The Driver Behaviour Questionnaire in South-East Europe countries: Bulgaria, Romania and Serbia

Predrag Stanojević[a], Timo Lajunen[b], Dragan Jovanović[c], Paul Sârbescu[d], Svilen Kostadinov[e]

[a]*Technical College of Applied Sciences, Urosevac (Leposavic), Serbia*

[b]*Department of Psychology, Norwegian University of Science and Technology, Trondheim, Norway*

[c]*Department of Transport, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia*

[d]*Psychology Department, West University of Timișoara, Timișoara, Romania*

[e]*Transport Department, University of Ruse, Ruse, Bulgaria*

Abstract

Using data from three samples and more than 1000 participants, this study examined the psychometric properties of the Driver Behaviour Questionnaire (DBQ) in three countries from South-East Europe. Differences in driving behaviour between countries were also investigated. Exploratory factor analysis results supported the distinction between errors and violations in all three countries. Furthermore, the positive associations of both errors and violations with self-reported traffic accidents were also consistent in all three samples. In terms of differencesin driving behaviour, Romanian drivers scored higher on many error and violation items. Also, speeding violations were the most common violations in all three countries. Overall, our results provide further support for using the DBQ to measure aberrant (i.e. errors and violations) driver behaviour.

Keywords: Manchester Driver Behaviour Questionnaire; Factor structure; Cross-cultural; Accidents

1. Introduction

The problem of safety in road traffic represents a major challenge at a global level. More than 1.24 million people are killed on the world's roads each year, with low and middle-income countries bearing a disproportionate burden (WHO, 2013). Even within Europe there are regional differences. Compared to west European countries, countries in South-East Europe have higher road accident fatality rate. For example, in 2012 Bulgaria had 8.2, Romania 9.6 and Serbia 9.6 road traffic fatalities per 100.000 inhabitants, whereas the corresponding figures for the United Kingdom, the Netherlands and Germany were 2.8, 3.2, and 4.4, respectively (European Commission, 2013; RTSA, Serbia, 2013). These differences can to some extent be explained by differences in economic, societal, and cultural factors (Özkan & Lajunen, 2011).

Driving behaviour can be assumed to reflect these differences in traffic safety.For example, comparing British, Dutch, Finnish, Greek, Iranian and Turkish drivers, Özkan, Lajunen, Chliaoutakis, Parker, and Summala (2006) showed that drivers in Western/Northern European countries scored higher on ordinary violations, whereas drivers in Southern/Middle Eastern European countries had higher scores on driving errors and aggressive driving. It was suggested that the higher level of aggressive driving and errors of drivers in these countries was due to higher levels of conflict attributed to less developed infrastructure, less respect for traffic rules and higher levels of driver stress. Also, it was claimed that the concept of being a "safe driver" depends on culture and, therefore, understood differently in different countries. Another study showed that Finnish and Swedish drivers reported aggressive violations and ordinary violations (with speeding being the exception) less frequently than Greek and Turkish drivers (Warner, Özkan, Lajunen, &Tzamalouka, 2011).

Driving can be seen as being composed of two separate components: driving skills and driving style (Elander, West, & French, 1993). Driving skills include those information processing andmotor skills, which improve with practice and training (i.e. with driving experience). Driving style concerns individual driving habits-thatis, the way a driver chooses to drive (Lajunen & Özkan, 2011). The Driver Behaviour Questionnaire (DBQ) (Reason, Manstead, Stradling, Baxter, & Campbell, 1990) isone of the most widely used instruments for measuring driving style. In their study, Reason et al. (1990) found that driving errors and violations are two empirically distinct classes of behaviour containing three factors: *violations, errors* and *slips and lapses*. They defined violations as "deliberate deviations from those practices believed necessary to maintain the safe operation of a potentially hazardous system" and errors as "the failure of planned actions to achieve their intended consequences". Reason et al. (1990) also found a third DBQ factor, which they named "slips and lapses". This factor included attention and memory failures, which can cause embarrassment but are unlikely to have an impact driving safety. Violations refer to behaviours such as "close following, speeding, risky overtaking". Errors refer to behaviours such as "failing to notice pedestrians crossing, miss "Give Way" signs and narrowly avoid colliding". Lastly, slips and lapses refer to behaviours such as "attempt to drive away from the traffic lights in third gear, forgetting where one's car is parked".

Later, Lawton, Parker, Manstead, and Stradling (1997) found that the original violations could be divided into interpersonally aggressive violations, which contain an interpersonally aggressive component, and ordinary violations, which are deliberate deviations from the highway code without a specifically aggressive aim.

In DBQ literature, the number of extracted factors has varied from two to six. This lead to scientific discussion about the most applicable factor solutions of the DBQ (see de Winter, 2013;

Martinussen, Hakamies-Blomqvist, Møller, Özkan, & Lajunen, 2013; Mattsson, 2012; Mattsson, 2014). The main distinction between errors and violations seems to be the most stable in all studies, despite some dissimilarity in factor structures (Özkan et al., 2006). 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 errors and violations. In the follow-up study by Özkan, Lajunen, and Summala (2006), the two-factor solution emerged as the most applicable and stable one over three years follow-up period among possible factor solutions of the DBQ. Furthermore, Warner, Özkan, Lajunen, and Tzamalouka (2011) shows that the two-factor solution including errors (errors and lapses) and violations (aggressive and ordinary violations) was fairly stable over the four countries (Greece, Finland, Sweden and Turkey), even though three of the ordinary violation items and two of the lapses items had their highest loading on different factors in different countries. However, evidence that supports the application of a four-factor solution should not be disregarded (e.g. Martinussen et al., 2013,Mattsson, 2012).

One of the most important applications of the DBQ is the prediction of individual differences in accident involvement. Most of the studies showed that violations were correlated with traffic accidents (e.g. Gras, Sullman, Cunill, Planes, Aymerich, & Font-Mayolas, 2006; Parker, Reason, Manstead, &Stradling, 1995; Parker, West, Stradling, &Manstead, 1995; Ozkan & Lajunen, 2005; Rimmo& Aberg, 1999; Ozkan et al., 2006; Kontogiannis, Kossiavelou, &Marmaras, 2002). However, results about errors and lapses are not so clear. Several studies showed that there are correlations between errors and traffic accidents (e.g. Guého, Granie, &Abric, 2014; Rimmo&Aberg, 1999;Sümer, 2003; Bener, Özkan, & Lajunen, 2008, regarding Qatar but not in United Arab Emirates), whilst in other studies that wasn’t the case (e.g. Gras et al., 2006, Kontogiannis et al., 2002; Parker et al., 1995; Ozkan et al., 2006, regarding all countries in the

study except for Turkey). However, Wåhlberg, Dorn, and Kline (2011) observed that in the literature “errors and lapses, taken together, have been significant predictors of accidents about as many times as the various violation factors” (p. 12). Also, a meta-analysis by De Winter and Dodou, (2010) showed that errors and violations are about equally strong predictors of self-reported accidents.

The aim of the present study was to investigate the factor structure of the DBQ and to identify differences in tendency to commit aberrant drivingbehaviours between the three countries in South-East Europe: Bulgaria, Romania and Serbia. Finally, we also examined the relationships between the factorsof the DBQ, background variables, and accident involvement.

2. Methods

2.1. Participants and procedure

The Bulgarian sample was constructed using the snowball sampling technique (Goodman, 1961). Each studentof Faculty of Transport applied the questionnaire (in paper-pencil or electronic format) to at least 5 persons holding a driver’s license. All respondents replied to the questionnaire anonymously and voluntarily. Students received extra credit for this task.

The Romanian sample was also constructed using the snowball sampling technique (Goodman, 1961). Psychology students applied the questionnaire (in paper-pencil or electronic format) to at least 5 persons holding a driver’s license. Students received extra credit in an introductory statistical course for this task.

The data in Serbian sample were collected by mail. The names and addresses of 500 individuals with valid driving licenses were obtained from the register of owners of motor

vehicles. The questionnaires were sent to the above-mentioned sample group, along with a cover letter explaining the purpose and objective of the research. We included a prepaid envelope to be used to return the completed questionnaires.

Onethousand and fifty one drivers (344 from Bulgaria, 342 from Romania, and 365 from Serbia) participated in this study.The characteristics of the Bulgarian, Romanian and Serbian samples are presented in Table 1. One-way analysis of variance and chi-square test were performed to test for differences between demographic variables.

[Insert Table 1 about here]

2.2. Measures

2.2.1. Driver Behaviour Questionnaire (DBQ)

The extended version of DBQ was used to measure aberrant driver behaviours (Lawton et al., 1997; Parker et al., 1998). This questionnaire consisted of a total of 27 items. Three of these items were designed to measure aggressive violations (e.g., sounding the horn to indicate annoyance), 8 items were used to measure general violations (e.g., pulling so far into a junction or intersection that the driver with right of way must stop and let the respondent pass), 8 items were used to measure omissions (e.g., underestimating the speed of an oncoming vehicle when overtaking another vehicle) and 8 items were used to measure errors (e.g., forgetfulness about where in a parkinglot a car had been left). Respondents were asked to indicate how often they committed each of the violations and errors when driving. Responses were recorded on a six-point Likert scale that ranged from 1 to 6 (1 = never; 6 = almost allthe time).

This DBQ version has been previously adapted and validated in Romania (Sârbescu, 2013). For Bulgaria and Serbia, the adaptation of the DBQ was done using the back-translation method. The items were translated into Bulgarian and Serbian by a Bulgarian and Serbian native,

proficient in both languages (native and English). Afterwards, they were translated back into English by a professional translator,and compared with the original version of DBQ. No major differences were identified.

2.2.2. Demographic measures

Participants answered questions about their age, gender, accident involvement duringthe previous 3 years (number of accidents), the number of years that they had beenlicensed to drive and estimated their annual mileage.

2.3. Statistical analyses

The factor structure of the 27-item DBQ was initially examined using confirmatory factor analysis (CFA). However, if the model produced poor fit to the data, principal component analysis (PCA) was run to examine the factor structure of the DBQ in Bulgaria,Romania and Serbia. The internal consistency of the DBQ scale scores was assessed by calculating Cronbach's alpha reliability coefficients.

One-way analysis of covariance (ANCOVA) was used to identify differences in tendency to commit aberrant drivingbehaviours between the three countries after controlling for age, gender and annual mileage.

The correlations between background variables, DBQ factors, and the number of traffic accidents were examined through the calculation of Pearson's correlation coefficients.

As the self-reported yearly accident rate did not follow normal distribution, Poisson or negative binomial regression analyses (see Lord, Washington, & Ivan, 2005) were performed for

all countries. In each of the analyses, age, gender, annual mileage as well as DBQ factors were entered by using forward selection (p-value for F-to-enter was 0.05).

3. Results

3.1. Factor analysis of the DBQ in Bulgaria,Romania and Serbia

A confirmatory factor analysis (CFA) was used to test the internal structure of the DBQ. The fit of the model was evaluated by χ^2/degree of freedom ratio, root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), and the root mean square residual (RMR). In general, good fit of model should have 2:1 or 5:1 χ^2/degree of freedom ratio, GFI > 0.90, AGFI > 0.90, CFI > 0.90 (preferably > 0.95), and RMSEA and RMR < 0.08 or 0.10 (preferably < 0.06) indexes (Byrne, 1998; Hu &Bentler, 1995, 1998, 1999; Russell, 2002).

Four competing models of the DBQ were tested: the two factor model (Özkan et al., 2006); the original three factor model proposed by Reason et al. (1990); the four factor model proposed by Lawton et al. (1997); and the second-order factors model (aggressive and "ordinary" violations constitute a second-order "violations" factor and "errors" and "lapses" form a general "unintentional mistakes" factor) proposed by Lajunen et al. (2004). As can be seen in Table 2, surprisingly no model showed good fit to the data. Given that the application of CFA provided poor fit, data were re-examined within an exploratory factor analysis framework. The 27 items were subjected to PCA in order to determine the factor structure. Initially, ten, seven and seven factors had eigenvalues over 1.0 in Bulgaria,Romania and Serbia samples, respectively.

However, both the Scree plot and parallel analysis suggested the two-factor solution to be the most interpretable one in all of three samples.

As there were a number of relatively high inter-correlations, the oblimin method of rotation was used.The factor analysis was then rerun specifying two factors. The two sets of items with factor loadings >0.30 were then interpreted (table 3).

[Insert Table 2 about here]

Table 3 shows that almost all violations (aggressive and ordinary violations) items had their highest factor loading on one factor, which could be labelled “violations”. However, the factor included one lapse (“Realize that you have no clear recollection of the road along which you have just been travelling”) and one error item (“Miss “Give Way” signs and narrowly avoid colliding with traffic having right of way”) in the Bulgaria sample. Also in the Bulgaria sample the two ordinary violation items (“Overtake a slow driver on the inside” and“Pull out of a junction so far that the driver with right of way has to stop and let you out”) had factor loadings lower than 0.30. The second factor combined items from the original errors and lapses subscales and was named “errors”. However, five items (11, 4, 21, 12 and 15) in Bulgarian sample, one item (15) in Romanian sample, and one item (2) in Serbian sample came from the original errors and lapses subscales had factor loadings lower than 0.30.

[Insert Table 3 about here]

3.2. Between countries comparisons on DBQ items

Table 4 shows that after adjusting for age, gender and annual mileage there were significant differences between the three countries for 23 of the 27 items. The most similarities were found between Romania and Serbia; specifically, no differences were identified for 15 out of the 27 items.

It seems that Romanian drivers are more prone to commit ordinary violations and lapses than Serbian and Bulgarian drivers. Romanian drivers scored higher on most ordinary violations and lapses items with a significant difference in comparison to the other two countries. The differences in speed related behaviour are especially highlighted, with scores at two items ("Disregard the speed limit on a motorway" and "Overtake a slow driver on the inside") a lot higher than in Bulgarian and Serbian samples.

The two most common violations in all three countries are "Disregard the speed limit on a motorway" and "Disregard the speed limit on a residential road". "Underestimate the speed of an oncoming vehicle when overtaking" was the most frequent error among Romanian and Serbian drivers, while "Fail to notice that pedestrians are crossing when turning into a side street from a main road" was the most frequent error of Bulgarian drivers.

[Insert Table 4 about here]

3.3. Multiple correlation coefficients

Table 5 lists correlations between demographic variables, violations, errors, and the number of traffic accidents.

Being male was related to a higher number of traffic accidents in Romania and Serbia. Age was negatively related to the number of traffic accidents only in Bulgaria.

Being female was negatively related to violations while it was positively associated to errors in Bulgaria and Romania. Age was negatively, whereas annual mileage was positively associated with violations in Bulgaria and Serbia. Also, annual mileage was negatively related to errors in Bulgaria.

Self-reported accident involvement was positively related to violations and errors in all three countries.

[Insert Table 5 about here]

3.4. The relationship between DBQ factors and accident involvement

The distributions of accidents did not follow normal distribution. Thus, Poisson or negative binomial regression analyses were performed for all three countries. In each of the analyses, age, gender,annual mileage,violations and errors were entered by using forward selection (p-value for F-to-enter was 0.05). We used goodness-of-fit statistics to test for the appropriateness of the regression models based on Poisson distribution. These statistics indicated misfit of Poisson distribution for self-reported yearly accident involvement in all three countries (Bulgaria - χ^2 (338) =515.23, $p < 0.001$; Romania - χ^2 (336) =451.11, $p < 0.001$; Serbia - χ^2 (359) =526.34, $p < 0.001$). Therefore, models based on negative binomial distribution were constructed for all three countries.

As shown in Table 6, gender was the significant predictor of accident involvement in Romanian and Serbiansamples. According to incidence rate ratios, female drivers had 39% and 57% less accidents in Romanian and Serbiansamples, respectively. Violations and errors were positively related to the total number of accidents in all three samples. Annual mileage was significantly associated with the number of accidents only in Romanian samples.

[Insert Table 6 about here]

4. Discussion

The main objective of this study was to verify the psychometric properties of the DBQ in three countries from South-East Europe: Bulgaria, Romania and Serbia. The between countries differences concerning driving behaviour were also examined and revealed several notable

differences. With regard to the factor structure of the DBQ, although the initial CFA results were not very satisfactory, the EFA revealed a pretty stable two-factor structure in all three countries.

The DBQ has been used in many studies of driving behaviour, with various factor structures being proposed. In the present study, CFA was used to test four competing models of the DBQ. Due to application of CFA provided poor fit, exploratory factor analyses were performed. The EFA of the DBQ using the Bulgaria, Romania and Serbia data produced a two-factor solution, which was in line with numerous previous research (e.g. Cordazzo, Scialfa, Bubric, & Ross, 2014; Lajunen et al., 2004; Özkan et al., 2006; Warner et al., 2011). Although not expected, the differences in DBQ structure show that different behaviours in general and questionnaire items in particular, can be interpreted differently even in countries as culturally similar as Bulgaria, Romania and Serbia. It seems that even though the three countries belong to the same geographical region, there are some cultural, social and economic factors which could have caused the dissimilarities in factor structures. Furthermore, as Baner et al. (2008) argue, the DBQ factor structure might get more blurred while the frequency of the behaviours gets higher when going far from West/North to East/South. In this study the reliabilities scores were in general lower than in the original British data and the factor Errors was even unreliable in the Bulgaria sample. It is quite possible that scaling or ways of response to items might vary from Western societies to the South-East European countries. In addition, the results of the present study clearly support the idea (see Özkan et al. 2006) about possibility to develop both fine-tuned ‘‘national scoring keys’’ for domestic use and keep the ‘‘core DBQ items’’ for cross-cultural comparisons.

Our results are in line with a large number of studies (e.g. Aberg &Rimmo, 1998; Bener et al., 2008; Özkan et al., 2006; Warner et al., 2011) which have found that the frequencies of the DBQ responses were, in general, between “never” to “hardly ever” and rarely “occasionally” in

all three countries. Furthermore, it seems that Romanian drivers are more prone to commit ordinary violations and lapses than Serbian and Bulgarian drivers. The two most common violations in all three countries are "Disregard the speed limit on a motorway" and „Disregard the speed limit on a residential road". These results show that regardless of socio-economic and cultural differences, the speeding problem is universal. Other studies indicate that disregarding the speed limit is considered the most frequently reported road traffic violation (Gras, et al., 2004; Stradling, et al., 1992). Speeding related behaviours are widespread, considered deeply entrenched and generally socially condoned (Croft, 1993). Speeding is also considered the main cause of road deaths around the world (European Traffic Safety Council [ETSC], 2011). Thus, the fact that speeding violations are the most common in all three countries is not surprising at all, taking into account the existing road and infrastructure conditions.

The results of our regression analyses are in consistence with numerous previous studies. Firstly, both errors and violations were positively related to accident involvement in all three samples. This association was previously confirmed by a meta-analysis (de Winter & Dodou, 2010); thus, our results further strengthen this association with data from South-East Europe. Secondly, gender was a significant predictor in two out of three samples, with females reporting lower accident involvement than men. This effect is also consistent with previous research and statistics; for example, the ETSC (2013) reported that females have a three times smaller rate of road mortality than men do, across all European countries. Lastly, one may have noticed the small *Pseudo* R^2 values in the regression analyses for all three countries. Although these values do not appear to be very encouraging, they represent (as other authors have noted as well; e.g. Dahlen et al., 2012) only a reminder of the complexity of traffic accidents. While demographics and aberrant driving behaviours (such as errors and violations) are definitely relevant, there are a lot of other variables (e.g. situational ones) that are related to traffic accidents.

The present study has some methodological limitations that should be taken into account. First, the samples of the study did not represent countries' population, and the sample sizes were small. Second, the data were based solely on self-reports of behaviour. This method of collecting data may lead to the possibility of collecting data that are distorted due to receiving socially desirable answers from the respondents. However, as no names were collected and data collection was undertaken remotely the impact of social desirability bias is unlikely to have significantly affected the results. Furthermore, in their experimental study about the DBQ and socialdesirability bias, Lajunen and Summala (2003) concluded that the bias caused by socially desirable responding is very small in the DBQ responses.

Although self-report methodology have been used for a wide variety of research in driving context, there are some concerns about biased and incorrect responses, especially when subjects have been asked about past accidents, near misses, mileage, and driver behaviour. However, based on the review of many studies that have used DBQ (de Winter and Dodou, 2010, reports on 174 studies using some version of the DBQ) we can conclude that DBQ has good construct validity, and that it is a useful scale to measure the self-reported aberrant behaviours. Lajunen and Özkan (2011) point out that "although the DBQ yields slightly different factor structures in different countries, the core structure of the instrument seems to be stable, showing high construct validity" (p. 54). Furthermore, studies show that bias caused by socially desirable responding is relatively small in DBQ response (Lajunen & Summala, 2003; Sullman & Taylor, 2010). In addition, recent research has shown that the DBQ scores (especially for the violations sub-scale) not only describe aberrant driving behaviours, but endorsement of these items are also associated with habits or practices of more risky driving styles observed on the highway (Zhao, Mehler, Reimer, D'Ambrosio, Mehler, & Coughlin, 2012).

To put it all together, this study enriches our view concerning the DBQ with results from three countries in South-East Europe. The generally acknowledged fact that driving behaviour varies a lot between countries is illustrated in our study as well. Also, the fact that speeding violations were the most common violations in all three countries provides further evidence for the severity of the phenomenon. Last but not least, the almost universal difference (when referring to driving behaviour) between errors and violations gained support from our results as well. Thus, it appears that the DBQ is a pretty reliable instrument for measuring driving behaviour in Romania, Bulgaria and Serbia.

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Table 1

The distribution of demographic variables for Bulgaria, Romania, and Serbia, respectively.

Demographics	Bulgaria	Romania	Serbia	P value
Age				
Mean	33.07	28.27	34.90	<0.001
SD	12.30	10.98	10.37	
Minimum- Maximum	18-60	18-63	18-68	
Gender				
Males (%)	206 (59.9)	190 (55.6)	210 (57.5)	0.517
Females (%)	138 (40.1)	152 (44.4)	155 (42.5)	
Annual mileage				
<10.000 (%)	204 (59.3)	109 (31.9)	211 (57.8)	
10.000-30.000 (%)	95 (27.9)	59 (17.3)	119 (32.6)	<0.001
30.000-50.000 (%)	28 (8.1)	52 (15.2)	18 (4.9)	
50.000> (%)	16 (4.7)	122 (35.7)	17 (4.7)	
Driving experience in years				
Mean	13.70	7.44	13.54	<0.001
SD	12.18	8.04	9.18	
Minimum- Maximum	1-47	1-40	1-46	
Number of accidents				
Mean	0.62	0.55	0.31	<0.001
SD	1.08	0.95	0.74	
Minimum- Maximum	0-6	0-6	0-5	

Table 2

Goodness of Fit statistics for competing models of the DBQ.

Model	χ^2/df	RMSEA	GFI	AGFI	CFI	RMR
Bulgaria						
Two factor	677.6/323=2.1	0.06	0.87	0.85	0.61	0.05
Three factor	665.3/321=2.1	0.06	0.87	0.85	0.62	0.05
Four factor	665.3/318=2.1	0.06	0.87	0.85	0.62	0.05
Second-order factors	665.3/319=2.1	0.06	0.87	0.85	0.62	0.05
Romania						
Two factor	801.7/323=2.5	0.07	0.85	0.82	0.76	0.06
Three factor	785.8/321=2.4	0.07	0.85	0.83	0.77	0.06
Four factor	736.3/318=2.3	0.06	0.86	0.83	0.79	0.06
Second-order factors	736.9/319=2.3	0.06	0.86	0.84	0.79	0.06
Serbia						
Two factor	904.8/323=2.8	0.07	0.85	0.82	0.78	0.06
Three factor	901.7/321=2.8	0.07	0.85	0.82	0.78	0.06
Four factor	876.9/318=2.8	0.07	0.85	0.82	0.79	0.05
Second-order factors	877.1/319=2.7	0.07	0.85	0.82	0.79	0.05

Note: A good fit of model should, in general, have 2:1 or 5:1 χ^2/df, GFI > 0.90, AGFI > 0.90, CFI > 0.90, and RMSEA and RMR < 0.10 (preferably <0.06) indexes.

21 **Table 3**

22 Results of the PCA with oblimin rotation for Bulgaria,Romania and Serbia data.

Items	Violations			Errors		
	Rom.	Ser.	Bul.	Rom.	Ser.	Bul.
10.Disregard the speed limit on a residential road (ov)	.71	.76	.57			
20.Race away from traffic lights with the intention of beating the driver next to you (ov)	.69	.63	.61			
19.Overtake a slow driver on the inside (ov)	.67	.47	-			-
24.Become angered by a certain type of a driver and indicate your hostility by whatever means you can (av)	.67	.65	.42			
27.Disregard the speed limit on a motorway (ov)	.67	.78	.59			
6.Sound your horn to indicate your annoyance to another road user (av)	.66	.65	.60			
23.Cross a junction knowing that the traffic lights have already turned against you (ov)	.65		.55		.40	
16.Become angered by another driver and give chase with the intention of giving him/her a piece of your mind (av)	.63	.59	.40			
22.Drive so close to the car in front that it would be difficult to stop in an emergency (ov)	.55	.33	.46			
9.Pull out of a junction so far that the driver with right of way has to stop and let you out (ov)	.39	.49	-	.37		-
17.Stay in a motorway lane that you know will be closed ahead until the last minute before forcing your way into the other lane (ov)	.38	.33	.43	.37		
5.Fail to notice that pedestrians are crossing when turning into a side street from a main road (e)			.31	.62	.40	.53
11.Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers (l)			-	.61	.38	-
7.Fail to check your rear-view mirror before pulling out, changing lanes, etc. (e)				.55	.52	.33
14.Attempt to drive away from the traffic lights in third gear (l)				.52	.56	.35
26.Underestimate the speed of an oncoming vehicle when overtaking (e)				.51	.66	.48
4.Queuing to turn left onto a main road, you pay such close attention to the mainstream of traffic that you nearly hit the car in front (e)			-	.51	.70	-
21.Misread the signs and exit from a roundabout on the wrong road (l)			-	.47	.68	-

25.Realise that you have no clear recollection of the road along which you have just been travelling (l)			.45	.47	.50	
13.Miss "Give Way" signs and narrowly avoid colliding with traffic having right of way (e)			.50	.46	.54	
12.On turning left nearly hit a cyclist who has come up on your inside (e)			-	.42	.54	-
18.Forget where you left your car in a car park (l)				.42	.31	.48
2.Intending to drive to destination A, you "wake up" to find yourself on the road to destination B (l)		-		.40	-	.51
1.Hit something when reversing that you had not previously seen (l)				.35	.42	.74
3.Get into the wrong lane approaching a roundabout or a junction (l)				.31	.51	.33
8.Brake too quickly on a slippery road or steer the wrong way in a skid (e)		.36		.30	.40	.46
15.Attempt to overtake someone that you had not noticed to be signalling a right turn (e)	-		-	-	.35	-
Eigenvalues	5.93	1.97	3.54	2.55	7.27	2.55
Cronbach's alpha	0.85	0.83	0.71	0.75	0.82	0.62
Variance (%)	21.97	7.30	13.10	9.44	26.93	9.43

av = Aggressive violation, ov = ordinary violation, e = error, l = lapse.

For clarity all factor loadings <.30 are excluded.

Table 4

ANCOVA results for DBQ items.

Variables	Bulgaria	Romania	Serbia	F	Eta^2
Aggressive violations					
Sound your horn to indicate your annoyance to another road user	2.30[a]	2.36[a]	2.39[a]	0.53	.001
Become angered by another driver and give chase with the intention of giving him/her a piece of your mind	1.52[a]	1.36[a]	1.51[a]	2.78	.005
Become angered by a certain type of a driver and indicate your hostility by whatever means you can	1.63[a]	1.58[a]	2.12[b]	30.35***	.055
"Ordinary" violations					
Pull out of a junction so far that the driver with right of way has to stop and let you out	2.10[b]	1.53[a]	1.46[a]	57.01***	.098
Disregard the speed limit on a residential road	2.27[a]	2.43[a]	2.45[a]	2.18	.004
Stay in a motorway lane that you know will be closed ahead until the last minute before forcing your way into the other lane	1.23[a]	1.59[b]	1.81[c]	47.62***	.084
Overtake a slow driver on the inside	1.47[a]	2.25[b]	1.51[a]	49.29***	.086
Race away from traffic lights with the intention of beating the driver next to you	1.28[a]	1.95[c]	1.72[b]	37.43***	.067
Drive so close to the car in front that it would be difficult to stop in an emergency	1.94[b]	1.65[a]	1.64[a]	14.09***	.026
Cross a junction knowing that the traffic lights have already turned against you	1.46[a]	2.05[b]	1.31[a]	59.83***	.103
Disregard the speed limit on a motorway	2.52[a]	3.58[b]	2.53[a]	68.58***	.116
Errors					
Queuing to turn left onto a main road, you pay such close attention to the main stream of traffic that you nearly hit the car in front	1.14[a]	1.47[b]	1.45[b]	26.23***	.048
Fail to notice that pedestrians are crossing when turning into a side street from a main road	2.78[b]	1.58[a]	1.62[a]	154.24***	.228
Fail to check your rear-view mirror before pulling out, changing lanes, etc.	1.41[a]	1.66[b]	1.68[b]	8.99***	.017

Brake too quickly on a slippery road or steer the wrong way in a skid	1.64[b]	1.43[a]	1.56[b]	5.54**	.010
On turning left nearly hit a cyclist who has come up on your inside	1.02[a]	1.18[b]	1.20[b]	17.93***	.033
Miss "Give Way" signs and narrowly avoid colliding with traffic having right of way	1.19[a]	1.24[b]	1.35[c]	17.35***	.032
Attempt to overtake someone that you had not noticed to be signalling a right turn	2.35[c]	1.25[a]	1.42[b]	189.92***	.267
Underestimate the speed of an oncoming vehicle when overtaking	1.61[a]	1.84[b]	1.85[b]	7.09***	.013
Lapses					
Hit something when reversing that you had not previously seen	1.50[a]	1.51[a]	1.54[a]	.75	.001
Intending to drive to destination A, you "wake up" to find yourself on the road to destination B	1.17[a]	1.67[b]	1.78[b]	73.44***	.123
Get into the wrong lane approaching a roundabout or a junction	1.98[b]	2.40[c]	1.60[a]	68.04***	.115
Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers	1.32[a]	1.81[b]	1.70[b]	30.09***	.054
Attempt to drive away from the traffic lights in third gear	1.25[a]	1.59[b]	1.36[a]	18.08***	.033
Forget where you left your car in a car park	1.37[a]	1.81[b]	1.66[b]	18.84***	.035
Misread the signs and exit from a roundabout on the wrong road	1.30[a]	1.54[b]	1.36[a]	8.72***	.016
Realise that you have no clear recollection of the road along which you have just been travelling	1.95[b]	1.67[a]	1.85[ab]	6.76***	.013

The results are based on ANCOVA combined with post hoc test with Bonferroni correction.

The means are adjusted for age, gender and annual mileage.

Mean values with different superscripts (a–c) within rows are significantly different at 5% level.

The scale used for all DBQ-items is 1 = never to 6 = very often.

$^{**}p < 0.01$.; $^{***}p < 0.001$.

Table 5

The correlations among demographic variables, violations, errors, and the number of traffic accidents.

Variables	1	2	3	4	5
Bulgaria					
1. Gender (1=M,2=F)	-				
2. Age	-.47**	-			
3. Mileage	-.30**	.01	-		
4. Violations	-.37**	-.38**	.27**	-	
5. Errors	.50**	-.54**	-.05	.19**	-
6. Accidents	.04	-.14*	-.02	.26**	.23**
Romania					
1. Gender (1=M,2=F)	-				
2. Age	-.17**	-			
3. Mileage	-.44**	.46**	-		
4. Violations	-.20**	-.10	.23**	-	
5. Errors	.13*	-.04	-.00	.40**	-
6. Accidents	-.21**	-.01	.25**	.25**	.18**
Serbia					
1. Gender (1=M,2=F)	-				
2. Age	.03	-			
3. Mileage	-.33**	.09	-		
4. Violations	-.09	-.25**	.15**	-	
5. Errors	.03	-.09	.05	.58**	-
6. Accidents	-.17**	-.09	.12*	.28**	.23**

*p< .05; ** p < .01.

Table 6

Negative binomial regression analyses on self-reported yearly accident involvement during the previous 3 years.

Variables	Incidence rate ratios (IRR)	Std. Err.	Z-value	95% conf. interval
Bulgaria; DV: Number of accidents			Pseudo R^2= .037	
Violations	1.055	0.016	3.62***	1.025 – 1.085
Errors	1.081	0.025	3.43***	1.034 – 1.131
Romania; DV: Number of accidents			Pseudo R^2= .073	
Mileage	1.298	0.107	3.15**	1.104 – 1.526
Violations	1.026	0.012	2.22*	1.003 – 1.049
Errors	1.053	0.019	2.85**	1.016 – 1.091
Gender (1=M,2=F)	0.606	0.131	-2.31*	0.396 – 0.926
Serbia; DV: Number of accidents			Pseudo R^2= .070	
Violations	1.046	0.020	2.41*	1.009 – 1.085
Gender (1=M,2=F)	0.425	0.116	-3.13**	0.249 – 0.726
Errors	1.043	0.075	2.19*	1.005 – 1.083

*p< .05; ** p < .01; *** p < .001.