2003). In terms of speeding and 'blaming others', almost no difference between Northern and Southern Europe was found.

It is difficult, on the other hand, to clearly differentiate between Southern and Northern European countries on the basis of societal and cultural measures. Eysenckian personality, Hofstede's culture dimensions and Schwartz values are, for example, widely used to measure societal and cultural characteristics of countries. The Eysenck Personality Questionnaire (EPQ, Eysenck & Eysenck, 1975) was constructed to measure E (extraversion vs. introversion), N (neuroticism vs. emotional stability), and P (psychoticism vs. ego control). Hofstede's (2001) culture dimensions include inequality between people ("power distance"), the level of stress in a society related to unknown future ("uncertainty avoidance"), the integration of individuals into primary groups ("individualism versus collectivism"), the division of emotional roles between males and females ("masculinity versus femininity"), and the time perspective of individuals ("long-term versus short-term orientation"). Schwartz values are based

on three main concerns that all societies have to confront and solve. According to Schwartz (1999) the first concern, a society's answer to the question of to what extent persons are either autonomous or embedded in their group, can be summarized by using three value types: "conservatism" (or embeddedness in Schwartz, 2004), (i.e., social order), "intellectual autonomy" (i.e., curiosity), and "affective autonomy" (i.e., pleasure). The second concern is to guarantee responsible behaviour that will preserve the social fabric. Value types named "hierarchy" (e.g., authority) and "egalitarianism" (e.g., equality) are the main solutions for preserving the social structure of the society. The third concern is the relationship between an individual and the natural and social environment. The relationship between human and environment can be based on two value types, which are "mastery" and "harmony". In this dichotomy, "mastery" emphasises a human's wish to shape his/her environment according to his/her needs whereas "harmony" refers to values in which protection of the environment is emphasised.

It seems that Southern European countries roughly score higher on *uncertainty avoidance*, *power distance*, *collectivism*, *egalitarianism*, *neuroticism* and *extraversion*, *masculinity* and are less conservative than Northern European countries (Hofstede, 2001; Lajunen, 2001; Schwartz, e.g., 1992, 1999). Specifically, for example, Greece scored the highest in uncertainty avoidance, extraversion, neuroticism, and mastery scores. Turkey also set a very high score in uncertainty avoidance, power distance, conservatism, and hierarchy. Great Britain and The Netherlands have very high score in individualism, and Great Britain has very low score in uncertainty avoidance. Finland has also low scores in masculinity, power distance, and uncertainty avoidance.

It was found that uncertainty avoidance correlated significantly with neuroticism (Lynn & Hampson, 1975), and masculinity dimensions of a culture were positively related to high speed limits in 14 European countries (Hofstede, 2001). In addition, Hofstede (2001, p.199) reported that uncertainty avoidance and masculinity were positively related to traffic death rates in 1971 in 14 European countries whereas individualism was negatively related to the accident rate. Drivers in individualistic cultures show a more calculative involvement in traffic (Hofstede, 2001), which leads to safer driving. Besides, as Eysenck (1965) suggested, persons scoring high on extraversion and neuroticism are more likely to have accidents; Lynn and Hampson (1975), Lester (2000), and Lajunen (2004) found that accidents were related to both extraversion and neuroticism. These findings indicate that the role of economic, societal and cultural factors should be taken into account to explain the regional differences between countries in traffic safety.

1.3. Predominant internal factors (i.e., Road user -human- factors in driving: Driver behaviour and performance)

Human factors in driving can be seen as being composed of two separate components, driving style and driving skills, or in other words, driver behaviour (i.e. “what drivers usually DO”) and driver performance (i.e. “what drivers CAN do”) (Elander et al., 1993; Evans, 1991; Näätänen & Summala, 1976). Driver performance includes information processing and motor skills, which improve with practice and training, i.e. with driving experience, as well as visual, perceptual, and attention capabilities. Driver behaviours refer to the ways drivers choose to drive or habitually drive (i.e., behavioural repertoires), including, for example, the choice of driving speed, habitual level of general attentiveness, and gap acceptance (Elander et al., 1993).

The literature on psychological factors associated with differential traffic accident involvement indicates that both driving skills and driving style are related to the crash risk (for a review see Elander et al., 1993). In other words, the interaction between these two elements, in addition to exposure actually determines the individual differences in accident liability (Lajunen, 1997). Although driving behaviours and skills are separated in terms of their contents and their relations to accident risk (Lajunen, 1997), they are also interrelated in expressing a general way of driving. Drivers seem to incorporate their driving skills into their general driving style after they learn and master how to drive (see Parker & Stradling, 2001; Groeger, 2000). Effective countermeasures should, therefore, include both the driving skill and style components and these components should be seen as related to each other.

1.3.1. Driver behaviour/style

As Ranney (1994) stated over a decade ago, several models of driving have been developed, but there is still little progress towards the development of a comprehensive model of driving. Ranney (1994), on the other hand, mentioned Reason et al.’s (1990) model about aberrant driver behaviour as a possible turning point for a comprehensive model of everyday driver behaviours. Thus, the present thesis is concerned mainly with Reason’s cognitive models of driving. Models dealing with risk, in spite of their importance, are not examined.

Examining the performance of a task, Reason (1990, p. 9) made a major division between error-free (correct performance) and erroneous performance. Although correct performance seems to constitute the large portion of driving, Reason concentrated on errors in driving because of the evident error – accident –connection. Errors were taken as a “generic term to encompass all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when these failures cannot be attributed to the intervention of some chance agency”.

According to Reason (1990, p.5), the notion of error and intention are inseparable. Since the notion of intention comprises “an expression of the end-state to be attained” and “an indication of the means by which it is to be achieved”, their success or failure are potentially available to consciousness. Thus, “the term error can only be applied to intentional actions” (Reason, 1990, p.7). As presented in Figure 4, the intentional behaviour was distinguished on the basis of yes-no answers to three questions regarding a given sequence of actions. However, the present study is mainly concerned with actions with prior intentions (see Reason, 1990, for intentional actions without a prior intention (spontaneous), and involuntary actions in Figure 4).

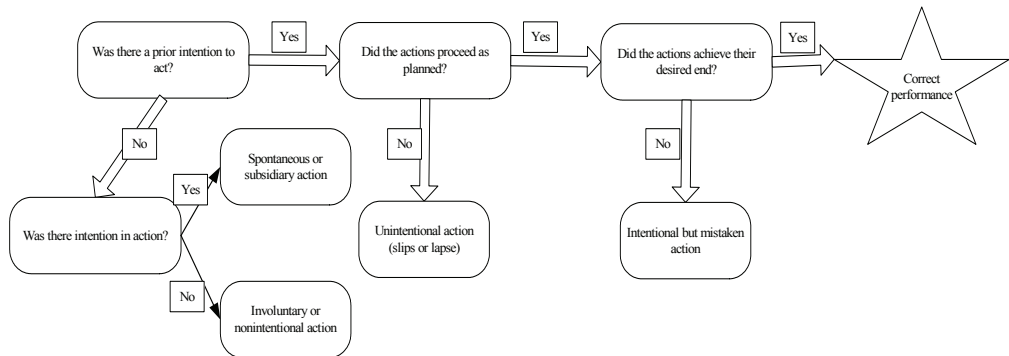


Figure 4. Algorithm for distinguishing the varieties of intentional behaviour (Adapted from Reason, 1990).

As presented in Figure 4, error types of behaviours with prior intentions depend on the failure of actions to go as intended, “actions-not-as-planned” or “execution and storage failures” (slips and lapses) and the failure of actions to achieve their desired consequences, “planning failures” (mistakes). Slips and lapses, which would later be known as “lapses” in literature, were mentioned in the skill-based category of Rasmussen’s “skill-rule-knowledge” taxonomy of human performance levels (for comprehensive review, see Rasmussen, 1980 and 1987). Skilled-based behaviours consist of the activation of over learned procedures i.e., smooth application of the sequences of automated schemata (e.g., gear shifting). On this level, with sufficient experience, the behaviour is effortless or routine and requires no attentional or conscious control (see Rasmussen, 1987). Similar to Rasmussen’s taxonomy, mistakes were further divided into two subcategories: knowledge-based mistakes and rule-based mistakes (Reason, 1999).

“Knowledge-based mistakes” category was later known in literature by Reason’s model’s generic name, errors. They emerge when pre-existing rules and automatic behavioural sequences do not work and a trial-and-error learning process is needed for finding new feasible solutions (see Reason, 1999) or in novel situations requiring conscious analytical process and stored knowledge (Reason, 1990). “Rule-based

mistakes” category was labelled as “violations” in driving task. This category involves automatic activation of rules (e.g., traffic rules) and procedures (e.g., techniques to regain control of a skidding vehicle on an icy road). Violations can be associated with the misapplication of normally good rules, the application of bad rules, a failure to apply a good rule, or erroneous performance in a no-rules situation. It should be noted that there is a dynamic relationship between behavioural levels during a trip depending on the degree of automatic-controlled processing and the degree of familiar (routine)-unfamiliar (unexpected) situations.

A further distinction has been suggested between two kinds of violations according to the reason why drivers violate (Lawton, Parker, Manstead, & Stradling, 1997). The first violation type, named as ordinary violations, involves deliberate breach/violation of the Highway Code (e.g., speeding for saving time). The second violation type involves overtly aggressive acts (e.g., showing hostility by chasing other vehicles). Aggression can be defined as “any form of behavior that is intended to injure someone physically or psychologically” (Berkowitz, 1993, p. 3) and categorized into two main types: emotional aggression and instrumental aggression. In cases of emotional aggression, the primary objective is to do harm or cause suffering to others when experiencing negative affect, especially anger (Baron & Richardson, 1994, p. 12; Berkowitz, 1993, p. 11). Instrumental aggression is, on the other hand, performed for gaining psychological or material advantage by doing harm or causing suffering to others (Baron & Richardson, 1994, p. 12; Berkowitz, 1993, pp. 11, 25-29). Similar to aggressive behaviour in general, driver aggression can, thus, be defined as “any form of driving behaviour that is intended to injure or harm other road users physically or psychologically” (Lajunen, Parker, & Stradling, 1998b). Although aggressive violations have a potential to cause Highway Code violations or other error types, the priori intention of aggression or an aggressive violation is to cause harm to other roads users in different ways but not to achieve error-free performance. Interpersonal violations are inherently not directed by rules or procedures. Contextual and motivational demands influence a priori intention to act aggressively. Aggressive violations form, in fact, a new category of “rule-based” violations (i.e., violence and ‘road rage’).

Everyday driving, on the other hand, involves other behaviours that cannot be classified as errors or violations or aggressive driving. These behaviours do not have to be based on coded rules and regulations, nor do they primarily take safety into account. The main intention in/the motive behind these behaviours is to take care of the traffic environment or other road users, to help and to be polite with or without safety concerns. Since intention is the main predictor of our behaviours (Fishbein & Ajzen, 1975) and the key factor for classifying aberrant driver behaviours into errors (no intention to make an error), violations (intention to violate), and aggression (intention to “harm”), we can suppose that not only targeting driver behaviours but also focusing on ‘what to intend

to do in traffic' (positive or negative) could be proactive and helpful intervention for improving traffic safety. However, "positive" driver behaviours have remained mostly unexamined in literature.

Taubman-Ben-Ari, Mikulincer, and Gillath (2003) aimed at developing a multi-dimensional omnibus measure of driver behaviour including "positive" driver behaviours (i.e., a patient and careful driving style). In their study, items included in these factors were classified as either "maladaptive" or "adaptive" behaviours, attitudes or emotions. It should be noted, however, that some types of violations (i.e. "correct violations" defined as correct performance achieved by deviating from inappropriate rules or procedures, see Reason, 1999) may actually be highly adaptive but still are violations, whereas strict obedience to the rule might actually be maladaptive in some situations. In addition to this conceptual difference, Taubman-Ben-Ari et al.'s (2003) new scale differed from the DBQ in how the measurement was conducted. While the DBQ is strictly a behavioural scale, with respondents indicating how often they commit behaviours described on a frequency Likert scale (from "never" to "all the time"), Taubman-Ben-Ari et al.'s (2003) scale measured behaviours, attitudes and emotions by asking drivers to indicate how well each item "fits to their feelings, thoughts and behaviours" (from "not at all" to "very much").

Driver behaviours should be evaluated by using an omnibus scale including items of "positive", "neutral (i.e., correct performance), and "negative" driver behaviours to have a measure of general driving style. It is necessary, on the other hand, to preserve the logic of the theoretical taxonomy of the DBQ and its characteristic as a behavioural scale. The relationships between driver behaviours, traffic offences, and accidents should also be investigated.

Aberrant driver behaviours and its measurement and factors in empirical studies

In their first study using the Driver Behaviour Questionnaire (DBQ), Reason et al. (1990) showed that their theoretical taxonomy also emerges in empirical data. They found that driver errors and violations are two empirically distinct classes of behaviour containing three factors (deliberate violations, dangerous errors, and 'silly' errors). Later studies have shown that the main distinction between errors (slips, lapses, and errors) and violations (ordinary violations and aggressive violations) seems to occur in different populations in the UK (Reason et al., 1990; Parker, Manstead, Stradling, & Reason, 1992; Lawton, Parker, & Stradling, 1997) as well as in different countries (in Australia by Blockey & Hartley, 1995; in Brazil by Bianchi & Summala, 2002; in China by Xie & Parker, 2002; in Greece by Kontogiannis, Kossiavelou, & Marmaras, 2002; in Finland and Netherlands by Lajunen, Parker, & Summala, 1999; in New Zealand by Sullman, Meadows, & Pajo, 2002; in Sweden by Åberg & Rimmö, 1998; and in Turkey

by Lajunen & Özkan, 2004). However, aggressive violations do not seem to cover all types of driver aggression (Lajunen & Parker, 2001), and lapses do not seem to always form their own factor but group together with errors (e.g., Sümer, 2003).

In general, the main distinction between errors and violations seems to be the most stable structure in all studies, although some small dissimilarity in factor structures can be found. Lajunen, Parker, and Summala (2004) studied the DBQ factor structure among British, Dutch, and Finnish drivers. The results of this study supported the idea of two second-order factors, named as errors and violations. In a more recent follow-up study by Özkan, Lajunen, and Summala (2006), the two-factor solution emerged as the most applicable and stable one over a follow-up period of three years among all possible factor solutions (two to six factors) of the DBQ. However, in spite of its good cross-cultural validity, DBQ showed surprisingly low test-retest factor stability over three years, and considerable changes in items and factor structures were observed (Özkan et al., 2006). However, the cross cultural validity of DBQ has not been comparatively tested in countries, which have worse safety records than Scandinavian and Anglo-American countries.

Relationship between the Driver Behaviour Questionnaire (DBQ) and traffic accidents

According to previous findings, violations predict accident involvement, both retrospectively and prospectively (Parker, Reason, Manstead, & Stradling, 1995a; Parker, West, Stradling, & Manstead, 1995b). Specifically, violations have been reported to be associated with active loss-of-control and passive right-of-way accidents (Parker et al., 1995b) as well as with speeding and parking offences (Mesken, Lajunen, & Summala, 2002). Although both slips (attention deficits) and lapses (memory failures) can cause embarrassment, they are less likely to have an impact on driving safety (Parker et al., 1995a). It should be noted, however, that passive accident involvement was associated with high scores on the lapses factor among elderly drivers (Parker, McDonald, Rabbitt, & Sutcliffe, 2000). In general, violations are mostly potentially dangerous and could lead to a crash. However, the role of driver behaviour in the differences between countries in accident risks has not been empirically tested before.

1.3.2. Driver performance/skills

The driving task can be described as a skilled activity with several distinct levels that are organised hierarchically (Summala, 1987; 1996). This hierarchy, from top to bottom, includes planning (strategic e.g., choice of route), manoeuvring (tactical e.g., choice of speed), and the control (operational e.g., steering, braking, or accelerating) (see Johannsen & Rouse, 1979; Michon, 1979, 1985; Mikkonen & Keskinen, 1980; Summala,

1987, 1996; Van der Molen & Bötticher, 1988). Later, Keskinen (1996) expanded the model (by Mikkonen & Keskinen, 1980) by adding a fourth level on the top named as goals for life and skills for living (see Keskinen, 1996; Laapotti, Keskinen, Hatakka, & Katila, 2001). Ranney (1994) combined Michon's three-level control hierarchies and Rasmussen's skill-rule-knowledge to classify selected driving tasks as strategic level/knowledge-based, tactical level/rule-based, and operational level/skilled-based tasks. Although different levels are interacting with each other in driving, the present study is mainly concerned with operational level/skilled-based tasks.

According to this classification, operational decisions normally take place on the skilled-based level. In the beginning, operational decisions and the acquisition of decision-related skills need conscious control, but gradually with more practises and driving experience these functions become increasingly automated (Summala, 1987) especially in a familiar situation. The degree of automatic-controlled processing and the degree of familiar (routine)-unfamiliar (unexpected) situations also influences learning of driving tasks. In this learning process (about the acquisition of skills and their transfer, see Groeger, 2000), basic motor skills are acquired soon whereas the development of perceptual skills is slower (about driving skills see Summala, 1987). For example, beginner drivers learn to use the manual gear and clutch rather quickly, but are slow to learn to use their peripheral vision for lane keeping (Mourant & Rockwell, 1972).

Practise and increased exposure to the diversity or familiarized traffic situations predictably result in improved skills but also increased subjective control of driving, less concern for safety, and habitual driving with narrow safety margins (Näätänen & Summala, 1976; Spolander, 1983; Summala, 1985). Overestimation of driving skills seems to predispose drivers to an unrealistic and overly optimistic evaluation of hazardous situations in traffic environment (e.g., McKenna, 1993). Biased perception of driving skills seems to cover most of the areas of driving skills and results in an illusory self-assessment of driving skills (McKenna, Stainer, & Lewis, 1991), especially when drivers compare themselves with other drivers (e.g., Walton, 1999; Delhomme, 1991). Karlaftis, Kotzampassakis, and Kanellaidis (2003), for instance, analysed the data obtained from 17,000 questionnaires from the European SARTRE 2 database and showed that drivers, who rated themselves as both less safety oriented (more dangerous) and faster (or "better") than others, reported breaking the speed limit more frequently, not wearing seat belts, and being involved in more crashes in the past than other drivers. Bias perception or overconfidence in turn results in a biased risk assessment leading to high levels of risk acceptance (Deery, 1999; Groeger & Brown, 1989; Näätänen & Summala, 1976).

Since driving is to some extent a self-paced task and drivers largely determine task demands and the margin of error, depending on their decisions or self-evaluations of

skills, a driver actually can make the driving task too difficult for himself/herself so that the demands exceed his/her capabilities. Similarly, if a driver feels that the demands of the driving task exceed his/her abilities and she/he is subjected to increased risk, she/he can use compensation mechanisms (e.g., lower speed) (Lajunen, 1997). It can be hypothesized that a driver's view of his/her skills (what she/he CAN do) affects operational level behaviours (e.g., steering), general driving style, and accident involvement in general.

Driver performance, its measurement and performance factors in empirical studies

When people learn to drive and then continue to drive, they need to have a number of different skills. Although there were earlier attempts to classify different skills (e.g., cognitive skills and motives by Näätänen & Summala, 1976), Spolander (1983) was the pioneer who introduced a distinction between technical and defensive driving skills. According to this distinction, technical driving skills include quick and fluent car control and traffic situation management while defensive driving skills consist of anticipatory accident avoidance skills. Spolander also developed a self-report instrument for measuring these dimensions. However, Spolander did not verify the empirical existence these two factors in his questionnaire data by factor analysis.

In Spolander's (1983) instrument, drivers were asked to compare themselves to "an average driver" in 13 aspects of driving. Later, Hatakka, Keskinen, Laapotti, Katila, and Kiiski (1992) replaced this external reference with an internal one in which drivers were asked to assess their own abilities in different aspects of driving skills. Lajunen and Summala (1995) developed the Driver Skill Inventory (DSI) further by extending the contents of the instrument and verifying the two-factor structure of DSI as perceptual-motor and safety skills by using factor analysis. A consistent factor structure and high reliability of the DSI was obtained in different populations (e.g., among male traffic criminals, male policemen, and male traffic instructor candidates by Summala & Hyvén, 1990). Later, the English version of the DSI was used in Australia (Lajunen, Corry, Summala, & Hartley, 1998a) and in the UK (Lajunen et al, 1998b). However, the DSI has not been validated in countries, which have worse safety records than Scandinavian and Anglo-American countries.

Relationship between the DSI and traffic accidents

According to previous studies, perceptual-motor skills were positively associated with the number of accidents, penalties and the level of speed, while safety skills were associated negatively with these variables (Lajunen et al., 1998a). It has been suggested that the overestimation of perceptual-motor skills may predispose drivers to risky driving behaviours, while safety skills buffer their risk by making them more cautious and able

to anticipate possible hazards on the road (Sümer, Özkan, & Lajunen, 2006). Supporting this suggestion, previous studies have revealed an asymmetric relationship between driving and safety skills in prediction of certain outcome variables. Besides, Lajunen et al. (1998a) pointed out that the driver's internal balance between perceptual-motor and safety skills is important for safe driving (Lajunen et al., 1998a). Sümer et al. (2006) tested the asymmetric link between perceptual-motor and safety skills on a sample of Turkish drivers. The results revealed that those who reported a low level of safety skills but a high level of perceptual-motor skills reported the highest levels of accidents and penalties. However, the asymmetric relationship between perceptual-motor and safety skills on the outcome variables has not been investigated in other traffic cultures.

1.4. Main factors influencing driver behaviour and performance

Driver behaviours and performance can be assumed to reflect drivers' individual characteristics such as personality, attitudes, motives or "extramotives", perceptual-motor and information-processing capacities (see Beirness, 1993; Elander et al., 1993; Groeger, 2000; Lajunen, 1997; Lester, 1991; Näätänen & Summala, 1976). In addition, contextual factors like traffic environments and cultures and other road users influence driver behaviours and performance. Driver behaviours and performance, in other words, can be supposed to vary in degree as they are shaped by both intrinsic (e.g., age and sex, and cognitive biases) and extrinsic (e.g., social and cultural context including other drivers) factors. It should be noted, however, that traffic researchers have paid very little attention to the effects of extrinsic factors on driving skills and style.

Age, sex and gender

General findings in literature point to the fact that sex and age are directly linked to driver behaviours, performance and accident liability. Although people from all age groups are killed in traffic accidents, young-aged people are over involved in accidents virtually in every country, and the majority of these drivers are young men (Blockey & Hartley, 1995; Doherty, Andrey, & MacGregor, 1998; Evans, 1991).

These differences in accident liability between male and female drivers may also be due to different driver behaviours including aggressive driving style and performance. It has been reported that men and young drivers tend to commit violations more frequently than women and older drivers. In contrast, female and older drivers committed more errors than male and young drivers (Åberg & Rimmö, 1998; Blockey & Hartley, 1995; Parker, McDonald, Rabbit, & Sutcliffe, 2000; Reason et al., 1990). Previous studies have also shown that mostly young, male, and inexperienced drivers commit aggressive driving behaviours rather than young female drivers and older drivers (Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000; Lawton et al., 1997; Shinar, 1998). Young

drivers are also more likely to get annoyed by other drivers and react in a more violent manner than older drivers (Lajunen & Parker, 2001). Male drivers have also been consistently assessed to have higher levels of perceptual-motor skills, whereas safety skills are more prominent among female drivers (Lajunen et al., 1998a; Lajunen & Summala, 1995).

Sex and age of the driver, in other words, are very critical in a driver's driver behaviour and performance. However, there is not much that can be done to change the age of the driver. The notion of sex and gender is inseparable and gender is supposed to be a modifiable component. Sex has a biological connotation and sex differences arise from innate temperamental differences between the sexes (e.g., biological theories by Buss, 1995) whereas gender is rather a social and cultural concept. According to Archer and Lloyd (2002, p.19), gender stereotypes refer to "the beliefs people hold about members of the categories man or woman" (Archer & Lloyd, 2002, p.19) while sex refers to "the binary categories 'male' and 'female' (Archer & Lloyd, 2002, p.17). Although sex is one of the most often measured (or 'main') variables in studies of driving behaviour, there have been only few studies (e.g., Laapotti, 2003; Kirkham & Landauer, 1985; Mayhew, Ferguson, Desmond, & Simpson, 2003; McKenna et al. 1991) in which the primary interests were sex differences in traffic behaviour. That the sex differences in driver behaviour have attracted little attention among traffic researchers may well suggest that gender as a social and cultural construct has remained mostly unexamined. Therefore, the relationship between sex, gender, driver behaviour and performance, and accident risk needs to be investigated.

Cognitive biases

Road users have to interact with each other and to take in to account each other's intentions and behaviours to be able to drive safely. Thus, drivers' causal attributions might be a source of their own and others' risky driving behaviours and performance and finally accident liability. Attribution refers to the process by which individuals arrive at casual explanations for their own and others' behaviour (Ross, 1977). Most of the studies examining attribution biases in traffic have mostly investigated the false consensus bias and actor-observer effect (see Baxter, Macrae, Manstead, Stradling, & Parker, 1990; Björklund, 2005; Manstead, Parker, Stradling, Reason, & Baxter, 1992). False consensus refers to the tendency of persons "to see their own behavioural choices and judgements as relatively common and appropriate to existing circumstances while viewing alternative responses as uncommon, deviant, or inappropriate" (Ross, Greene, & House, 1977, p.280). Manstead et al. (1992), for example, found that drivers who committed specific violations and errors, perceived these behaviours as being committed by a higher proportion of drivers than they really were as compared to drivers who did not commit these driver behaviours. The actor-observer effect refers to a "pervasive

tendency for actors to attribute their actions to situational requirements, whereas observers tend to attribute the same actions to stable personal dispositions” (Jones & Nisbett, 1972, p.80). When reporting causes for close following and running traffic lights, for instance, drivers attribute their own violations to situational factors and the others’ violations to their personal dispositions (see Baxter et al., 1990). Based on the literature, it can be assumed that age, sex, and cognitive biases are “universal” factors influencing driving behaviour and accident involvement. However, only few cross-cultural studies have been so far conducted. In the present study, the role of sex and age in general driving style and accident involvement will be investigated and cognitive biases will be used to interpret the role of road user interaction (“self” vs. “others”) in aggressive driving and accident involvement across countries.

Contextual, cultural, and social factors (i.e., interpersonal factors - other road users)

It is well known that social behaviours, cognitive processes, and attitudes are influenced by cultural background including values and norms (Berry, Poortinga, Segall, & Dasen, 1992). In addition, social environment including other road users, general social norms, as well as formal and informal traffic rules, influence every individual driver. Other road users are studied as a source of information, communication, imitation, and as a reference group (see Björklund, 2005; Zaidel, 1992). Cultural and environmental factors define acceptable and “normal” behaviours, which in turn, influence the definition of violations, not only simply in the strict legal sense (Manstead, 1998) but also informally (Björklund, 2005). Besides, they might influence appraisals of the intentions and behaviours of other road users, which in turn, could influence attribution of intentionality, controllability, and responsibility of driver behaviours and potential reactions (i.e., retaliation). Moreover, these factors might lead to different evaluations of risk, one’s own and other’s performance and behaviours across countries, and interpersonal conflicts in traffic (Björklund, 2005).

Åberg, Afram, and Nilsson (2005) showed that drivers consistently think that they themselves are “normal” while others commit violations, mistakes, and errors. Earlier studies have also shown that there are differences among nationalities in drivers’ self-assessment (Sivak, Soler, & Tränkle, 1989a), risk perception (Sivak, 1987), and the target risk-level of performance (Sivak, Soler, & Tränkle, 1989b). Blockey and Hartley (1995) found dissimilarities in DBQ factor structures arising from socio-economic and cultural differences between British and Australian samples. Besides, it has been found that drivers score differently on DBQ factors (i.e., especially aggressive and ordinary violations) in different countries (e.g., Sweden by Åberg & Rimmö, 1998; Australia by Blockey & Hartley, 1995; UK by Reason et al., 1990). Contextual and motivational demands, in fact, should influence violations rather than slips and lapses and errors (Reason et al., 1990). Similarly, drivers score differently on driver performance in

different countries. Lajunen et al. (1998a) showed that driving skills, the other main component of human factors in driving, is related to culture. Australian drivers were found to be less safety-oriented as compared to Finnish drivers. However, comparative research about DBQ and DSI factor structure and drivers' conceptualisation of driving in general has not been conducted in countries with low level of motorization and safety and those with high level of motorization and safety.

1.5. Studying and measuring traffic accidents and driving – Methodological considerations

Research and comparative studies are needed to get a better inside into the reasons, especially human factors, behind the considerable regional differences between countries in traffic safety, and to develop effective countermeasures. There are numerous methods for studying the reasons for regional differences between countries in traffic safety. However, each has some limitations that have to be taken into account.

1.5.1. Accident frequency and the rate of fatalities as criteria for safety

In most studies, a driver's (number, type, and/or the severity of accidents) and a country's (per 100,000 population or 1 billion vehicle km) accident history has been used as a criterion for safety. These accident data are collected either from drivers' self-reports or from official institutes (e.g., police statistics), which yield approximately the same result (e.g., Laapotti et al., 2001). However, they are subject to systematic and random error and, therefore, somewhat biased. Besides, accidents are rare events and statistically complex (see Elander et al., 1993).

The advantage of self-reports of accidents is that minor accidents can also be recorded and that self-reports are usually more detailed than official reports. However, it has been found that respondents often intentionally or unintentionally underreport accidents (e.g., Harano, Peck & McBride, 1975), simply because some drivers define self-reported accidents differently or forget to report some accidents (forgetting rate is approximately 30% per year) (Maycock et al, 1991).

Although the acts of forgetting, defining accidents in a varied way, or under-reporting deliberately do not distort the official accident records; official accident records have some other limitations (Lajunen, 1997). For example, official databases do not include minor accidents and some groups (e.g., older drivers) can be over-represented in these records for reasons not related to their risk of accident (e.g., fragile body) (Elander et al., 1993). In addition, every country might have different time criteria for recording traffic fatalities (i.e., 24-hour or 30 days rule). In spite of several shortcomings, the accident rate is still the best criterion for the level of safety in an individual's driving style and in a country's traffic.

1.5.2. The effect of exposure on criterion variables

Exposure, i.e. the degree to which a driver exposes himself to traffic and the probability of being involved in an accident, is “a systematic process affecting the crash system” (see Chapman, 1973) and, therefore, one of the main reasons for the overrepresentation of a particular driver group in accident statistics (Laapotti, 2003). In addition, exposure can be supposed to be the main way of interaction between intrinsic and extrinsic factors, risky general driving style, and accident involvement. The average male driver has a higher mileage than the average female driver (Stradling & Parker, 1996). Exposure measures, such as the proportion of driving licence holders in each sex group, also indicate that male drivers are exposed to driving more frequently than females (IRTAD, 2003; United Nations, 1997). Drivers who drive frequently violate traffic rules more often than those who drive less frequently. They also tend to commit more aggressive driving behaviours than young female drivers and older drivers (e.g., Lawton et al., 1997). Besides, it has been found that driving experience is associated with confidence in one’s own driving skills, but negatively related to concern for safety (Lajunen & Summala, 1995). In addition, the relationship between mileage and accidents seems not to be linear but rather a negatively accelerating curve, with smaller increase in accident rate at higher level of mileage (Maycock et al., 1991). It should be noted that, however, the results of earlier studies about the relationship between sex, age, exposure, risky driving, and accident involvement have been mixed (see Hyman, 1968; Maycock et al., 1991). On the other hand, the quantity and quality of exposure should be taken into account while investigating the possibility of getting involved in an accident (Laapotti, 2003). Ignoring the role of exposure can increase error variance and reduce the true association between intrinsic and extrinsic factors, general driving style, and accident risk.

1.5.3. Limitations of self-report measures and comparability of data from different countries

Previous studies have shown that self-report measures are inaccurate or even biased to some degree because of socially desirable responding, i.e. “impression management” and “self-deception”, or in other words, “other-deception” and “self-deception”. It should be noticed that not only questionnaire studies but also all studies with an obtrusive design are liable to social desirability (see Lajunen, 1997).

Lajunen and Summala (2003) concluded that, on the other hand, the bias caused by socially desirable responding is very small in DBQ responses when the respondents complete the questionnaires anonymously and cannot gain anything by giving embellished responses. It is still likely that there is a difference between self-reported and

actual behaviour in traffic even though several studies have indicated that self-reports of driving correspond well to actual driving behaviour. For instance, West, French, Kemp, and Elander (1993) reported a correlation of 0.65 between observed driving speed and responses on the driving speed subscale of their Driving Style Questionnaire. In addition, Ingham (1991) found high correlations between recorded driving on a 40 km test route and self-reported driver behaviour.

It should be noted that the issue of cross-cultural validity of self-reported measures needs great care in the translation procedure, sampling, and data collection because differences in these factors can be an important source of data distortion. For example, driving behaviours in general, and questionnaire items in particular, could be interpreted differently in different countries (e.g., “honking” in Lajunen et al., 2004), and surveys conducted in different ways may produce different data (postal survey vs. surveys among students). All of these factors could significantly affect the comparability and equivalence of data sets (see van de Vijver & Leung, 1997 for detailed information).

1.6. Aims of the study

In the present study, the general aim is to find reasons for high accident rates in Southern Europe in order to develop effective countermeasures and, at the same time, to find factors for high traffic safety in Northern Europe in order to achieve sustainable traffic safety. For these purposes, the factors of traffic accidents were modelled at the aggregated level and the level of individual drivers and were investigated both cross-culturally and in a case country (i.e., Turkey). Specifically, this study has the following objectives:

- I. The role of economy, personality factors, and culture in traffic fatalities (sub-study I)
 - To test whether different types of unintentional injuries form a single general factor.
 - To investigate the relationship between economy, Eysenckian personality dimensions, Hofstede’s cultural dimensions and Schwartz’s values, and traffic fatalities across 46 countries.
- II. Cross-cultural differences in driving behaviour/style (sub-study II)
 - To investigate the cross-cultural applicability of the three-factor structure (aggressive violations, ordinary violations, and errors) of the Driver Behaviour Questionnaire (DBQ)
 - To compare driving behaviours across six countries (Finland, Great Britain, Greece, Iran, The Netherlands, and Turkey).

- To investigate the relationship between the three factors of DBQ and the number of traffic accidents in each country.
- To evaluate the role of driving styles in the relationship between culture and the number of traffic accidents, utilizing a mediational framework.

III. Cross-cultural differences in driving performance/skills (sub-study III)

- To investigate the cross-cultural applicability of the two-factor structure of the Driver Skill Inventory (DSI)
- To investigate the asymmetric relationship between perceptual-motor and safety skills in traffic penalties and accident involvement among British, Dutch, Finnish, Greek, Iranian, and Turkish drivers.

IV. Cross-cultural differences & aggressive driving: self and others (sub-study IV)

- To investigate different types of aggressive driving (emotional and instrumental) cross-culturally among British, Dutch, Finnish, and Turkish drivers by using a newly developed behavioural scale.
- To examine the effects of combinations of self reported high ratings of aggressive behaviours (“self” scale) and perception of oneself as an object of other drivers’ aggressive acts (“other” scale) on accident involvement among British, Dutch, Finnish, and Turkish drivers separately for men and women.

V. Gender roles and driving behaviour/style (sub-study V)

- To investigate the effects of sex (male and female), gender (masculine and feminine), and their interaction on self-reported driver behaviour and accident involvement among young Turkish drivers.

VI. Gender roles and driving performance/skills (sub-study VI)

- To investigate the effects of sex (male and female), gender (masculine and feminine), and their interaction on self-assessed driving skills (perceptual-motor and safety skills), and accident involvement among young Turkish drivers.

VII. “Positive Driver Behaviours” (sub-study VII)

- To develop a reliable scale for measuring self-reported “positive” driver behaviours in the same line with the theoretical taxonomy of the DBQ and by preserving its characteristic as a behavioural scale.
- To investigate the relationships between positive driver behaviours, violations, errors, aggression, traffic offences, and accidents.

2. METHODS AND RESULTS

2.1. Role of economy, personality, and culture in traffic fatalities (Sub-study I)

Injuries are usually categorized on the basis of the intent either as unintentional, injuries not caused by a person's intent to harm, or intentional (e.g., WHO, 2004). There are, on the other hand, different opinions among prevention professionals if intentional and unintentional injuries should be addressed together as one field or separately (e.g., see Cohen et al., 2003). However, the question whether or not different types of intentional or unintentional injuries form a general factor or sub-factors has mainly remained unquestioned.

Among unintentional injuries (e.g., fire and drowning injuries, fallings, poisonings, occupational and traffic accidents), especially traffic accidents have attracted great attention in general and in the present study in particular. The relationship between traffic accidents, economy, Eysenckian personality factors, and Hofstede's values has been studied, however, the role of Schwartz values and Hofstede's short vs. long orientation in traffic fatalities has not been studied before. Besides, the data from different countries with different level of traffic safety are necessary for studying the underlying factors behind regional differences in traffic safety. Moreover, economic, societal and cultural factors should be primarily taken into account for explaining the regional differences between countries in traffic safety.

Method

In the present study, the same dataset as in the study by Lynn and Martin (1995) and Lajunen (2001) was used to obtain national scores for extraversion, psychoticism, and neuroticism. National scores for Hofstede's culture dimensions (i.e., power distance, uncertainty avoidance, individualism, masculinity, and long-term versus short-term orientation) were obtained from Hofstede (1980, 2001) and for values (i.e., conservatism, intellectual autonomy, affective autonomy, hierarchy, egalitarianism, mastery, and harmony) from Schwartz (e.g., 1992, 1994, 1999). The final dataset included a total of 46 countries, from which 28 countries were used for EPQ analyses, 34 countries for Hofstede dimensions, and 24 countries for Schwartz values.

The number of traffic fatalities per 100,000 inhabitants for each country was obtained from World Health Statistics (World Health Organization, 2005b). GNP per capita figures (current USD, Atlas method) for 1999-2001 were obtained from World Development Indicators (World Bank, 2005a). In general, statistics were obtained for a period of three years (mostly from 1999 to 2001, depending on availability) and an average was calculated to smooth possible annual fluctuation.

The data were analysed by using Pearson product-moment and partial correlations, and hierarchical regression analysis after controlling the effect of GNP per capita. More detailed information about the method and statistical analyses may be found in the original report of sub-study I.

Results

The results of factor analyses showed that unintentional fatalities had three independent components named as safety of daily life, work safety, and traffic safety. The results revealed that GNP was the most important predictor for traffic safety in a country and the main reason behind regional differences between countries in traffic safety. GNP per capita was negatively related to traffic fatalities. GNP also correlated with both culture dimensions and values. After controlling the effect of GNP per capita, as in earlier studies (e.g., Hofstede, 2001; Lajunen, 2001), neuroticism and uncertainty avoidance were positively related to traffic fatalities. Partial correlation coefficients showed that conservatism correlated negatively and egalitarianism correlated positively with traffic fatalities.

Discussion and conclusions

We did not study if injuries could be classified into two sub-fields on the basis of intention, i.e. unintentional and intentional injuries (see Cohen et al., 2003). However, we can say that “not having an intention” is not such a dominating feature which would force unintentional injuries under one factor in factor analysis. This indicates that different types of unintentional injuries might have different underlying contributors (or valence of intentions) and, therefore, injury prevention interventions should be targeted according to the injury type.

The results suggest that economy drastically affects not only internal factors (i.e., road user and engineering) but also societal and cultural factors and accident risk. Uncertainty avoidance, for example, is negatively related to economy, which might result in intolerable anxiety and stress (Hofstede, 2001). Lynn and Hampson (1975) found a significant correlation between uncertainty avoidance, anxiety, and neuroticism in their study of 18 industrialized nations. Uncertainty is “a situation in which anything can happen and one has no idea what” (Hofstede, 2001, p. 148). An escape from uncertainty avoidance leads to an escape from ambiguity. Societies have developed ways (i.e., technology, religion, law) to cope with uncertainties. Laws, for instance, include formal rules that guide social behaviour; in other words, rules make the behaviour of people interpretable and predictable. Obviously, good rules lead to a desired end if they are obeyed whereas bad rules (or no rules) might increase ambiguity. People in cultures with high uncertainty avoidance look for structures in their daily practices to avoid

ambiguities and risk. Ironically, these same people are often ready to engage in risky behaviour when in hurry (e.g., driving fast to release stress) rather than wait patiently and lower their sense of stress and urgency (Hofstede, 2001). Besides, people of high-uncertainty-avoidance (UAI) societies (e.g., Turkey, Greece, Italy) are supposed to express their emotions strongly and, hence, the environment allows people to be more expressive (e.g., expressive of anger) (Hofstede, 2001).

In addition, conservatism correlated negatively with traffic fatalities whereas egalitarianism correlated positively with traffic fatalities. This result might indicate that respect for social order leads to rule obedience including traffic rules. Although egalitarianism represents respect to the welfare of others, it correlated positively with traffic fatalities. Obviously, safe traffic behaviour requires mostly strict rule obedience and values like egalitarianism do not promote safe driving. It can be assumed that these factors would be reflected on general driving style of a driver in high UAI, conservative, and egalitarian societies.

Macro analysis is a very useful method for investigating the relationship between personality factors, culture dimensions, values, and traffic fatalities. It should be noted that, however, well-designed studies including age and sex differences as well as driver behaviour are needed. Specifically, the full path from these factors to traffic accidents via behaviours and performance remains open. Therefore, the sub-studies II and III aimed at investigating the effects of driver behaviour and performance on the differences in accident risk across different countries.

2.2. Cross-cultural differences in driving behaviour/style (Sub-study II)

Driving style can also be supposed to vary in degree to which it is shaped by extrinsic factors. It could be hypothesized, therefore, that the vast difference between countries in traffic culture and level of safety would be reflected in the drivers' driving behaviours. For example, countries representing different regions with different traffic fatality risk (see Figure 1 & 2) should have relatively different conceptualisation of driving and, consequently, scores on driving behaviour scales. In the present study, it was hypothesized that Southern European (i.e., Greek and Turkish) and Iranian drivers should have higher scores on the three factors of DBQ than drivers in Northern European (i.e., Finland, Great Britain, The Netherlands) countries.

Although it was supposed that driver behaviour has a dominant role in the differences between countries' level of traffic safety (Evans, 2004), it is still empirically unknown how driver behaviour influences the relationship between traffic cultures and accident involvement across countries. Nonetheless, the relationship between intrinsic factors (i.e., age, sex, and exposure), driver behaviour, and accident involvement has been reported in several earlier studies conducted in a single country.

Method

Two hundred and forty two (146 male and 96 female) drivers were chosen from large data sets (see the data sets in sub-study IV) of each of the four countries and the new data sets were collected from Greece and Iran, and matched for age and sex (in both sub-study II and III). All participants had a driving license and the participants were assured of anonymity and confidentiality (sub-studies II, III, IV, V, VI, and VII). The participants filled out the extended version of Manchester Driver Behaviour Questionnaire (Lawton et al., 1997a; Lajunen et al, 1998b), and responded to items related to demographic variables.

The data were analysed by using LISREL with maximum likelihood estimation, confirmatory factor analyses (see Russell, 2002, for detailed information about the use of confirmatory and exploratory factor analyses), Procrustes target rotation techniques (see Lajunen et al., 2004 for detailed information), Cronbach's alpha reliability coefficients, the analysis of variance (ANOVA) after controlling the effect of age, sex, and annual mileage within the sample, the mediational regression, and Poisson and Poisson-gamma (or negative binomial) regression analyses with forward stepwise procedure (see Lord, Washington, & Ivan, 2005). More detailed information about the method and statistical analyses may be found in the original report of sub-study II.

Results

The results revealed that the three-factor structure of DBQ is applicable but not firmly stable in every country included in the study. It is obvious that, in addition to intrinsic factors, extrinsic factors considerably influence different components of driving styles in varying degrees. The factorial agreement was incongruent especially for aggressive violations and errors (except for Greek drivers). It seems that the interpretation of errors and aggressive violations factors differs from country to country. Besides, some alpha reliability coefficients seemed unacceptably low although the reliability coefficients were still at the same level as those found in previous DBQ studies. It should be noted, however, that the DBQ aggressive violations subscale used in that study included only three items and, therefore, measured only few aspects of driver aggression.

As hypothesized, the vast difference between the Southern and Northern Europe in traffic culture and level of safety was reflected in driving behaviour. The results of analysis of variance revealed that drivers from Western/Northern European countries with high levels of safety scored higher on the ordinary violations, especially on 'speeding on a motorway' item, than drivers from high-risk Southern European/Middle Eastern countries. In contrast, drivers from the latter group scored higher on aggressive violations and errors than drivers from countries in the former one.

Findings demonstrated that addition of driving styles (especially aggressive violations and errors) not only improved the models for predicting the number of traffic accidents, but also mediated the relationship between culture/country and accidents. Thus, it was empirically shown that driving style could explain the differences in accident risk across countries to some extent.

Consistent with the previous studies, (e.g., Reason et al., 1990), intrinsic (i.e., age) and DBQ factors (i.e., aggressive violations and errors) emerged as an important factor in accident involvement. For example, a significant relationship between aggressive violations and the number of accidents was found in Finland and Iran. In fact, errors are used to be regarded as unrelated to accidents (e.g., Reason et al., 1990). The results of the present study, on the other hand, showed that errors were significantly related to the number of accidents in Turkey. It seems that the type of relationship between driving behaviours and the number of traffic accidents varied from country to country.

Discussion and conclusions

The present study showed that the three-factor structure of DBQ is applicable but not firmly stable in every country and some factors (e.g., aggressive violations) are sensitive to social context. It might still be better to develop both fine-tuned national scoring keys for domestic use and keep the core DBQ items for cross-cultural comparisons. Besides, aggressive violations scale could be extended to cover different types of aggressive driving.

The results of the present study indicate that each country has its own problems in its traffic culture in addition to global problems like ordinary violations (i.e., speeding) and young male drivers. To achieve sustainable traffic safety, even “safe” countries have to cope with the speeding problem. Pan-cultural regulations should also take into account the local characteristics and requirements. Southern European and Iranian traffic authorities should, for example, urgently focus on aggressive violations and errors.

The most striking finding of the present study is that the differences between countries in traffic safety can be partly reduced by targeting driver behaviour (i.e., regulations and enforcement), which has a significant effect on accident risk “within” and “between” countries. Similarly, it was hypothesized that driver skills/performance, the other main component of human factors in driving, influences the differences between countries in traffic safety (Evans, 2004) and is also influenced by both intrinsic and extrinsic factors.

2.3. Cross-cultural differences in driving performance/skills (Sub-study III)

It was supposed that different traffic cultures require different components of driver performance for safe driving (i.e., Finnish vs. Australian drivers) (Lajunen et al., 1998a). Although there are some variations across cultures and countries in self-assessments of perceptual-motor and safety skills, earlier results indicate that there are some similarities within countries in driving skills too (e.g., being male drivers and overestimation of driving skills, see McKenna et al., 1991). It is likely, on the other hand, that intrinsic variables, driver performance and the asymmetric link between perceptual-motor and safety skills and accident involvement might be shaped differently by the interaction between intrinsic and extrinsic factors in different traffic cultures. Age, for example, correlated significantly with safety skills, but not with perceptual-motor skills in the Australian sample whereas age correlated significantly with perceptual-motor skills, but not with safety skills in the Finnish sample (Lajunen et al., 1998a). However, intrinsic variables and the asymmetric relationship between perceptual-motor and safety skills on the outcome variables have not been investigated in other traffic cultures except Western and Anglo-American cultures.

Method

The participants filled out the Driver Skill Inventory (Lajunen & Summala, 1995) and responded to items related to demographic variables.

The data were analysed by using factor analysis and Procrustes target rotation techniques (see Lajunen et al., 2004, for detailed information), Cronbach's alpha reliability coefficients, and Pearson product-moment correlations and moderated regression analyses. In each of the moderated regression analyses, age, sex, and annual mileage were entered in the first step. Perceptual-motor and safety skills were entered in the second step, and their interactions were entered in the third step. Moderator and independent variables were first centred (Individual score minus mean) scores of variables, and then an interaction term (e.g., multiply by subscales) was calculated before the analyses (see Aiken & West, 1991). SIMPLE syntax program developed by O'Connor (1998) was used to plot statistically significant interactions. Significant interactions were plotted by generating simple regression equations of a given outcome (dependent) variable at low (i.e., 1 standard deviation below the mean), moderate (mean), and high (i.e., 1 standard deviation above the mean) levels of DAIS scales (cf. Aiken & West, 1991) (the same method was also used in sub-studies IV, V, and VI). More detailed information about the method and statistical analyses may be found in the original report of sub-study III.

Results

Sub-study III indicated that DSI is a viable instrument for measuring drivers' self-assessment of their perceptual-motor and safety skills with relatively stable two-factor structure and fairly consistent and high reliability coefficients in different traffic cultures. It should be, however, noted that the factorial agreement was unsatisfactory for safety skills in Southern European countries (i.e., Greece and Turkey) and in Iran. On the other hand, handling one's vehicle is the same everywhere constituting "pan-cultural" perceptual-motor skills. Similarly, age correlated positively with safety skills across all countries in the present study. It was also found that being male was significantly associated with self-reported perceptual-motor skills. In addition, annual mileage correlated significantly with self-reported perceptual-motor skills. As hypothesized, safety skills were negatively associated with number of penalties in all countries whereas perceptual-motor skills were positively associated with the number of penalties in Finland, Greece, and the Netherlands. However, the statistically significant interaction between perceptual-motor and safety skills on the number of penalties was found only in Finland and Turkey (see the original report of sub-study III for plotting). This result suggests that high safety skills are essential for buffering the effect of high perceptual-motor skills on reckless driving and that this relationship depends on the traffic culture.

Discussion and conclusions

The findings of this study have critical implications for driver education, training and safety campaigns in different traffic cultures. The results partly support the general findings in literature underlining that greater accident-risk and more deviant driving styles are related to being male and young (Elander et al., 1993) especially because of overconfidence, biased risk assessments and risk acceptance. Unbalanced perceptual-motor skills by high levels of safety skills can be seen as a simple demonstration of this event, especially among young male novice drivers. Therefore, self-awareness or insight into "real" driving skills should be enhanced by giving feedback during the practice or technical mastery phase of driving. Specifically, safety skills should be incorporated into driving skills through driver education and licensing by putting emphasis on careful and anticipatory driving strategies (e.g., skid training in Katila, Keskinen, & Hatakka, 1996). Special care for teaching style might be necessary because the basic goal of training (i.e., priority of anticipatory skills over manoeuvring skills in slippery driving courses) was not as clear to trainees as it was to the trainers (Katila et al., 1996). It is possible that, on the other hand, devaluation of the role of safety skills might play a more important role in some cultures (e.g., in Turkey by Sümer et al., 2006, and probably both in Greece and Iran) as compared to others. Therefore, road safety campaigns should be

used to change the prototype of “good driver” to a type in which both perceptual-motor skills and safety skills are important.

The present study showed that the DSI factor structures are almost the same in different countries, but there may still be some differences in safety skills, especially in Southern Europe and Iran. It can be supposed that the content of the safety skills factor of DSI does not exclusively include the safety skills in these countries. This distinction is, in fact, parallel with Lawton et al.’s (1997) distinction of violation types. According to their distinction, violations can be divided into two categories. The first, named ordinary violations, involves breaking the Highway Code and/or the law deliberately. The second involves interpersonal aggressive violations. As it was found in sub-study II, the Southern Europeans/Middle Easterners reported committing more aggressive violations compared to Northern/Western Europeans. It seems that the lack of social tolerance and interpersonal aggressive violations are important components of driving in Greece, Iran, and Turkey. It might therefore be better to develop a new scale to catch the aspects of interpersonal interaction in a wide spectrum for cross-national comparisons.

2.4. Cross-cultural differences in aggressive driving: Self and others (Sub-study IV)

Sub-studies II and III showed that interpersonal interaction in driving is to a large degree shaped by extrinsic factors. Specifically, the factorial agreement was unsatisfactory for aggressive violations in Greece, Iran, and Turkey. In addition, Southern European countries and Iran scored higher on aggressive violations in sub-study II. It seems that the lack of social tolerance and interpersonal aggressive violations are important components of driving in Greece, Iran, and Turkey. It should be noted, however, that the DBQ aggressive violations subscale included only three items and, therefore, measured only few aspects of driver aggression. The first aim of the present study was, therefore, to investigate cross-cultural differences in different types (emotional and instrumental) of aggressive driving by using a newly developed behavioural scale among British, Dutch, Finnish, and Turkish drivers.

In addition to cultural and environmental characteristics unique for each country, there are “universal” findings related to driver aggression. Previous studies have shown that mostly young, male, and inexperienced drivers commit aggressive driving behaviours compared to young female drivers and older drivers. Young drivers are also more likely to get annoyed by other drivers and react in a more violent manner than older drivers. In addition, another “universal” finding is that anger and aggressive driver behaviours contain anger provoking interpersonal elements, which is the main component of extrinsic factors of a traffic culture in addition to impersonal situations

(e.g., encountering road constructions) (Lajunen et al., 1998). Road users, in other words, have to interact with each other and to take each other's intentions and behaviours into account for safe driving. It was claimed that the primary reason for drivers' frustration is that other road users are obstructive. Since anger is "a sense of displeasure plus the urge to do some of the things that remove or harm its agent" (Frijda, 1988), retaliation is very likely to emerge. Aggressive driving behaviours are also linked to accidents via the impact of negative emotions (e.g., anger) on task performance by increasing the likelihood of a perceptual, judgmental or behavioural error (Manstead, 1998). However, the role of road user interaction ("self" vs. "others") in aggressive driving and accident involvement has remained mostly unexamined. Previous studies also showed that provocation attenuates the differences between sexes. Thus, sex differences in appraisal of the provocation intensity and the fear of retaliation partially mediate the attenuating effect of provocation. Sub-study IV, therefore, aimed to investigate the combination of self reported high ratings of aggressive behaviours ("self" scale) and high ratings of self-perceived state of being the object of other drivers' aggressive acts ("other" scale) on accident involvement in four different countries separately for men and women.

Method

A total of 3673 drivers were surveyed in several studies in four countries, i.e. in Finland (N = 1125), Great Britain (N = 849), The Netherlands (N = 709), and Turkey (N = 1002). The participants filled out the Driver Anger Indicators Scale (DAIS) and items related to demographic variables. It should be noted that the main aim in developing a new aggressive driving scale was to obtain a behavioural scale, which would cover aggressive driving behaviours that are out of the scope of aggressive violations subscale of Driver Behaviour Questionnaire (DBQ) (Reason et. al., 1990).

The data were analysed by using descriptive statistics, factor analysis, reliability analysis, Paired sample t-test, Pearson product-moment correlations, analysis of variance (ANOVA), and moderated regression analysis with SIMPLE syntax for plotting. More detailed information about the method and statistical analyses may be found in the original report of sub-study IV.

Results

The results of the present study indicated that the DAIS has a clear two-factor structure (aggressive warnings and hostile aggression and revenge), high item loadings, and acceptable internal consistency across different traffic cultures. Turkish drivers scored higher on aggressive driving behaviours than British and Dutch drivers, who in turn reported more aggressive behaviours than Finnish drivers. In all samples, on the other

hand, “other” drivers mostly were scored higher on aggressive driver behaviours than drivers’ themselves.

Consistent with the previous studies, age and sex (being young male) correlated positively with the aggressive driving behaviours in almost all countries. In contrast, annual mileage correlated positively with self-reported aggressive behaviours in Finland and Great Britain, but not in The Netherlands and Turkey.

Another expected universal finding is that symmetric interpersonal aggression between aggressive warnings and hostile aggression and revenge factors of ‘self’ and ‘others’ created a serious risk for road accident involvement in every country except among British male and Finnish female drivers. The statistically symmetric interaction between aggressive warnings and hostile aggression and revenge factors also indicated that aggressive warnings might have a potential to release anger and escalate aggression both within drivers and between drivers (see the original report of sub-study IV for plotting).

Discussion and conclusions

The present study showed that the spectrum of both aggressive warnings and hostile aggression and revenge factors varied from country to country even though some “pan-cultural” items were found. It might therefore be better to develop “nation-specific aggressive driving items” to catch the local aspects of aggression as well as include “core DSI items” for cross-national comparisons. In addition, it was found that the conceptualisation of those items also vary from self to others and others to self-perspectives. It is very likely that different attributions of intentionality and responsibility to their agent occur. Drivers could then react in a more violent manner than they would because of the different appraisal of these aggressive behaviours from different perspectives. It seems that cognitive biases (i.e., anonymity, false consensus, and actor-observer effect) might also shape these attributions and diminish the effect of social disapproval of aggression by “legitimising” aggressive behaviours and “abandoning” social pressure or norms. Thus, aggression may actually be used by some as a social problem-solving strategy. Besides, road infrastructure (e.g., traffic congestion) and the perception of time and sense of urgency might be the primary cause of aggressive driving even in countries with well-regulated traffic and good road infrastructure.

Drivers should recognize that other road users, like themselves, make mistakes now and then not only because of their “bad” and steady characteristics but also because of situational factors (see Baxter et al., 1990 and Björklund, 2005, for actor-observer effect in traffic). It should be noted, however, that aggressive driving is always inappropriate and deviant behaviour in contrast to “false consensus effect”. Drivers should be self-

aware of their own responsibility and role in aggressive driving rather than blame others. Drivers should know that uncontrolled feelings and retaliating might aggravate the original problem rather than reducing the threat or anger. Therefore, it is better to encourage drivers to report the Police aggressive driver behaviours rather than to show their reaction to the aggressor. This might also diminish the feeling of “being anonymous” in traffic. Besides, strict and fair enforcement should focus on interpersonal aggressive behaviours as much as ordinary violations (e.g., speeding). Since conflicts between drivers result largely from design problems in infrastructure and ambiguous rules, special attention should be paid to system design to reduce potential interpersonal conflicts (i.e., roundabouts). It is more efficient to change bad design than to force people to adapt to it.

It seems that the relationship between exposure and aggressive driving across countries is rather a complex one. This difference can emphasize the different meaning of exposure to traffic in different countries in terms of quantity and quality. In addition, frequent exposure to conflicts might heighten a driver’s threshold for getting annoyed and teach him/her to cope with frustration or anger in some countries, e.g., in Turkey, but not in others. Besides, drivers might also have learned to cope with frustration and anger by changing their driving style and reserving more time for the trip in traffic (see Lajunen & Parker, 2001).

The present study clearly indicated that “others” was a critical component of safe driving across countries and the symmetric interpersonal aggression between aggressive warnings and hostile aggression and revenge factors of “self” and “others” created a serious risk for road accident involvement in almost all countries. In addition to the interaction between “others” and “self”, a driver’s arousal level (anger) is also important in escalation of aggression and retaliation. Driver education should, therefore, include training courses about the sources (e.g., attributions) and coping strategies (i.e., relaxation techniques) of anger and aggression, and aggressive driving (i.e., avoiding straight contact with the aggressor).

2.5. Turkish Case

Sub-studies II, III, IV, and I indicated that economy, social and cultural values, driver behaviour including aggressive driving and performance determine differences between countries in traffic safety. The origins of economic and societal norms and the mechanisms behind these factors can be found elsewhere (e.g., Hofstede, 2001). It should be noted, however, that they (e.g., cultural values) remain relatively constant over the decades and that the aim of psychology is rather to change human behaviours by using “human factors”. Sub-studies VI, VII, and V, therefore, aimed at investigating

the potential but neglected antecedents (i.e., gender) of human factors in driving (i.e., driver behaviour and performance) and at introducing “Positive Driver Behaviours” as an “intervention” for safe driving in a case country (i.e., Turkey).

Since the sub-studies II, III, IV, and I clearly showed that young male drivers are risky groups in every country, the sub-studies V and VI aimed at examining the relationship between sex, gender, driver behaviour and performance among young drivers in Turkey. It was hypothesized that gender might buffer the effect of sex (being male) in risky general driving style and accident involvement.

2.5.1. Turkey and gender roles

Many social psychological studies have shown that the gender stereotypes vary among different cultures and ethnic groups (Harris, 1994). Williams and Best (1990) found that, for example, the gap between male and female gender stereotypes was small in highly developed countries whereas it was larger in countries where the difference between the educational level of males and females was large. In addition, they suggested that gender roles are closely associated with socio-economic development, importance of religion, urbanization and high latitudes.

Traditionally, Turkey has been seen as a geographical and cultural bridge between East and West or a melting pot of Western and Islamic values. Recent rapid social transition in Turkey makes her an especially interesting country to study gender issues. In the last decade, Turkey has gone through a period of fast urbanization, industrialization, and Westernisation supported by large-scale exposure to European and North American culture through mass media. The current candidate status of Turkey for the European Union seems to accelerate this movement. In addition, international and regional migration, increasing educational opportunities, emphasis on secularism, the newly acted civil code of equal property division, recognition of the value of housewives’ unpaid labour, and the increased protection of the rights of working women might have facilitated the change of the gender stereotypes too. In this way, gender stereotypes would be results of many different cultural factors. Since the present study was carried out in Turkey, it should be noted that gender roles are likely to differ from other countries (see Özkan & Lajunen, 2005 for detailed information).

2.5.2. Gender roles and driving behaviour/style (Sub-study V)

In literature, many variables have been identified as correlates of over-involvement of young male drivers in accidents. However, the effects of gender-roles on young male risky driving style or aggressive driving have not been investigated. Krahe and Fenske (2002) studied the effects of “macho personality” on aggressive driving among male

drivers and found that men endorsing macho personality reported more aggressive driving behaviour than other men. It should be noted that Krahe and Fenske's (2002) study was not aimed especially at young drivers' problems and the sample in that study included men from all age groups (age range from 20 to 67 years). In addition, Krahe and Fenske (2002) studied the relationship between driving and macho personality, rather than masculinity.

Masculinity consists of characteristics that are perceived as male characteristics in society (e.g. assertive, strong personality, dominant, etc.) while femininity includes characteristics that are perceived as female characteristics in society (e.g. emotional, sympathetic, understanding, etc.). It can be assumed that masculine characteristics like "Being dominant", "Being assertive", "Willingness to take risks", "Strong personality" and "Readiness to defend one's own beliefs" may be 'instrumental' in the situations in which a person has a chance and opportunity to express them in one's behaviour (e.g., aggression in "permissive" traffic cultures). In contrast, 'Caring for others' might be related to more careful and safe driving. In the present study, it was hypothesized that male drivers report more accidents, offences, and aggressive and ordinary violations than female drivers. In addition, masculine drivers were supposed to report more accidents, offences, and aggressive and ordinary violations whereas feminine drivers report less accidents, offences, and aggressive and ordinary violations. It was finally hypothesized that femininity buffers aggressive driver behaviour among masculine drivers.

Method

The data reported in this study were collected from 354 undergraduate students (221 males and 133 females) taking psychology courses at the Middle East Technical University in Ankara. Students received the questionnaires in classrooms or in dormitories, filled them out on the spot and returned the envelopes upon completion. The participants filled out the short form of BSRI (Bem, 1981), the DBQ (Reason, et al., 1990), and responded to items related to demographic variables.

The data were analysed by using reliability analyses, Pearson product-moment correlations and hierarchical regression analyses with SIMPLE syntax for plotting. More detailed information about the method and statistical analyses may be found in the original report of sub-study V.

Results

The results of the present study confirmed that male drivers reported more Highway Code ("ordinary") violations than female drivers but not accidents, offences, and aggressive violations. A driver's gender-role was found to have a relationship with

the number of traffic accidents and offences, aggressive and ordinary violations, and errors even after controlling the kilometres driven and age. As hypothesized (except for accidents), the number of offences, and aggressive and ordinary violations increased as a function of masculinity while the number of accidents, offences, aggressive and ordinary violations, and errors decreased as a function of femininity. Interaction effects of masculinity and femininity on the number of accidents and aggressive violations were found (after excluding ‘overlapping’ items i.e., aggressiveness between masculinity and aggressive violations scales as well). Specifically, the high levels of masculinity were related to the highest levels of accidents and aggressive violations when combined with the low levels of femininity (see original report of sub-study V for plotting). As hypothesized, the high levels of femininity buffered the effects of masculinity on accidents and aggressive violations. However, no statistically significant interaction effect of masculinity and femininity on offences, ordinary violations, and errors was found.

Discussion and conclusions

The results of the present study identified gender (i.e., masculinity), in addition to sex, as a predictor of Highway Code violations, aggressive violations and offences. Interestingly, femininity was negatively related to each type of risky behaviour (ordinary and aggressive violations, errors) and negative outcome variables (accidents, offences) measured in this study. This finding emphasizes the fact that not only masculinity, but also femininity should be taken into account when investigating sex and gender differences in risky driving.

According to the results of this study, masculinity was primarily related not only to non-aggressive violations and number of penalties but also to aggressive behaviour towards other drivers. In addition to direct effects on risky driving (ordinary violations) and driver aggression, exaggerated masculinity might influence a driver’s interpretation of the traffic situation and other drivers’ behaviours. It is possible that together with tendency to over-estimate his/her skills and general readiness to behave aggressively, a masculine driver may be more likely to interpret other drivers’ acts as aggressive than a non-masculine driver is under low enforcement and social sanction conditions.

Earlier findings show that especially young men overestimate their driving skills and give more importance to vehicle handling skills rather than to safety (see Lajunen & Summala, 1995) and over trust their driving skills, which is related to risky driving rather than deficiencies in driving skills (Lajunen & Summala, 1995; Näätänen & Summala, 1976). Similarly, masculine drivers may perceive “being a skilful driver” as a masculine characteristic whereas feminine drivers might not see car driving as part of

their identity. It can be assumed that “being a skilful driver” is considered as a masculine feature whereas “being a safe driver” is seen as a neutral or feminine characteristic. Sub-study VI, therefore, aimed to test this assumption.

2.5.3. Gender roles and driving performance/skills (Sub-study VI)

Although sex, gender, and driving style have been identified as correlates of over-involvement of young male drivers in accidents, the effects of gender on driving skills (i.e., perceptual-motor and safety skills) have not been investigated before. In the present study, as it was assumed in sub-study V, the aim was to investigate the effects of sex (male and female), gender (masculinity and femininity), and their interaction on self-assessed driving skills (perceptual-motor and safety skills), and accident involvement among young Turkish drivers.

Method

The data reported in this study were collected from 217 undergraduate students (131 males and 86 females) taking psychology courses at the Middle East Technical University in Ankara. Questionnaires were distributed to students in classrooms. The participants filled out the short form of BSRI (Bem, 1981), the DSI (Lajunen & Summala, 1995), and answered items related to collecting demographic information. The data were analysed by using reliability analyses, Pearson product-moment correlations and hierarchical regression analyses with SIMPLE syntax for plotting. More detailed information about the method and statistical analyses may be found in the original report of sub-study VI.

Results

The results of the present study showed that sex (being male) predicted the number of total, active, and passive accidents. In contrast to findings of sub-study V, a driver’s gender-role was not found to have a relationship with the number of traffic accidents. On the other hand, the results of the present study showed that self-assessed perceptual-motor skills were positively related with traffic accidents whereas safety skills were negatively related with traffic accidents, especially with the number of active accidents. Also, drivers who scored high on safety skills had better safety records than drivers who scored higher on perceptual-motor skills in the present study (see the asymmetric effect in sub-study III).

Male drivers reported higher scores on perceptual-motor skills than female drivers. No sex difference was found on safety skills although the present study clearly assumed that “being a safe driver” is seen as a feminine characteristic because femininity was highly related to the safety skills. The present study also showed that masculinity was

associated with perceptual-motor skills. Hence, it seems that “being a skilful driver” is seen as a masculine characteristic. However, there was no interaction effect between masculinity and femininity on driver performance.

Discussion and conclusions

The results of the sub-studies V and VI indicated that gender influenced drivers’ general driving style as much as sex of drivers did. Sub-study V reported that risky driving style increased as a function of masculinity and being male whereas it decreased as a function of femininity. Similarly, sub-study VI showed that perceptual-motor skills increased as a function of masculinity and being male while safety skills increased as a function of femininity. It can, therefore, be concluded that the feminine driver characteristics might be used for promoting safety-oriented driving especially among young drivers. Both sexes can have masculine and/or feminine characteristics. Since gender is a social and cultural construct rather than innate arising from temperamental differences between sexes, social psychological theories (e.g., the social role model by Eagly, 1987) might be used to reshape the relationship between gender roles of drivers and general driving style through driver education and media campaigns. In this way, some of the feminine characteristics (e.g., ‘caring for others’), which were found to be related to more careful driving and fewer errors (see sub-study V), might also be attached to masculine characteristics by creating new role models in the relatively patriarchal Turkish society. By these approaches, policy makers might gain a new tool for the improvement of traffic safety. It should be noted, however, that biological and psychological explanations for these differences in driving are mutually inclusive. Besides, focusing on the antecedents of the driver behaviour and performance might, if not immediately and directly, lead to the development of a safe general driving style. Moreover, the effect of gender (i.e., masculinity) in risky driving and accident involvement might be predominant among young drivers but not middle-aged or elderly drivers.

2.5.4. “Positive Driver Behaviours” (Sub-study VII)

The sub-studies and previous studies in literature clearly showed that driver behaviour (especially aberrant or “negative” behaviours) is highly related to the level of traffic safety “within” and “between” countries. Focusing on negative behaviours is justifiably necessary to target (i.e., by enforcement, education, and engineering) and change negative driver behaviour in order to promote safe driving and traffic safety in a country. It is also well known that it is better to target behaviour for the highest, the most immediate and stable change. Sub-study VII, therefore, aimed at developing a reliable scale for measuring “positive” driver behaviours while holding onto the theoretical taxonomy of the DBQ and its characteristic as a behavioural scale and at investigating the relationships

between positive driver behaviours, violations, errors, aggression, traffic offences, and accidents.

Method

The data reported in the present study were collected from 312 Turkish drivers in Ankara. Students of the traffic psychology course at the Middle East Technical University collected the data from drivers in Ankara as part of their course work. The participants filled out the DBQ, “Positive Driver Behaviours Scale” (see the original report of sub-study VII for the development of the scale), Driver Aggression Indicators Scale (DAIS), and provided information on items related to drivers’ driving records and demographic variables.

The data were analysed by using descriptive statistics, factor analysis, reliability analysis, Pearson product-moment correlations, and hierarchical and negative binomial regressions. More detailed information about the method and statistical analyses may be found in the original report of sub-study VII.

Results

The results of the present study indicated that the DBQ with positive driver behaviours items had a clear factor structure, high item loadings, and acceptable internal consistency. It was found that positive driver behaviours were negatively associated with errors and violations but positively with age and mileage. The results revealed that violations were related to all dependent variables except hostile aggression and revenge committed by self. This result might indicate that violations in DBQ (both ordinary and aggressive violations) do not capture aggression in traffic well. It seems that DAIS covered the other types of aggressive behaviour in traffic. Errors were significantly associated with the hostile aggression and revenge committed by self and other drivers, and aggressive warnings committed by self. Positive driver behaviours were negatively related to the hostile aggression and revenge committed by self and other drivers, but not with traffic offences or accidents. Those who reported a high number of positive driver behaviours showed a low number of hostile aggression and revenge, and they were exposed to a low amount of hostile aggression.

Discussion and conclusions

The present study clearly showed that driving style includes both “negative” and “positive” driver behaviours. It was found that positive driver behaviours were negatively associated with errors and violations but positively with age and mileage. Obviously, being a polite driver requires a driver to scan the traffic environment well and be aware of the situation in order to avoid behaviours that might annoy other road users. It is

also possible that drivers learn the “unofficial behaviour code” of driving during the time spent in traffic, which may also be called as “secondary” behaviours, which come into play in less-demanding driving situations. In the beginning of their driving career, novice drivers’ driving behaviours can be expected to be more based on formal rules. Within the first years of their driving, drivers learn that some rules are more important than the others. At the same time, the socialization process of driving teaches drivers the behavioural code of driving. Positive driver behaviours are “good manners of driving” which are learnt by experience in traffic.

It seems that respondents express their anger and get a similar reaction from other road users when they reported a high number of errors and a low orientation to positive driver behaviours. Since positive driver behaviours were negatively related to hostile aggression and revenge committed by drivers themselves and other drivers, positive driver behaviours can be said to be good for the traffic climate and driving atmosphere, the perception of which, in turn, may positively influence drivers’ driving style by buffering the effects of errors and violations on aggression, especially at places in which interpersonal contacts are frequent.

Traffic safety in the literature is normally seen as the *lack* of accidents, damage or injury, and hence, is mainly defined by using negative terms (Lehtimäki, 2001). In addition to the lack of safety training in the driving school curriculum, there is no training for stimulating “positive” driving style because the main emphasis of driving courses is to improve only driving skills and make candidates to drive autonomously. However, it is obvious that behaviours, which could potentially cause accidents or create a traffic atmosphere in which drivers are more likely to commit more violations, must also be considered. We may also need to extend the definition of traffic safety by emphasizing the positive side of driving too. Traffic should remind drivers of a lack of accidents and conflicts, i.e. “Positive Traffic Culture”, rather than the fear of a danger.

3. GENERAL DISCUSSION

The behaviour is a result of a contribution of the person, the situation or environment, and some probabilistic interactive function of person and environment (Lewin, 1952, p. 25). Since a road user is embedded in the whole traffic system or culture (see Figure 3), road user behaviour and its outcome (i.e., traffic accident), therefore, is a result of the contribution of an individual road user, the traffic culture and the probabilistic interaction of an individual road user and the traffic culture. Each component of traffic culture (see Figure 3) has its own weight on traffic safety level of a country (or unintentional injuries) and that weight depends on their relevance and importance in time and space of an event. The present study, however, aimed to investigate the role of some predominant external factors (e.g., economy and cultural values and characteristics), driver behaviours and

performance, and individual level factors affecting driver behaviours and performance and, thus, differences between countries in traffic safety.

The results of sub-study I showed unintentional injuries did not form a single general factor. Rather, unintentional fatalities had three independent components named as safety of daily life, work safety, and traffic safety. In traffic safety, economy and societal and cultural factors partly explain differences between countries. Specifically, GNP per capita and conservatism had a negative relationship with traffic fatality rates whereas uncertainty avoidance, neuroticism, and egalitarianism were positively related to the traffic fatalities. It is also very likely that economy is related to engineering (e.g., investment to the road infrastructure and vehicles), road user behaviour (e.g., high total mileage), and increasing attention to safety concerns and calculative judgement (i.e., individualism). This might supply a predictable and good rule-based (“conservative”) traffic environment, which has low level of uncertainty and which stresses road as the primary goal of the traffic system.

As claimed by Evans (2004), sub-studies II and III indicated that driver behaviour and performance are very important factors determining the overall safety and the differences between countries in traffic safety. Especially, driver behaviour (i.e., aggressive violations and errors) mediated the relationship between culture/country and accidents. Drivers from “dangerous” Southern European countries and Iran also scored higher on aggressive violations and errors than drivers from “safe” Northern European countries. However, “speeding” appeared as a “pan-cultural” problem of traffic. In addition, the conceptualisation (i.e., factor structure) of driver behaviour and performance was found to vary from one traffic culture to another. Specifically, the factorial agreement was unsatisfactory for aggressive violations and safety skills in Greece, Iran, and Turkey. It seems that the lack of social tolerance and interpersonal aggressive violations are important components of driving in Greece, Iran, and Turkey. However, DBQ aggressive violations subscale included only three items and, therefore, measured only few aspects of driver aggression.

In sub-study IV, thus, the cross-cultural differences in different types (emotional and instrumental) of aggressive driving were examined by using a newly developed behavioural scale among British, Dutch, Finnish, and Turkish drivers. The results showed that the conceptualisation of aggressive driving also varied from one traffic culture to another. Contextual demands, in other words, seem to influence aggressive driving. Turkish drivers scored higher on most of the “emotional” and “instrumental” aggressive behaviours than British, Dutch, and Finnish drivers did.

Everyday driving, on the other hand, does not involve only erroneous (i.e., risky or dangerous driving) or correct performance (i.e., normal habitual driving) but also

“positive” driver behaviours. The differences between countries in traffic safety, therefore, should be evaluated by taking into account all possible intentional behaviours in traffic. In sub-study VII, hence, a reliable scale for measuring “positive” driver behaviours was developed while keeping the theoretical taxonomy of the DBQ and its characteristic as a behavioural scale. As expected, the results showed that positive driver behaviours were negatively associated with errors, violations, aggressive warnings and hostile aggression and revenge.

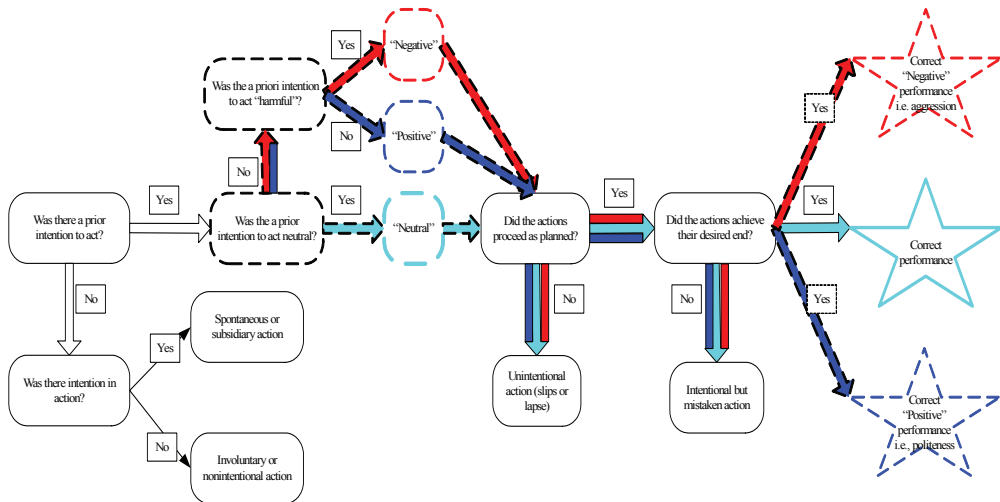


Figure 5. Revised version of Reason’s algorithm for distinguishing the varieties of intentional behaviour (dashed lines, colours, and boxes were added).

As a result of sub-studies II, III, IV, and VII, the model of Reason’s algorithm for distinguishing the varieties of intentional behaviour was revised (see Figure 5). Hence, the new DBQ, which this study is based on, can be used as an omnibus scale for measuring general driving style by including “negative”, “neutral” (i.e., correct performance), and “positive” behaviours. As presented in Figure 5, the intentional behaviour can be distinguished through four questions requiring yes-no answers regarding a given sequence of actions. Since intention is the main predictor of our behaviours (Fishbein & Ajzen, 1975) and the key factor for classifying the driver behaviours (Reason, 1990), the question tapping the “nature” of the intention (“was the a priori intention to act neutral?”), in other words ‘motive’, was added to the original version of Reason’s algorithm so as to distinguish the varieties of intentional behaviour.

When having a “neutral” intention, a driver is supposed to perform a task correctly (i.e., correct performance) without any “extra-motive” (Reason, 1990). However, it is likely that a driver could aim to “harm” other road users in traffic because of some other reasons (e.g., gaining advantage) and this could be ‘correctly done’ even though the

outcome may be unacceptable in a certain traffic culture. In contrast, a driver might be considerate of the traffic environment or other road users and try to help and to be polite with or without safety concerns. This could be called as correct “positive” performance. It can be, therefore, concluded that ‘what you get as the end-state’ might depend mainly on ‘what you intend to do in traffic’. These “negative”, “neutral”, and “positive” behaviours can be committed, on the other hand, without a violation (mistakes) or an error (slips and lapse) if the action and the plan were adequate for reaching their desired goals. In contrast, these behaviours may sometimes include errors or violations when the aforementioned requirements are not fulfilled.

The results of sub-studies II and VII showed that errors and violations were related to the number of traffic accidents. In sub-study IV, it was also found that aggressive warnings and hostile aggression and revenge were associated with the number of accidents. The results of sub-study VII, on the other hand, indicated that “positive” driver behaviours had a negative relationship with errors, violations, and aggression. It can be supposed that “positive” driver behaviours might buffer the effect of aberrant driver behaviours on accident involvement by emphasizing the positive side of driving (e.g., the lack of accidents and conflicts) or “Positive Traffic Culture”. Similarly, the results of sub-study III indicated that overestimation of the perceptual-motor skills might be related to risky driving style and offences if not buffered by the high level of safety driving skills.

Sub-studies II, III, IV, and VII all seem to emphasize the role of interpersonal interaction of drivers in dangerous general driving style and accident involvement even though “blaming others” is widespread across countries. Sub-study IV, for example, clearly showed that the interaction between “others” and “self” was a critical component of safe driving across countries, and the symmetric interpersonal aggression between aggressive warnings and hostile aggression and revenge factors of “self” and “others” created a serious risk for road accident involvement in almost all countries. In addition to the interaction between “others” and “self”, a driver’s arousal level (anger) is also an important factor in escalation of aggression and retaliation (i.e., Turkish and British male samples). Moreover, the results of sub-study IV showed that cognitive biases (i.e., actor-observer effect, false consensus bias, and anonymity) should be taken into account when evaluating the general driving style of “self” and “others”.

Consistent with the previous studies, intrinsic variables (i.e., age and sex) were related to driver behaviours including “negative” and “positive” behaviours as well as to drivers performance and accident involvement. In general, it can be assumed that young and male drivers are the most risky driver group in traffic. Sub-studies V and

VI, thus, targeted young drivers to investigate the role of gender in driver behaviour, performance, and accident involvement. The results of sub-studies V and VI showed that, in addition to biological sex, gender role is also closely related to Turkish young drivers' driver behaviour and performance. Similar to sub-study III, the asymmetric relationship between masculinity and femininity in general driving style was found in sub-studies V and VI. In particular, masculinity was positively related to the number of offences, aggressive and ordinary violations whereas femininity was negatively related to the number of accidents, offences, aggressive and ordinary violations and errors. In addition, masculinity was positively associated with highly self-evaluated perceptual-motor skills while femininity was positively associated with safety driving skills.

3.1. Implications

In sub-study I, it was demonstrated that economic situation and societal and cultural factors partly explain the differences between countries in traffic safety. It should be noted that, however, it is not easy to change societal and cultural factors. On the contrary, they are external factors to the traffic system and, therefore, it is very likely that internal factors (i.e., engineering and road user factors) might buffer or facilitate their effects on traffic safety. It seems that in addition to the traditional three E's in injury prevention (i.e. Engineering, Enforcement, and Education), Economy should be added as the fourth E of injury prevention. For example, economic incentives should be used for encouraging injury prevention (e.g., monetary incentives for purchasing safety equipment) and structural modifications. Economic resources might also be efficiently spent on not only traffic and road and automotive engineering but also education, enforcement, and emergency services to have a more predictable, certain, interpretable, and preventive traffic system. Besides, the GNP also correlated with both culture dimensions and values, which influenced their relationship with unintentional injuries. It is likely that economical incentives could be used as tool for developing a more safety-minded cultures and values. Moreover, up-to-date Highway Code and applicable legislative interventions (i.e., enforcement) and education should also target driver behaviour and performance of everyday traffic.

Sub-study II showed that driver behaviour (i.e., aggressive violations and errors) mediated the relationship between a country and accident risk. Southern European countries and Iran scored higher on aggressive violations and errors than Northern/West European countries. Road safety interventions should, therefore, target aggressive violations and errors to reduce the differences between countries in traffic safety. Although errors were seen as mainly related to cognitive processes of the individual (Reason et al., 1990), the results of sub-study II reminded us about the interaction between individual

and environment. Errors might occur even in the absence of any cognitive deficiencies because of the lack of supportive social and physical context (i.e., the importance of engineering). “Speeding”, on the other hand, was found to be the main “pan-cultural” problem of the traffic cultures. Technology (i.e., in-vehicle technologies) could be used, for example, to cope with speeding problems both in “safe” and “dangerous” countries’ traffic.

Results of sub-study III showed that safety and perceptual-motor skills are independently related factors and that high levels of safety skills buffered the effects of perceptual-motor skills in traffic offences. A subjective sense of control might lead to biased perception or overconfidence which, in turn, results in a biased risk assessment and high levels of risk acceptance (e.g., Matthews & Moran, 1986; unrealistic optimism or illusion of control, McKenna, 1993). It should be noted that, however, overconfidence in skills will not inevitably lead to more accidents or offences. It depends on the driver’s style or strategy in driving (Katila et al., 1996) and the level of safety skills. Inevitably, however, targeting cognitive biases should activate self-awareness or deepen insight into “real” driving skills (especially) when accompanied by heavy incorporation of safety skills into driving skills through driver education and licensing, media, and social norms (i.e., the definition of a “good” driver).

As sub-studies II and III implied, sub-study IV clearly revealed that aggressive driving is a problem especially in “dangerous” Southern European countries. However, the interaction between “others” and “self” had an important role in aggressive driving across all countries. In addition, a driver’s arousal level (anger) is also important in escalation of aggression and retaliation. Driver education should, therefore, include training courses about the sources (e.g., attributions, cognitive biases) and coping strategies (i.e., relaxation techniques) of anger and aggression, and aggressive driving (i.e., avoiding straight contact with the aggressor).

Sümer et al. (2006) showed that drivers with low levels of safety skills tend to experience relatively more frequent feelings of hostile aggression and revenge, which in turn, causes aggressive driving. The mediating effect of the safety skills between anger and aggressive driving was, in fact, reported by Lajunen et al. (1998). Besides, positive driver behaviours, i.e. polite driving, had a negative relationship with aggressive driving in sub-study VII. Moreover, strict and fair enforcement should focus on interpersonal aggressive behaviours as much as on ordinary violations (e.g., speeding). “Inter-road user skills” might be put into driver education as well vehicle handling skills and knowledge of traffic code (e.g., Finnish driver education curriculum) (Lajunen, 1997). Since conflicts between drivers result largely from design problems in infrastructure and ambiguity of rules, special attention should be paid to system design in order to

reduce potential interpersonal conflicts (i.e., roundabouts) (Shinar, 1998). It should be noted, however, that engineering activities should focus not only on reducing “negative” behaviours and increasing “correct-performance” but also on increasing “positive” driver behaviours.

As presented in the revised version of Reason’s algorithm for distinguishing the varieties of intentional behaviour (see Figure 5), all types of behaviours depend mainly on ‘what to intend to do in traffic’ rather than on the adequacy of the plan and action for reaching their desired end. This points out that ‘intention’ is the most important element in driving. In addition to interventions on behaviours, therefore, ‘intentions’ should be targeted for improving positive and correct driver behaviour. Theory of Planned Behaviour (TPB by Ajzen, 1991), for example, revealed that intentions are predicted by attitudes, social norms and perceived behavioural control as well as habits, self-efficacy, and anticipation regret. Targeting the ‘intention’ could be, in fact, proactive and helpful intervention for improving traffic safety (see Forward, in press for detailed information). Recently, in addition, the implication of implementation intentions technique (e.g., see Gollwitzer, 1999) was successfully worked in the context of drivers’ compliance with speeding behaviour (see Elliott & Armitage, 2006 for detailed information).

It is well known that young male drivers are overrepresented in accident involvement and risky driving. Therefore, aforementioned issues should be especially taken in to account among young drivers. Beside, the sub-studies V and VI showed that gender is an influential factor as much as sex of drivers in expressing their general driving style. It was reported that risky driving style increased as a function of masculinity and being male whereas it decreased as a function of femininity. Similarly, the present study showed that perceptual-motor skills increased as a function of masculinity and being male while safety skills increased as a function of femininity. It can, therefore, be concluded that the feminine characteristics of the drivers might be used to promote safety-oriented general driving style. Both sexes can have masculine and/or feminine characteristics. Since gender is a social and cultural construct rather than one that arises from innate temperamental differences between sexes. Social psychological theories (e.g., the social role model by Eagly, 1987) might be useful for reshaping the relationship between gender roles of drivers and general driving style. In this way, some of the feminine characteristics (e.g., ‘caring for others’), which were found to be related to more careful driving and fewer errors (see sub-study V), might also be attached to masculine characteristics in the relatively patriarchal Turkish society by role models.

CRITICAL REMARKS

The limitations of the present study were presented either in the methodological considerations part of the study or in the limitations of the study part of each original article. Besides, additional consideration of the concepts and methods used, possible limitations of the results and their implications might be needed before making firm general conclusions. In other words, results should be generalized to similar driver groups, places, and conditions.

The conceptualisation of traffic culture seems to be broad and sometimes equals to traffic system. Traffic culture and traffic system are, in fact, mutually inclusive and the main reasons contributing to the differences in traffic safety between countries. It should be noted that, however, they are based on different principles. For example, rules, values, and norms are the centre of the mechanism of traffic culture (or software) whereas traffic system (or hardware) is mainly based on goals and formal decisions and regulations to cope with mainly internal factors of traffic. Functional traffic system would guarantee the high level of traffic safety in a country. While traffic culture would anyhow emerge in any traffic system, the level of functionality of a traffic system would determine whether traffic culture could positively influence the high level of traffic safety in a country.

Safety was defined as the lack of accidents and near accidents in the present study. In spite of the single definition of safety used in the present study, different measures (i.e., fatalities per 100,000 population or 1 billion vehicle-kilometres or the number of accidents) were used for the indication of the level of safety. As presented in the introduction, it should be noted that accidents and their consequences are different and different safety measures have different origins. In addition, it is known that reasons of accidents might vary across countries, age groups, and sex groups, even types of accidents. The samples of some studies were heterogeneous (i.e., different exposure scores of drivers in different countries) and student samples (i.e., sub-study V and VI). Therefore, the characteristics of samples were matched in the main studies (i.e., sub-study II and sub-study III) and the analyses were run separately for men and women (i.e. sub-study IV). However, the sample sizes were not large enough to run separate analyses according to the types of accidents (e.g., active vs. passive). Using the same indicator for safety in each sub-stud was not practically possible either.

Sub-studies are mainly correlational studies and based on either data, which had been collected earlier for other purposes (sub-study I), or self-reported measures. In such studies, it is likely that possible important factors, which are not controlled, can influence the results of the study. In sub-study IV, for instance, the interaction of road

users and the possible escalation of aggression were studied. It should be noted that, however, drivers reported their own aggressive acts and their exposure to aggressive acts. It is likely that there might be no connection between these behaviours and they do not necessarily happen in the same situation. Experimental and field studies might be, therefore, needed for validating (and/or making cause-effect conclusion) the results of some sub-studies in further studies.

CONCLUDING REMARKS

In the next decades, one of the primary challenges of traffic psychology will be to provide better understanding of the reasons for the considerable regional differences between countries in traffic safety as well as in traffic cultures and, consequently, to develop effective countermeasures. These aims can be achieved by developing a more comprehensive theory of accident risk that should include major factors influencing a country's traffic safety. In the present study, traffic culture framework was used to study the differences between countries in traffic safety. However, the present study was able to focus only on some elements of the two levels of external factors (i.e., eco-cultural-socio-political and individual levels) and on road user component of internal factors.

The results showed that economy and societal and cultural factors appeared to be the important factors in the reasons of differences between countries (i.e., Southern Europe/Iran vs. Northern/Western Europe) in traffic safety. As claimed by Evans (2004), the present study revealed empirically that driver behaviour and performance are the dominant factors in explaining this difference. As Elvik (2004) pointed out, effective road safety measures have to influence human behaviour. The present thesis, on the other hand, extended the definition and content of driver behaviour by adding 'new' taxonomies (i.e., "positive" and "negative" behaviour). In addition, it seems that the outcome (i.e., behaviour) is mainly shaped by apriori intention. Thus, traffic safety measures have to target intentions too.

To achieve and/or sustain safe driving style, the results indicated that safety skills, "positive" driver behaviour, and cooperative interpersonal interactions with others have to be incorporated into driver education and enforcement strategies. Engineering interventions should provide drivers with a supportive context and environment for these. Moreover, in-vehicle technologies could be used for reducing especially "speeding" violations. The role of cognitive biases and other road users in traffic safety should be comprehensively evaluated and incorporated into traffic system through driver education, media, and enforcement.

Since the young male drivers group is the most risky group across countries, road safety measures might focus on how to reduce their risky general driving style. The results indicated that gender roles could be as important as sex in shaping their driver behaviour and performance. Role models, therefore, can be used to improve safe driving by activating some gender characteristics (e.g., caring for others) in traffic. Further research should be directed, on the other hand, to the investigation of the relationship between other components of traffic culture and accident risk. More specified and concise models of accident causation (see e.g., Lajunen, 1997) should be developed by using “traffic culture” concept as a framework.

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