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Do drivers behave differently when driving a car or riding a motorcycle?

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Abstract

The paper focuses on a research gap in existing literature, where there is research regarding the behaviour of car drivers and motorcycle riders, but no direct link between them. This paper builds on past research findings and further examines different behaviour of the driver when he/she rides a motorcycle and when he/she drives a car, meaning the research compares behaviour of the same person in different situations. A survey was performed among drivers/riders using the standard Driver Behaviour Questionnaire for determining behaviour when driving a car and the Motorcycle Rider Behaviour Questionnaire for determining behaviour when riding a motorcycle. To examine the differences in behaviour, Explanatory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) approaches were applied based on a survey in Slovenia. The results of the SEM model overall point to the fact that drivers are consistent in their compliance (or non-compliance) with traffic regulations regardless of which type of vehicle they are operating, the same is also true for the recklessness of their driving behaviour and errors while driving a car or riding a motorcycle.

*Keywords:*driving behaviour; Driver Behaviour Questionnaire; Motorcycle Rider Behaviour Questionnaire

1. Introduction

Concerns about road safety are increasingly important, and many efforts are geared towards decreasing fatalities and serious injury in this field. The European Union (EU) reported a significant reduction in the number of car accidents with fatal outcomes in the period from 2010 to 2014, as well as a decrease in the annual number of road deaths by 18%. This means 5700 fewer deaths in 2014 compared to 2010 (European Commission 2015). However, based on reports from the International Traffic Safety Data and Analysis Group (IRTAD), the reduction in the number of fatalities in road transport in the IRTAD Member States was relatively modest in 2012 (OECD 2014). When looking at these numbers, we have to be aware that they are the sum of all road fatalities regardless of modality used.

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Motorcyclists are among the most vulnerable and exposed road users (Houston 2011) and they are at great risk to be involved in a road accident and to suffer some form of injury (Hurt, Ouellet, and Thom 1981). Diamantopoulou et al. (1995) found that 50 % of motorcycle accidents can end with serious injury or even death. In 2013 the EU countries recorded 3993 fatalities in case of motorcyclist (European Commission 2015). Motorcycle registrations in Europe have increased considerably during the last years. From 2003 to 2012, the number of registered motorcycles in the European Union grew by almost 30% (Eurostat 2015). Motorcyclists make up 15 % of all deaths on the road in the EU (European Commission 2015). There are 11 motorcyclist deaths per 100 000 registered motorcycles compared to 5 car occupant deaths per 100 000 registered cars (European Commission 2015). In the EU countries, the mileage-related risk of being killed in a road accident is on average 18 times higher for motorcyclists than it is for other road users (DEKRA 2010). The number of motorcycle traffic accidents in the EU differs depending on the Member. The lowest shares are reported from Estonia, Romania and Bulgaria, where motorcyclists account for less than 5 % of all road deaths; these percentages are much higher in countries such as Greece, Italy and France, where they represent up to 20% (European Commission 2015).

Among others, the cause of an accident can be found on the driver side, for instance his or her number of trips, driving behaviour and choice of vehicle type (Lindberg 2005). Drivers usually acknowledge this, therefore safety is becoming one of the crucial non-financial factors when deciding about vehicle purchasing (Knez, Jereb, and Obrecht 2014). In 90 % of all traffic accidents, their cause is related to human factors (Rumar 1985). The driver/rider behaviour can be measured in different ways. According to Wåhlberg, Dorn, and Kline (2011), the simplest way of measuring behaviour is to ask drivers how they typically behave. Reason (1990) distinguishes the possible types of human error into slips, lapses, and error. Elliot, Baughan, and Sexton (2007) found that there is a great deal of research in the field of risk factors associated with the vehicle and the environment, but there is little research related to the motorcyclists' accident risk. Because of this they designed The Motorcycle Rider Behaviour Questionnaire (MRBQ), used to measure motorcyclist behavioural factors, i.e. traffic and control errors, speed violations, stunts, and use of safety equipment. The MRBQ is derived from the Driver Behaviour Questionnaire (DBQ) (Reason et al. 1988; Reason et al. 1990).

The MRBQ consist of 43 items on aberrant and safety related motorcycle rider behaviour (Elliot, Baughan, and Sexton 2007). Özkan et al. (2012) examined the MRBQ structure, and research revealed that the MRBQ has a clear five-factor structure (Speed violations, Traffic errors, Safety equipment, Stunts, and Control errors), with high item loadings and acceptable internal consistency in compared countries.

The DBQ is a commonly used tool in traffic psychology research (Senserrick and Swinburne 2001; Conner and Lai 2005; Lajunen, Parker, and Summala 2004; Sümer et al. 2001; Özkan et al. 2006; De Winter and Dodou 2010; Salmon et al. 2010; Bener et al. 2013; Newnam and Von Schuckmann 2012; Nordfjærn and Şimşekoğlu 2014; etc.) and does not have a formal scoring system (De Winter, Dodou, and Stanton 2015).

Few attempts have been observed (Cheng and Ng 2010) to provide the link between how a person behaves when he/she is riding a motorcycle and how they behave when driving a car. Banet and Bellet (2008) concluded that car drivers consider some situation as more critical than the motorcyclist. But in this research, the respondents for driving a car and riding a motorcycle were not the same, meaning that the survey did not present differences in behaviour of a selected person in different environments, but rather differences among different groups of people. Horswill and Helman (2003) note that motorcyclists drive faster than car drivers, they overtake more, and they pull into smaller gaps in traffic. Motorcyclists do not seem to be a unique group of people who differ from the driving population in terms of their general risky behaviour. Motorcycle riders who completed similar measures as if they would be driving a car did not differ from car drivers or behave safer while riding a motorcycle (Horswill and Helman 2003).

In summary, previous studies have dealt with the behaviour of car drivers as well as behaviour of motorcyclists, and the impact of this behaviour on safety. However, these studies have been carried out on separate populations and thus a direct comparison of behaviour of individuals when they ride a motorcycle or when they drive a car cannot be performed. This paper builds on past research findings and further examines different behaviour of the driver when he/she rides a motorcycle and when he/she drives a car, meaning the research compares behaviour of the same person in different situations. Does the driver, in these cases, behave equally safely?

Towards these goals, the purpose of this paper is to investigate individual behaviour when driving a car (using the DBQ) and comparing it with the behaviour when the same individual rides a motorcycle (using the MRBQ). As shown in the conceptual framework presented in Fig. 1, this paper examines how the three factors resulting from DBQ (violations, lapses and errors) are related with four factors resulting from MRBQ (safety equipment, speed violations, errors, and stunts). To examine the differences in behaviour, Explanatory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) approaches were applied based on a survey in Slovenia.

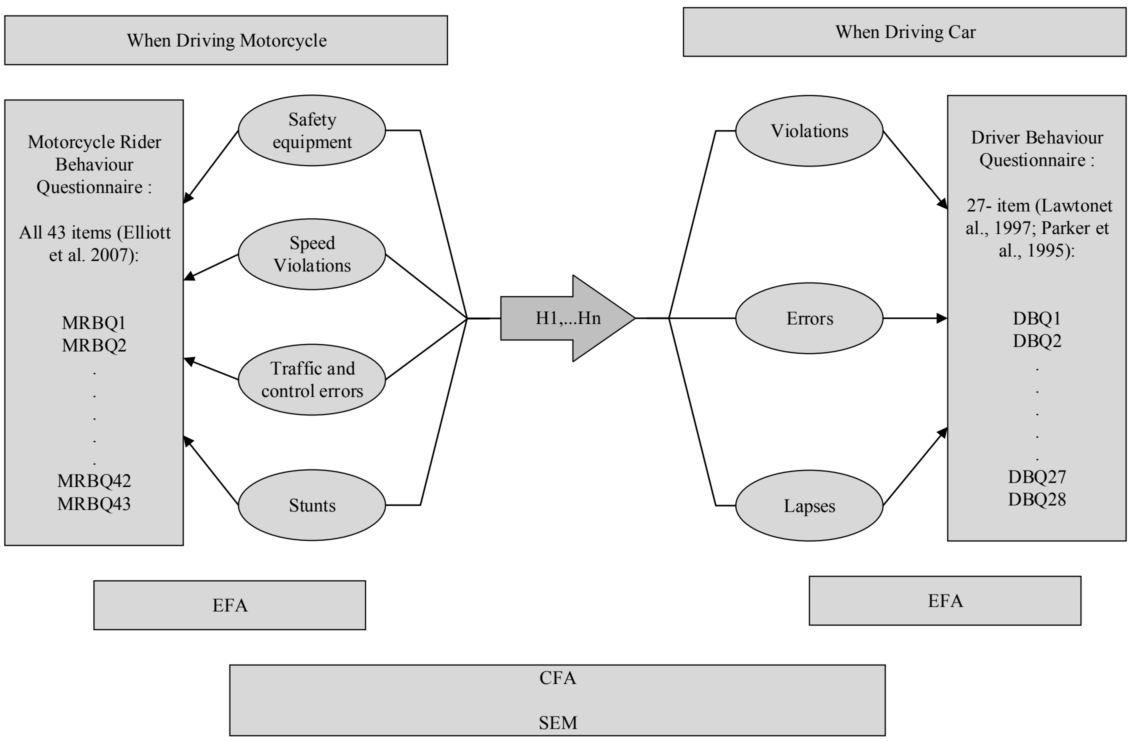

Figure 1: Conceptual framework.

Based on previous research, the following four main hypotheses were examined:

1. Hypothesis 1. Use of safety equipment when riding a motorcycle is significantly related with Violations (a), Errors (b), and Lapses (c) when driving a car.
2. Hypothesis 2. Speed violations when riding a motorcycle are significantly related with Violations (a), Errors (b), and Lapses (c) when driving a car.
3. Hypothesis 3. Errors when riding a motorcycle are significantly related with Violations (a), Errors (b), and Lapses (c) when driving a car.
4. Hypothesis 4. Stunts when riding a motorcycle are significantly related with Violations (a), Errors (b), and Lapses (c) when driving a car.

2. Methodology

2.1 Procedure and participants

In order to establish a relation between the different behaviour of individuals when riding a motorcycle or when driving a car, an anonymous survey among Slovenian motorcyclist was conducted. The motorcyclist filled out the Motorcycle Rider Behaviour Questionnaire, Driver Behaviour Questionnaire, items related to riders' driving record (in reference to driving a motorcycle), and demographic variables. The MRBQ and DBQ were translated into Slovenian. Data collection lasted over a 5-week period in fall 2014, and was carried out with the help of online surveys as well as with a traditional questionnaire. Within the time frame, 182 fully filled out questionnaires were received, which have been included in this research.

A conceptual model encompassing seven abstract variables and their proposed relationships was designed. These variables are not directly observable and as such have to be measured by other variables.

2.2 Measures

2.2.1. Motorcycle Rider Behaviour Questionnaire (MRBQ)

The MRBQ consists of 43 claims relating to the safe/dangerous behaviour of motorist. Those 43 variables result from a study by Elliot, Baughan, and Sexton (2007). Participants were asked to assess the frequency of committing each of those riding elements when riding a motorcycle on a 5-point Likert scale from "Never" to "Nearly all the time". Most of research in this field, as well as the original MRBQ (Elliot, Baughan, and Sexton 2007), used a seven or six-point scale for the measurement of these positions. Due to local characteristics, this study used a five point scale. The items are listed in Table 1.

Table 1: Means and standard deviations of the MRBQ answers.

Variable	Description	Mean	S.D.
MRBQ1	Pull onto a main road in front of a vehicle you have not noticed or whose speed you misjudged	1.60	.603
MRBQ2	Fail to notice or anticipate another vehicle pulling out in front of you and had difficulty stopping	1.88	.703
MRBQ3	Distracted or pre-occupied, you suddenly realize that the vehicle in front has slowed, and you have to brake hard to avoid a collision	1.91	.707

MRBQ4	Not notice someone stepping out from behind a parked vehicle until it is nearly too late	1.47	.670
MRBQ5	Ride so fast into a corner that you feel like you might lose control	1.90	.759
MRBQ6	When riding at the same speed as other traffic, you find it difficult to stop in time when a traffic light has turned against you	1.62	.768
MRBQ7	Run wide when going around a corner	1.59	.729
MRBQ8	Ride so fast into a corner that you scare yourself	1.83	.664
MRBQ9	Not notice a pedestrian waiting at a crossing where the lights have just turned red	1.41	.721
MRBQ10	Fail to notice that pedestrians are crossing when turning into a side street from a main road	1.36	.680
MRBQ11	Queuing to turn left on a main road, you pay such close attention to the main traffic that you nearly hit the vehicle in front	1.42	.623
MRBQ12	Find that you have difficulty controlling the bike when riding at speed (e.g. steering wobble)	1.38	.677
MRBQ13	Needed to brake or back-off when going round a bend	2.42	.781
MRBQ14	Skid on a wet road or manhole cover, road marking, etc.	2.01	.838
MRBQ15	Needed to change gears when going around a corner	2.06	.893
MRBQ16	Miss 'Give Way' or 'Stop' signs and almost crash with another vehicle	1.18	.414
MRBQ17	Ride so close to the vehicle in front that it would be difficult to stop in an emergency	1.63	.730
MRBQ18	Exceed the speed limit on a motorway	3.12	1.104
MRBQ19	Exceed the speed limit on a country/rural road	3.16	1.027
MRBQ20	Exceed the speed limit on a residential road	2.25	.964
MRBQ21	Disregard the speed limit late at night or in the early hours of the morning	2.32	1.116
MRBQ22	Open up the throttle and just go for it on a country road	2.25	1.151
MRBQ23	Get involved in racing other riders or drivers	1.48	.826
MRBQ24	Race away from the traffic lights with the intention of beating the driver/rider next to you	1.54	.838
MRBQ25	Attempt or done a wheelie	1.34	.738
MRBQ26	Intentionally do a wheel spin	1.18	.476
MRBQ27	Pull away too quickly and your front wheel lifted off the road	1.53	.770
MRBQ28	Unintentionally had your wheels spin	1.33	.632
MRBQ29	Motorcycle protective trousers (leather or non-leather)	1.69	.944
MRBQ30	Motorcycle boots	1.66	.993
MRBQ31	A motorcycle protective jacket (leather or non-leather)	1.40	.793
MRBQ32	Body armour/impact protectors (e.g. for elbow, shoulder or knees)	2.16	1.531
MRBQ33	Bright/fluorescent stripes/patches on your clothing	3.21	1.580
MRBQ34	Ride when you suspect that you might be over the legal limit for alcohol	1.45	.717
MRBQ35	Another driver deliberately annoys you or puts you at risk	1.89	1.061
MRBQ36	Do you have trouble with your visor or goggles fogging up	2.50	.962
MRBQ37	A leather once-piece motorcycle suit	4.34	1.355
MRBQ38	Bright/fluorescent clothing	3.43	1.560
MRBQ39	Do you use daytime running lights or headlights on in daylight	1.20	.804
MRBQ40	Motorcycle gloves	1.38	.882
MRBQ41	Do you wear no motorcycle specific protective clothing	1.97	.983
MRBQ42	Attempt to overtake someone who you have not noticed to be signalling a right turn	1.23	.575
MRBQ43	Ride between two lanes of fast moving traffic	1.74	.990

2.2.2. Driver Behaviour Questionnaire (DBQ)

The DBQ is a very popular questionnaire and is used as a psychometric instrument and accident predictor. The DBQ originally included 50-items (Reason et al. 1990; Blockey and Hartley 1995). Mattsson (2012) used the 28-item DBQ for investigating factorial invariance. The present research used the 27-item version (Lawton et al. 1997; Parker et al. 1995), which is most commonly used in latest years. The items are listed in Table 2. Respondents were asked to indicate how often they themselves do each of the violations or errors when driving a car on a 5-point Likert scale from "Never" to "Nearly all the time".

Table 2. Means and standard deviations of the DBQ answers.

Variable	*Description*	*Mean*	*S.D.*
DBQ1	Hit something when reversing that you had not previously seen	1,275	0,527
DBQ2	Intending to drive to destination A, you "wake up" to find yourself on the road to destination B	1,440	0,803
DBQ4	Get into the wrong lane approaching a roundabout or a junction	1,176	0,460
DBQ5	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	1,379	0,685
DBQ6	Fail to notice that pedestrians are crossing when turning into a side street from a main road	1,489	0,996
DBQ7	Sound your horn to indicate your annoyance to another road user	1,692	0,830
DBQ8	Fail to check your rear-view mirror before pulling out, changing lanes, etc.	2,011	1,570
DBQ9	Brake too quickly on a slippery road or steer the wrong way in a skid	1,247	0,481
DBQ10	Pull out of a junction so far that the driver with right of way has to stop and let you out	1,137	0,431
DBQ11	Disregard the speed limit on a residential road	2,368	1,326
DBQ12	Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers	1,143	0,351
DBQ13	On turning left nearly hit a cyclist who has come up on your inside	1,148	0,372
DBQ14	Miss "Give Way" signs and narrowly avoid colliding with traffic having right of way	1,126	0,349
DBQ15	Attempt to drive away from the traffic lights in third gear	1,192	0,495
DBQ16	Attempt to overtake someone that you had not noticed to be signalling a right turn	1,275	0,527
DBQ17	Become angered by another driver and give chase with the intention of giving him/her a piece of your mind	1,236	0,617
DBQ18	Stay in a motorway lane that you know will be closed ahead until the last minute before forcing your way into the other lane	1,489	0,763
DBQ19	Forget where you left your car in a car park	1,247	0,492
DBQ20	Overtake a slow driver on the inside	1,280	0,634
DBQ21	Race away from traffic lights with the intention of beating the driver next to you	1,533	0,798
DBQ22	Misread the signs and exit from a roundabout on the wrong road	1,214	0,539
DBQ23	Drive so close to the car in front that it would be difficult to stop in an emergency	1,473	0,619

DBQ24	Cross a junction knowing that the traffic lights have already turned against you	1,599	0,704
DBQ25	Become angered by a certain type of a driver and indicate your hostility by whatever means you can	1,511	0,749
DBQ26	Realise that you have no clear recollection of the road along which you have just been travelling	1,473	0,839
DBQ27	Underestimate the speed of an oncoming vehicle when overtaking	1,319	0,637
DBQ28	Disregard the speed limit on a motorway	2,819	1,219

2.2.3. Background variables

Motorcyclist also answered questions about their gender, age, and education. The final sample comprised of 88.8% males. The most represented age range was from 50 to 59 years of age (32.4%), followed by the group from 40 to 49 (31.3%), 30 to 39 (22.0%), over 59 years (8.2%), and from 20 to 29 years of age 6.1%.

2.2.4. Analysis

The data was analysed using descriptive statistics, to determine the normality issues, exploratory factor analysis, confirmatory factor analysis, and structural equation modelling.

Exploratory factor analysis was used as a data reduction method. The EFA algorithm starts with the setup of the appropriate factor model structure, where the appropriate estimation method must also be selected for the extraction of the corresponding factors. Based on an EFA analysis, the CFA was carried out to investigate how well the theoretical factors' specification matches the reality (real data) (Hair et al. 2010) and to test whether the data fits a hypothesized measurement model, which is based on the theory and/or previous analytic research. When the CFA was successfully elaborated, the measurement part of the SEM model appeared as a final result of CFA. Next stage of analysis is the structural part of the SEM model and after the derivation of the SEM model, the goodness of fit measures were investigated, which enabled the testing of model validity and adequacy. All used steps of presented methodology are supported by different scientific literature (e. g. Kline 2005; Hoyle 2012; Hair et al. 2010; Byrne 2009; Mulaik 2009; Raykov and Marcoulides 2006, etc.).

In this research, Structural Equation Modelling was used to explore different behaviour of the driver when he/she rides a motorcycle and when he/she drives a car. Seven latent variables for DBQ (violations, lapses and errors) and MRBQ (Safety equipment, Speed Violations, Traffic and control errors, and Stunts) were constructed.

For the research analysis, the used software was SPSS 22 and AMOS 22.

3. Analysis and results

3.1 Exploratory factor analysis

Before conduction of the Exploratory factor analysis (EFA), a normality test was made. Both the skewness and kurtosis were in limits.

The main goal in EFA was to extract seven factors, four for MRBQ and three for DBQ. The principle axis factoring (PAF), with Promax rotation (with Kaiser Normalization), of the baseline 70-item data (N = 182) was used. To determine reliability, the Bartlett's test of sphericity (BTS) and the Kaiser-Meyer-Olkin (KMO) test were also conducted. The BTS value was highly significant (χ^2=2899.111 with df=231 and $p<0.001$), while the value of KMO was 0.776 > 0.05. Based on recommendations from Frohlich and Westbrook (2001) and Sahin et al. (2013), we can argue that the factor analysis is reliable. Item loadings on factors was significant, since they reached the value 0.40 or more (Hair et al. 2010).

The EFA resulted in seven factors; namely for MRBQ: Safety Equipment (MRBQ30, MRBQ31, MRBQ29, MRBQ32), Speed Violations (MRBQ19, MRBQ18, MRBQ20, MRBQ21), Traffic and control errors (MRBQ3, MRBQ11, MRBQ5, MRBQ1, MRBQ16, MRBQ7, MRBQ6, MRBQ2) and Stunts (MRBQ28, MRBQ27, MRBQ25, MRBQ26, MRBQ23) and for DBQ: Aggressive Ordinary Violations (DBQ25, DBQ7, DBQ17, DBQ24, DBQ23, DBQ21, DBQ10, DBQ20), Lapses (DBQ26, DBQ15, DBQ22, DBQ19), and Errors (DBQ6, DBQ8). The factors and related variables are also represented in Fig. 2.

From the EFA results it is evident that the variables related to motorcycle riding are significantly loaded on the corresponding factors for MRBQ (Elliot, Baughan, and Sexton 2007; Özkan et al. 2012) and the variables related to the behaviour when driving a car are significantly loaded on the corresponding factors for DBQ (Lawtonet al. 1997; Parker et al. 1995).

3.2 Confirmatory factor analysis

Loading factors resulting from EFA were assigned to confirmatory factor analysis (CFA). Based on the assumption of multivariate normality, the maximum likelihood (ML) method was used. In the data set used in the CFA, there is no missing data issues. Based on different research (e.g. Jackson, Gillaspy, and Purc-Stephenson 2009; Hair etaol. 2010) we evaluated the modal fit. Evaluation included goodness of fit test, Goodness of Fit Index (GFI) and Adjusted Goodness of Fit Index (AGFI), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Residual (Standardized RMR). All these criteria were above the recommended value.

According to Hair et al. (2010) and others, it is necessary to verify the convergent and discriminant validity, as well as reliability. In case of this research the Composite (construct) Reliability (CR) and Average Variance Extracted (AVE) were greater than the limit value.

3.3 Structural equation model

On the basis of the conceptual framework shown in Fig. 1, the structural part of the model was conducted. Six steps of SEM modelling were performed as recommended by Kline (2005). In SEM the maximum likelihood (ML) estimation method was used, which requires certain statistical assumptions about multivariate normality and thus achieves the precise estimates for continuous and normally distributed data (Bentler 2006; Hoyle 2012: Kline 2011; Lei and Wu 2007; Raykov and Marcoulides 2006; etc.).

Fig. 2 shows a graphical representation of the standardized SEM model with the estimated path coefficients significant at $p \leq 0.10$ level among the variables; insignificant paths are not shown in Fig. 2 because of the transparency of the SEM model. Those significant paths have the corresponding standardized weights marked, and the hypotheses are also shown in Fig. 2.

3.3.1. Relationship between measured and latent variables

The EFA and CFA revealed seven latent variables, four for MRBQ and three for DBQ. The MRBQ latent variables are ordered as followed: Safety equipment, Speed violations, Traffic and control errors, and Stunts.

The latent variable “Safety equipment” was constructed, based on EFA and CFA, with five measured variables which covered a wide range of using different protective equipment (trousers, boots, jacket, gloves, and armour/impact protectors) and participants were asked to assess the frequency of using those elements. From the path coefficient it is obvious that motorcycle boots and motorcycle protective jacket (MRBQ30 and MRBQ 31, respectively) had the largest coefficients in constructing “Safety equipment”. This suggests that using motorcycle boots and jackets is more important for riders than other protective equipment.

The latent variable “Speed Violations” is presented by four measured variables, which covered different fouls regarding speed limits on different road types and sections. The SEM revealed that the largest coefficient refers to “Exceed the speed limit on a country/rural road” (MRBQ19), and to “Exceed the speed limit on a motorway” (MRBQ18), which means that riders frequently exceed the speed limit outside urban areas. Factor “Traffic and control errors” includes most measured variables representing a variety of errors that can be caused by motorists while driving. From the path coefficients it is obvious that there is not a specific variable with the largest coefficients, which means that all variables are comparable in affecting the observed latent variable. “Stunts” is the last constructed latent variable of MRBQ and is represented by five measured variables, which covered a wide range of different dangerous ventures made by motorcyclist. From the path coefficient it is obvious that variable “Pull away too quickly and your front wheel lifted off the road” (MRBQ27) had the largest coefficients in constructing “Stunts”.

For DBQ variables, the EFA and CFA revealed three latent variables. Those latent variables are, as already mentioned, significantly loaded on the corresponding factors “Violations”, “Errors”, and “Lapses”. The latent variable “Violations” was constructed by eight measured variables which covered a wide range of making different traffic violations. From the path coefficient it is obvious that “Become angered by a certain type of a driver and indicate your hostility by whatever means you can” and “Overtake a slow driver on the inside" (DBQ25 and DBQ20, respectively) had the largest coefficients in constructing "Violations" within DBQ. The second latent variable for DBQ is "Errors", constructed by two measured variables DBQ 6 and DBQ8, representing "Fail to notice that pedestrians are crossing when turning into a side street from a main road" and "Fail to check your rear-view mirror before pulling out, changing lanes, etc." "Lapses" represent the third latent variable conducted by four measured variables, of which the measured variable "Misread the signs and exit from a roundabout on the wrong road "(DBQ22) stands out for largest path coefficient.

Comparing different previous research (Elliot, Baughan, and Sexton 2007; Özkan et al. 2012; Lawton et al. 1997; Parker et al. 1995), it can be concluded that all variables are significantly loading on corresponding factors.

3.3.2. Relationship among latent variables

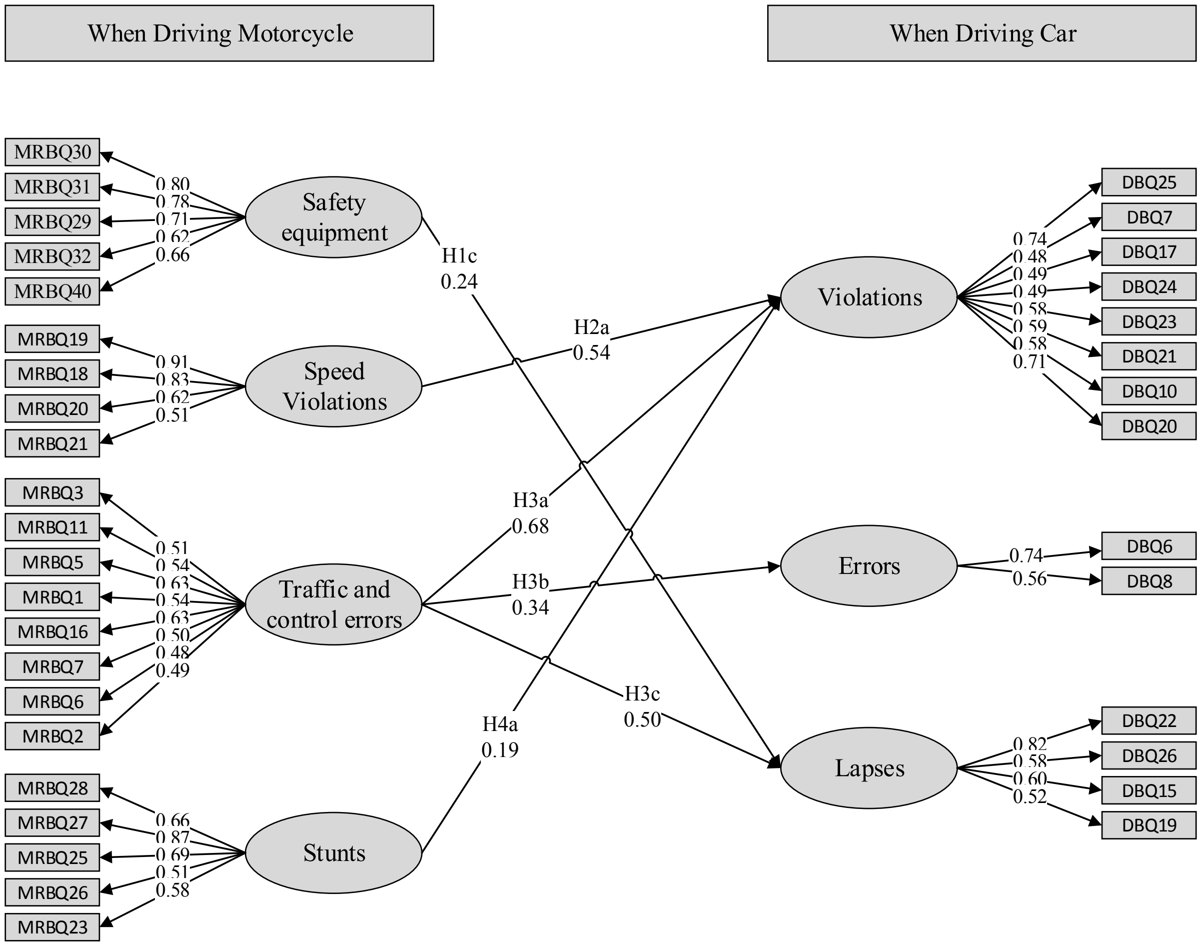

Figure 2: SEM of driving behaviour when driving a motorcycle or car: seven latent variables.

The SEM results also identified six significant relations among the seven latent variables that were consistent with the hypotheses. First positive relation is between “Safety equipment” (for MRBQ) and “Lapses” (for DBQ). This indicates that drivers who use more safety equipment when riding a motorcycle are more likely to make some lapses when driving a car. The path coefficient between “Speed violation” and “Violations” is positive which suggests that drivers who repeatedly exceed the speed limits when riding a motorcycle also cause more violations when driving a car. In the case of positive relation between “Traffic and control errors” when a driver rides a motorcycle and “Violations”, “Errors”, and “Lapses” when the same driver drives a car, it can be concluded that drivers making more traffic and control errors when riding a motorcycle will most likely make more violations, errors and lapses when driving a car. It was also found that “Stunts” are positively related to “Violations”, indicating that a person who is performing more stunts when driving a motorcycle will make more violations when driving a car.

3.3.3. Model fit

After the completed estimation, different model fit indices were calculated. According to Yuan (2005), most practical fit indices involve the chi-square test statistic. According to different authors (e.g. Byrne 2009; Hair 2010; Kline 2005; Hoyle 1995; Hoyle 2012; Hooper, Coughlan, and Mullen 2008; Washington, Karlaftis, and Mannering 2011), the SEM report should include several fit indices. The most representative goodness-of-fit statistics according to mentioned research are shown in Table 3, including their threshold values, and the corresponding descriptions. From these values we can conclude that the developed structural equation model ensures a good fit to the data.

Table 3:The goodness-of-fit (GOF) statistics of the SEM of the developed SEM model.

Fit Index	*Acceptable Threshold Levels*	*For the developedSEM model*
Chi-Square (χ^2)	Low value relative to degrees of freedom df	495.221
Relative Chi-Square of the discrepancy ($\frac{\chi^2}{df}$)	<3 good <5 permissible	1.187
Root Mean Square Error of Approximation (RMSEA)	<0.07 good 0.07-0.10 moderate >0,10 bad	0.023
Normed-fit Index (NFI)	>0.90 acceptable >0.95 good	0.903
Non-Normed-fit Index (NNFI)	>0.95 good >0.90 acceptable	0.973
Comparative Fit Index (CFI)	>0.90 acceptable	0.982

	>0.95 good	
Bollen's Incremental Fit Index (IFI)	>0.90 acceptable >0.95 good	0.983
Standardised Root Mean Square Residual (SRMR)	<0.08 good	0.0591

4. Discussion

This paper examined the behaviour of drivers when riding a motorcycle and when the same driver drives a car, via estimating a Structural Equation Modelling (SEM) based on survey data from Slovenia in 2014. In the modelling process, the exploratory factor analysis (EFA) and Confirmatory Factor Analysis (CFA) were also applied as the intermediate stages of the modelling design.

Evaluation of motorist behaviour was based on the Motorcycle Rider Behaviour Questionnaire (MRBQ) consisting of 43 claims relating to the safe/dangerous behaviour of motorist. Those 43 variables result from a study by Elliot, Baughan, and Sexton (2007). Evaluation of the same person when driving a car was based on the Driver Behaviour Questionnaire (DBQ) consisting of 27 items (Lawton et al. 1997; Parker et al. 1995).

The EFA and CFA revealed seven factors, four for MRBQ and three for DBQ, and all variables related to motorcycle riding are significantly loaded on the corresponding factors from MRBQ and the variables related to the behaviour when driving a car are significantly loaded on the corresponding factors from DBQ.

Only hypotheses which had statistical significance were observed (H1c, H2a, H3a, H3b, H3c and H4a). Main findings are presented below.

The SEM results suggest that safety equipment is related to lapses: motorists who reported more frequent use of motorcycle protective equipment such as trousers, boots, jacket, gloves, and body armour/impact protectors committed more lapses when driving a car. This confirms hypothesis H1c and can potentially be explained by the presumption that such motorists are aware of their more dangerous driving style and as such feel safe while driving a car, but feel the need for more protection when riding a motorcycle. SEM results also revealed that motorists who often exceed speed limitations on a motorcycle perform more violations when driving a car, which confirms the H2a. Traffic and control errors while riding a motorcycle are positively correlated with three types of dangerous elements while driving a car: violations (confirming H3a), errors (confirming H3b) and lapses (confirming H3c). Riders who perform stunts while riding a motorcycle make more violations while driving a car, which confirms hypothesis H4a.

To sum up, the results of the SEM model overall point to the fact that drivers are consistent in their compliance (or non-compliance) with traffic regulations regardless of which type of vehicle they are operating, the same is also true for the recklessness of their driving behaviour and errors while driving a car or riding a motorcycle.

However, there are some limitations to viewing these results. The survey was performed exclusively in Slovenia. The results can have significance in many other countries, since according to the 2009 report on European road safety, users of motorized two-wheelers are among the most vulnerable road users in most European countries (WHO 2009). Motorcyclists face much higher risks of being involved in serious accidents. For the same travelled distance, the average risk of a motorcycle rider to be killed is 18 times higher than for a car driver, but the inequalities between European countries here are notable, since this ratio between rider/driver risk of being killed in a road accident varies from 6 times higher in Norway to 50 times higher in Slovenia (ETSC 2008). On one hand, this means that Slovenia in not necessarily comparable to other countries in the field of motorcyclists' safety, but on the other hand, this also means that since the survey was performed in an environment where the problematic is at its biggest, the results most clearly show points to be considered when searching for improvement potential. Anyhow, the survey and modelling efforts should be performed in other countries in the same way in the future to expand the research scope and result applicability. It is also important to consider that this survey focused on an issue that is unpleasant for many, meaning that there is potential that the respondents distorted their responses in order to cover up their actual unsafe behaviour, even though the survey was completely anonymous.

The findings of this paper can be used to revise current approaches of legislative bodies in addressing the drivers who performed traffic violations or accident when driving a motorcycle or riding a car, since the results show that their behaviour and risk taking is the same in both modes of transport, therefore at the least, their records should be cumulated, not be exclusive for each modality, as is currently still the practice in some countries. Moreover, strategies for reducing drivers' and riders' risk taking and reckless behaviour should be implemented, since we can presume that influencing the behaviour of drivers of one modality will have positive effects on the other modality as well. This should include as many aspects of changing the driving culture as possible, not only legislative prohibitions or regulation and incentives on a wide scale, but also focus on increasing the overall traffic safety culture (see Edwards et al. 2014).

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