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BEHAVIOURAL COMPARISON OF DRIVERS WHEN DRIVING A MOTORCYCLE OR A CAR: A STRUCTURAL EQUATION MODELLING STUDY

ABSTRACT

The goal of the study was to investigate if the drivers behave in the same way when they are driving a motorcycle or a car. For this purpose, the Motorcycle Rider Behaviour Questionnaire and Driver Behaviour Questionnaire were conducted among the same drivers population. Items of questionnaires were used to develop a structural equation model with two factors, one for the motorcyclist's behaviour, and the other for the car driver's behaviour. Exploratory and confirmatory factor analyses were also applied in this study. Results revealed a certain difference in driving behaviour. The principal reason lies probably in mental consciousness that the risk-taking driving of a motorbike can result in much more catastrophic consequences than when driving a car. The drivers also pointed out this kind of thinking and the developed model has statistically confirmed the behavioural differences. The implications of these findings are also argued in relation to the validation of the appropriateness of the existing traffic regulations.

KEY WORDS

motorcycle rider behaviour; car driver behaviour; traffic accidents; structural equation modelling; violations; errors;

1. INTRODUCTION

Road traffic accidents have an adverse impact on all levels of society. Not only individual victims of accidents and their families are frustrated, but also their employers and society as a whole suffer certain consequences. Traffic accidents also lead to significant costs, related to health care, lost productivity of individuals, premature death of the victim, short-term or long-term disability, etc. In order to avoid frustration and all costs related to the accidents, the safety aspects are also becoming one of the most crucial non-financial factors when a decision about purchasing a new vehicle is adopted [1].

There are several organizations dealing with road safety, like the "National Highway Traffic Safety Administration" (NHTSA), established by the US Department of Transportation, the "International Traffic Safety Data and Analysis Group" (IRTAD), instituted by the OECD, etc. These organizations also administrate the annual statistics about the tragic accidents in road transport. From IRTAD reports it is depicted that only a modest success in reducing the number of fatalities during the last years was achieved [2]. In general, it is true that the entire number of traffic accidents has been slowly decreasing during the last decade. However, on the other side, this does not hold for the number of deaths, which even increased in 2012 in several countries, compared to the year 2011 [2].

It is well known that the motorcyclists are one of the most vulnerable road participants [3]. The amount of fatalities related to the drivers of powered two wheelers (PTW) drops more slowly than with car occupants while the entire number of motorcycle traffic accidents is unfortunately still increasing. The fact is that the riders are often involved in road accidents and can get severe injuries [4]. Diamantopoulou and his colleagues [5] revealed that as many as 50% of all motorcycle accidents can end in serious injury or death. In 2013 the European Union (EU) countries recorded 3,993 fatalities in case of motorcyclists [6]. At the same time, the EU authorities also reported a significant decrease of car accidents with fatal outcomes, which means 12,535 fatalities in case of car accidents [6]. On the one side, the car-related deaths were 50% reduced between the years 2000 and 2012. Nevertheless, on the other hand, the mileage-related risk of being killed in a road accident is even eighteen times higher for riders than it is for other road users [7].

It is also reported that the low-mileage drivers of any age have a significantly higher crash rate than the middle-mileage drivers of the same age. Also, the latter have a considerably higher crash rate than higher-mileage drivers of the same age [8]. This implies that the driving experiences are also closely related to the possibility of having an accident.

Reason [9] distinguishes between the possible types of human errors, which can be in general classified as slips, lapses, mistakes, and violations. The cause of a traffic accident most frequently relates to the number of trips, driving behaviour and the choice of vehicle type [10]. As it turns out, in 90% of all traffic accidents their cause is hidden in the human factors [11]. There are several ways to measure the driver/rider behaviour, and according to Wåhlberg, Dorn and Kline [12], the simplest way is to ask the drivers how they typically behave. Elliot and his colleagues [13] discovered that a significant amount of research in the scholarly literature is devoted to the field of risk factors associated with the vehicle and the environment. However, on the other hand, a quite big gap was detected in a research related to the motorcyclists' accident risk.

To overcome this gap, the "Motorcycle Rider Behavior Questionnaire" (MRBQ) has been designed and introduced in the study [13]. Its main purpose is to measure the motorcyclist behavioural factors, such as control and traffic errors, stunts, use of safety equipment, speed violations, and others. As introduced in this study, the MRBQ questionnaire was applied to a very massive sample of 8,666 participants and was designed on the basis of taxonomy [14]. The questionnaire which comprises 43 items should measure the riders' behaviour as reliably as possible. It also attempts to investigate how the behaviour is related to the crash risk. As final result of Reason and the others' work, the 5-factor model structure was derived. This study was later updated with another study carried out by Özkan and his colleagues [15]. They investigated the original 5-factor model structure with Turkish riders. Also, they studied the relationships between different types of motorcyclist behaviour on the one hand and the active and passive accidents and offenses, on the other hand. They confirmed that the factor model contains five factors (speed violations, traffic errors, safety equipment, stunts, and control errors), which were apparently extracted. The analysis has also revealed high item loadings and acceptable internal consistency.

The MRBQ was developed on the basis of previously designed "Driver Behavior Questionnaire" (DBQ), which is a commonly used tool in traffic psychology research. The original version of this questionnaire was based on 50 items [9], but afterwards, several other versions were also conducted, as described in the study of Mattson [16]. This author introduced the 28-item-based version of the DBQ questionnaire in his work. Another frequently used version of DBQ was presented by Lajunen et al. [17], who translated an extended 27-item questionnaire [18, 19] into the Dutch and Finish case. Since the latter covers all necessary aspects of car driving behaviour, this version of the questionnaire was used in our study as well.

The investigation of the literature shows that only several studies included a behavioural comparison between motorcyclists and car drivers. For instance, authors Banet and Bellet [20] concluded that globally car drivers consider the particular situation as more critical than the motorcyclists. Another study, carried out by Horsewill and Helman [21], showed a slightly different findings. In this study it was concluded that there were no significant differences in risk-taking tendencies between the riders and car drivers. However, in these studies, the drivers' and riders' populations were in principle independent of each other. In other words, this means that it was unnecessary that the drivers are also the riders and vice versa.

In the spirit of research introduced by Elliot et al. [13], this study was focused on the driving behaviour of motorcyclists, which are all car drivers as well. Therefore, the primary aim of the research was the examination of possible differences between a person's risk-taking tendencies when they use roads as a rider or as a driver. On this basis, two questionnaires were conducted in a survey, performed among the same population of riders. The MRBQ was applied in the sense of motorcyclist's behaviour while the DBQ was employed in the spirit of car driver's behaviour. To the best of our knowledge, nearly no similar studies have been conducted, which would investigate the link between a person's behaviour as a rider and their behaviour as a driver. For this reason, it is our belief that our research, which applied both questionnaires, MBRQ and DBQ, to the same population, could be one of the major contributions of this paper.

For the purpose of research, an anonymous survey among Slovenian motorcyclists has been conducted. The indicator variables, obtained from both questionnaires were input into the statistical modelling procedure in the next step. After the preliminary use of exploratory factor analysis (EFA), the structural equation model (SEM model) was designed [22, 23, 24, 25].

The structural equation modelling is a very advanced statistical tool, which comprises factor analysis and multiple regression analysis into a comprehensive modelling framework. SEM can be also addressed as a generalization of causal path modelling, which provides an efficient modelling mechanism to reveal the complex causal relationships between the multiple variables. In our case, the SEM procedure was used by applying two consecutive stages. In the first stage, the measurement part of the SEM model was derived by means of the confirmatory factor analysis (CFA). Afterwards, in the second stage, the structural part of the SEM model was also extracted, which enabled us to finish the development of the SEM model. All the corresponding computations were carried out with the program package IBM SPSS V21, where its extension AMOS was also used.

The derived SEM model was used to study the relationship between the risk-taking behaviour, when the person is a motorcyclist, and when this same person is a car driver. The principal task of the model was to confirm statistically the subjective opinion of the target population, who claimed that they actually behave in a safer way when driving a motorcycle. If, namely, the confirmation of different behaviour is positive, the findings of the present study might be very interesting for the traffic legislature. Maybe the latter should consider again the fairness of Slovenian traffic laws, which regulate that a person is punished by losing all driving licenses in case of severe violation. For instance, why should they be disciplined by the loss of the motorbike license if the violation happened while driving a car or even a bicycle?

2. CONCEPTUAL FRAMEWORK, HYPOTHESIS, AND SURVEY

2.1 Conceptual framework and hypothesized model

Figure 1 depicts the conceptual framework associated with the hypothesized model. It can be seen that the 43-item indicators of the MRBQ questionnaire [13] were denoted by M_i, $i=1,...,43$ while the 27-item indicators of the DBQ questionnaire [17] were symbolized by D_i, $i=1,...,27$. It is supposed that such adequate model can be found, which includes two latent factors only, each related to the corresponding questionnaires (MRBQ and DBQ). One factor (named MRBQ) is linked to the motorcyclists' behaviour-based item measures while the other (named DBQ) can be expressed via the measurements of the car drivers' behaviour-based indicators. The model comprises two factors since we are only interested in identifying the possible causal relationship between rider-related behaviour and driver-related behaviour of the same person. This relation can be addressed as a part of our main hypothesis H_1, which implies that the drivers do not behave in the same way, when they are driving a motorcycle or a car. Hypothesis H_1 also involves the positively directed impact from factor MRBQ to factor DBQ, weighted by a certain level L_1.

2.2 Sample and participants in the survey

To establish the possible relationship between the different behaviour of individuals, when they drive a motorcycle or a car, an anonymous survey among Slovenian motorcyclists has been conducted. Each motorcyclist filled out the MRBQ questionnaire, DBQ questionnaire, and items related to the riders' driving record (when driving a motorcycle). In addition, the questions about demographic variables were filled in too. The MRBQ and DBQ were translated into the Slovenian language to avoid any misunderstanding. The data were collected over the 5-week period in fall 2014, and this collection was carried out by the means of online surveys, together with a traditional questionnaire.

Motorcyclists were also asked to answer the questions about their gender and age. The final sample comprised 88.8% males and 11.2% females. There were 32.4% of the participants aged between 50 and 59 years, 31.3% between 40 and 49 years, 22.0% between 30 and 39 years, 8.2% were aged over 59 years, and finally, 6.1% were aged between 20 and 29 years.

Apparently, the middle-age generation represented the majority in our sample. When the survey was finished, 182 fully completed MRBQ and DBQ questionnaires were received, which were afterwards included in further research.

In the following two sections, the structure of both questionnaires and the descriptive statistical proper-

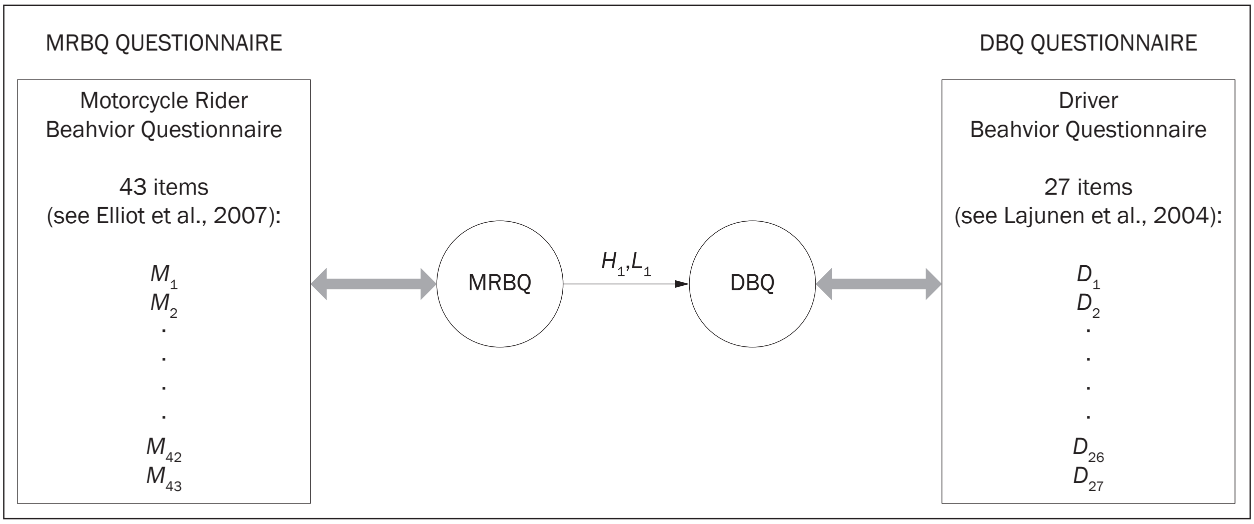

Figure 1 – Conceptual framework and the main hypothesis H_1 (an assumption of a different driving behaviour as a rider or a car driver)

ties of the measured items are briefly presented to get a clear picture of the nature of the collected data.

2.3 Data collected in the MRBQ questionnaire

The MRBQ consists of 43 items related to the safe/dangerous behaviour of the motorists (see *Table 1*). Each item explains a specific behaviour characteristic that could be attributed to a motorcycle rider. The frequency of committing the event described by the item was expressed by using the 5-point Likert scale from "Never" to "Nearly all the time". It is true that most of research in the field, including the original MRBQ work [13], applied the seven or six-point scale for the indicators. However, in our case, due to local characteristics, it was decided to use the scale with the five points only.

Table 1 – Mean, standard deviation (SD), skewness index (SI) and kurtosis index (KI) of the MRBQ indicators

Item	Content of the item	Mean	SD	SI	KI
M_1	1. Pull onto a main road in front of a vehicle you have not noticed or whose speed you misjudged	1.60	.603	.455	-.648
M_2	2. Fail to notice or anticipate another vehicle pulling out in front of you and had difficulty stopping	1.88	.703	.559	.440
M_3	3. Distracted or pre-occupied, you suddenly realize that the vehicle in front has slowed, and you have to brake hard to avoid collision	1.91	.707	.600	.624
M_4	4. Not notice someone stepping out from behind a parked vehicle until it is nearly too late	1.47	.670	1.346	1.434
M_5	5. Ride so fast into a corner that you feel like you might lose control	1.90	.759	.781	1.153
M_6	6. 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	1.434	2.615
M_7	7. Run wide when going around a corner	1.59	.729	1.076	.652
M_8	8. Ride so fast into a corner that you scare yourself	1.83	.664	.318	-.274
M_9	9. Not notice a pedestrian waiting at a crossing where the lights have just turned red	1.41	.721	2.324	6.984
M_{10}	10. Fail to notice that pedestrians are crossing when turning into a side street from a main road	1.36	.680	2.713	7.781
M_{11}	11. 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	1.356	1.378
M_{12}	12. Find that you have difficulty controlling the bike when riding at speed (e.g. steering wobble)	1.38	.677	1.964	3.840
M_{13}	13. Needed to brake or back-off when going round a bend	2.42	.781	.505	.536
M_{14}	14. Skid on a wet road or manhole cover, road marking, etc.	2.01	.838	.617	.216
M_{15}	15. Needed to change gears when going around a corner	2.06	.893	.540	-.202
M_{16}	16. Miss 'Give Way' or 'Stop' signs and almost crash with another vehicle	1.18	.414	2.130	3.770
M_{17}	17. Ride so close to the vehicle in front that it would be difficult to stop in an emergency	1.63	.730	1.043	.862
M_{18}	18. Exceed the speed limit on a motorway	3.12	1.104	-.106	-.600
M_{19}	19. Exceed the speed limit on a country/rural road	3.16	1.027	-.027	-.466
M_{20}	20. Exceed the speed limit on a residential road	2.25	.964	.706	.197
M_{21}	21. Disregard the speed limit late at night or in the early hours of the morning	2.32	1.116	.669	-.223
M_{22}	22. Open up the throttle and just go for it on a country road	2.25	1.151	.536	-.691
M_{23}	23. Get involved in racing other riders or drivers	1.48	.826	1.987	4.063
M_{24}	24. Race away from the traffic lights with the intention of beating the driver/rider next to you	1.54	.838	1.896	4.075
M_{25}	25. Attempt or done a wheelie	1.34	.738	2.545	6.598
M_{26}	26. Intentionally do a wheel spin	1.18	.476	2.983	7.954
M_{27}	27. Pull away too quickly and your front wheel lifted off the road	1.53	.770	1.411	1.384
M_{28}	28. Unintentionally had your wheels spin	1.33	.632	2.129	4.701
M_{29}	29. Motorcycle protective trousers (leather or non-leather)	1.69	.944	1.583	2.545
M_{30}	30. Motorcycle boots	1.66	.993	1.707	2.641
M_{31}	31. A motorcycle protective jacket (leather or non-leather)	1.40	.793	2.652	7.194
M_{32}	32. Body armour/impact protectors (e.g. for elbows, shoulders or knees)	2.16	1.531	.951	-.696
M_{33}	33. Bright/fluorescent stripes/patches on your clothing	3.21	1.580	-.196	-1.489
M_{34}	34. Ride when you suspect that you might be over the legal limit for alcohol	1.45	.717	1.652	2.355
M_{35}	35. Another driver deliberately annoys you or puts you at risk	1.89	1.061	.951	-.056
M_{36}	36. Do you have trouble with your visor or goggles fogging up	2.50	.962	.094	-.620
M_{37}	37. A leather one-piece motorcycle suit	4.34	1.355	-1.826	1.670
M_{38}	38. Bright/fluorescent clothing	3.43	1.560	-.422	-1.367
M_{39}	39. Do you use daytime running lights or headlights on in daylight	1.20	.804	4.276	7.302
M_{40}	40. Motorcycle gloves	1.38	.882	2.644	6.619
M_{41}	41. Do you wear no motorcycle specific protective clothing	1.97	.983	1.044	.925
M_{42}	42. Attempt to overtake someone whom you have not noticed to be signalling a right turn	1.23	.575	3.313	6.761
M_{43}	43. Ride between two lanes of fast moving traffic	1.74	.990	1.277	.953

As can be seen from *Table 1*, the range of skewness index (SI) for indicators was (–1.826, 4.276), while the range of kurtosis index (KI) was (–1.489, 7.954). According to several authors [22, 26, 27, 28, 29, 30, 31], the normality of the given indicator data was not severely violated, but only slightly. Therefore, it can be said that these ranges do not represent a serious non-normality problem.

2.4 Data collected in the DBQ questionnaire

In our study, as mentioned before, we decided to use the 27-item questionnaire presented by Lajunen et al. [17]. These authors investigated a four-factor based model structure, where the indicator variables were assigned to the following factor categories: Aggressive violations, "Ordinary violations", Errors, and Lapses. The indicator items and their properties are given in *Table 2*. Participants were questioned to estimate how often they cause any of the specified violations and errors when they are driving. Their answers were recorded on a five-point Likert scale, ranged from "Never" to "Nearly all the time".

As can be noticed from *Table 2*, the range of skewness index for items was (–0.223, 4.050), while the range of kurtosis index was (–0.945, 6.997). Thus, as with MRBQ, it can be supposed that the normality of the given item data was not severely violated, but only slightly.

3. METHODOLOGY

3.1 Methods for analysis and model development

Figure 2 shows the block diagram of the methods used in the analysis of our research [24]. In the first stage, the exploratory factor analysis was applied. The EFA is often used as a preliminary statistical technique for identification of the latent factors and estimation of their indicator loadings. This way, the relationships between the observed indicator variables and the corresponding factors can be investigated.

In the next stage, the confirmatory factor analysis was engaged, which examines how well the presumed

Table 2 – Mean, standard deviation (SD), skewness index (SI) and kurtosis index (KI) of the DBQ indicators

Item	Content of the item	Mean	SD	SI	KI
D_1	1. Hit something when reversing that you had not previously seen	1.275	0.527	2.016	4.517
D_2	2. Intending to drive to destination A, you "wake up" to find yourself on the road to destination B	1.440	0.803	2.332	6.176
D_3	3. Get into the wrong lane approaching a roundabout or a junction	1.176	0.460	4.050	5.784
D_4	4. 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	2.273	6.412
D_5	5. Fail to notice that pedestrians are crossing when turning into a side street from a main road	1.489	0.996	2.492	5.764
D_6	6. Sound your horn to indicate your annoyance to another road user	1.692	0.830	1.566	3.332
D_7	7. Fail to check your rear-view mirror before pulling out, changing lanes, etc.	2.011	1.570	1.169	-.396
D_8	8. Brake too quickly on a slippery road or steer the wrong way in a skid	1.247	0.481	2.068	5.510
D_9	9. 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	.791	-.565
D_{10}	10. Disregard the speed limit on a residential road	2.368	1.326	2.058	2.261
D_{11}	11. Switch on one thing, such as the headlights, when you meant to switch to something else, such as the wipers	1.143	0.351	2.317	4.432
D_{12}	12. On turning left nearly hit a cyclist who has come up on your inside	1.148	0.372	2.653	6.378
D_{13}	13. Miss "Give Way" signs and narrowly avoid colliding with the traffic having the right of way	1.126	0.349	3.702	2.174
D_{14}	14. Attempt to drive away from the traffic lights in third gear	1.192	0.495	2.245	6.694
D_{15}	15. Attempt to overtake someone that you had not noticed to be signalling a right turn	1.275	0.527	3.234	2.072
D_{16}	16. Become angered by another driver and give chase with the intention of giving them a piece of your mind	1.236	0.617	1.620	2.179
D_{17}	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	1.489	0.763	3.686	5.579
D_{18}	18. Forget where you left your car in a car park	1.247	0.492	1.859	2.680
D_{19}	19. Overtake a slow driver on the inside	1.280	0.634	2.850	6.763
D_{20}	20. Race away from traffic lights with the intention of beating the driver next to you	1.533	0.798	1.638	2.663
D_{21}	21. Misread the signs and exit from a roundabout on the wrong road	1.214	0.539	3.539	6.997
D_{22}	22. Drive so close to the car in front that it would be difficult to stop in an emergency	1.473	0.619	1.236	1.804
D_{23}	23. Cross a junction, knowing that the traffic lights have already turned against you	1.599	0.704	1.324	2.909
D_{24}	24. Become angered by a certain type of a driver and indicate your hostility by whatever means you have	1.511	0.749	1.719	3.956
D_{25}	25. Realize that you have no clear recollection of the road along which you have just been travelling	1.473	0.839	2.444	6.963
D_{26}	26. Underestimate the speed of an oncoming vehicle when overtaking	1.319	0.637	2.845	5.395
D_{27}	27. Disregard the speed limit on a motorway	2.819	1.219	.223	-.945

theoretical structure of the factor model fits the real data. This way, the confirmatory test of our measurement theory is executed, which gives us the measurement part of the SEM model as the final result.

In the final stage, the structural part of the SEM model is derived via the SEM modelling procedure, so the causal relations between factors are also identified. The design of the overall SEM model is completed when the validation tests and goodness of fit (GOF) measures give adequate results.

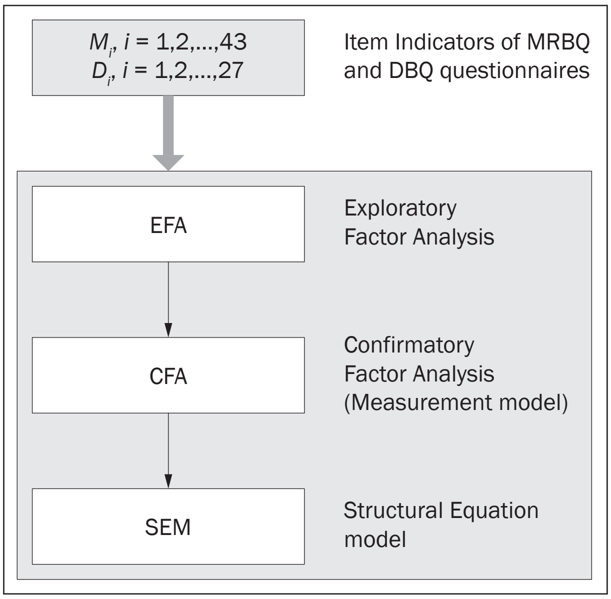

Figure 2 – The block diagram of the methods used in the analysis [24]

3.2 Used estimators

During the estimation of parameters in CFA and SEM procedure, the maximum likelihood (ML) method was conducted, since the ordinal indicator variables were only slightly non-normal. The excuse to apply this commonly used estimator is based on the findings of several previously introduced studies in the scholarly literature. In these studies, it is reported that the ML estimator gives the satisfactorily accurate estimated parameters, if the ordinal indicators contain at least five levels and are nearly normal [23, 32, 33, 34]. This can be particularly justified since the χ^2 statistic and GOF indices are not significantly false in such case [23].

4. ANALYSIS AND MODELLING RESULTS

4.1 Exploratory factor analysis

The main goal while doing the EFA analysis was to extract only two factors, one related to the MRBQ, and the other related to the DBQ. The correctness of conducting the factor analysis was inspected by means of two tests: Bartlett's test of sphericity, and the Kaiser-Meyer-Olkin KMO test [22, 23, 24]. The value of the Bartlett's test was very large (χ^2=1,878.168 with df=378 and p<0.001) while the KMO value was 0.828>0.5. Based on the recommendation from Frohlich and Westbrook [35], Sahin et al. [36], and Li et al. [37], the factor analysis can be reliably used in further research. While processing the extraction of factors, the principal axis factoring (PAF) method, with additional Promax rotation (and Kaiser Normalization) was employed.

The PAF method analyses only common factor variability and removes unexplained variability from the factor model. It is based on searching of the lowest number of factors that can describe the common variance or correlation of a set of variables. After the completion of this method, only those items were retained which were significantly loaded on MRBQ factor or DBQ factor (which means: loadings λ_{ij}>0.40, according to [24]).

The results of the rotated factor pattern matrix (factor loadings λ_{ij}, Cronbach's alpha coefficients, and % of the total variance explained) are presented in *Table 3*. The calculation of Cronbach's alphas' statistics is a commonly used procedure while doing the factor analysis. Alphas represent the estimated values of reliability or internal consistency of a statistical instrument. They measure how well a set of observed items represents the corresponding unmeasured construct (factor). They also evaluate whether the items have an adequate internal consistency, i.e. whether they are strongly correlated and truly measure the same construct [22, 32].

In our case, the Cronbach's alphas are both bigger than 0.7, which implies that reliability and internal consistency are, according to the recommendation of Hair and his colleagues, adequate [24]. Cumulative percent of the total variance explained is low since many ill-fitting items were dropped from further analysis. The reason is that their communalities and/or loadings on factors MRBQ and DBQ were not adequate. This was expected since only two factors were applied in the analysis due to our specific research goals. Naturally, in a different configuration with more than two factors, the achieved results would differ from the one presented.

4.2 Confirmatory factor analysis

While executing the CFA analysis, the results of the earlier EFA analysis were considered as a baseline (see *Figure 2*). After the completed estimation of the parameters of our 2-factor model, the majority of estimated factor loadings remained quite similar as in the EFA case (see *Table 3*), and their range was consistent with the recommendations in literature [24].

The fitting performance of the derived CFA measurement model was investigated via the calculation of several model fit indices, which are typically suggested in literature [23, 24, 25]. Some of the most important indices are, for example: Chi-Square χ^2 of

Table 3 – The results of the rotated factor pattern matrix in EFA

EFA Pattern Matrix		
	Factor	
	MRBQ	DBQ
Cronbach Alpha	0.853	0.827
% of Variance	23.835	11.776
Cumulative %	23.835	35.610
Retained Item	Loadings λ_{ij}	
M_{18}	.744	
M_{22}	.718	
M_{17}	.685	
M_{24}	.659	
M_{26}	.623	
M_{19}	.527	
M_{20}	.525	
M_{27}	.523	
M_{21}	.521	
M_{23}	.496	
M_{42}	.461	
M_{25}	.414	
M_{13}	.401	
D_{15}		.677
D_{12}		.645
D_{13}		.622
D_{1}		.618
D_{26}		.602
D_{25}		.569
D_{4}		.489
D_{14}		.483
D_{9}		.472
D_{24}		.447
D_{18}		.425
D_{23}		.423
D_{8}		.420
D_{22}		.417
D_{11}		.409

the discrepancy between the sample and fitted covariance matrices, relative Chi-Square χ^2/df, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Normed Fit Index (NFI), Non-Normed-fit Index (NNFI), also called Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Residual (SRMR), etc. As it turned out, they all had the adequate value regarding their threshold ranges, recommended in the scholarly literature, i.e.: $\chi^2/df<5$; $GFI>0.9$; $AGFI>0.9$; $NFI>0.9$; $NNFI>0.8$; $CFI>0.9$; $RMSEA<0.07\div0.1$; and $SRMR<0.09$ [22, 23, 38].

In the sequel, the convergent validity was also inspected through the computation of composite reliability (CR) and the adequate average variance extracted (AVE). According to the authors of [24], the thresholds of CR and AVE values are 0.70 and 0.5, respectively. The CR values and the AVE values have been calculated for both factors, MRBQ and DBQ, and they appeared to be greater than the prescribed threshold values, which means: $CR_{MRBQ}=0.721$; $CR_{DBQ}=0.894$; $AVE_{MRBQ}=0.512$; $AVE_{DBQ}=0.638$.

4.3 Structural equation model

Considering the block diagram in *Figure 2*, the structural equation modelling procedure was the next and the last stage in the SEM modelling process. Herein, the structural part of the SEM model was also derived. Since this part is inseparably connected with the measurement part derived in the CFA, the composite of both parts had provided the overall structure of the SEM model. When the estimation procedure was completed, practically equal results for the estimated factor loadings occurred, as they were before calculated in the CFA analysis.

The goodness of fit of the derived SEM model was, similarly as with the CFA, inspected through the computation of several model fit indices, which are recommended in the scholarly literature. Here again, as in CFA case, these indices provided evidence of a good mod-

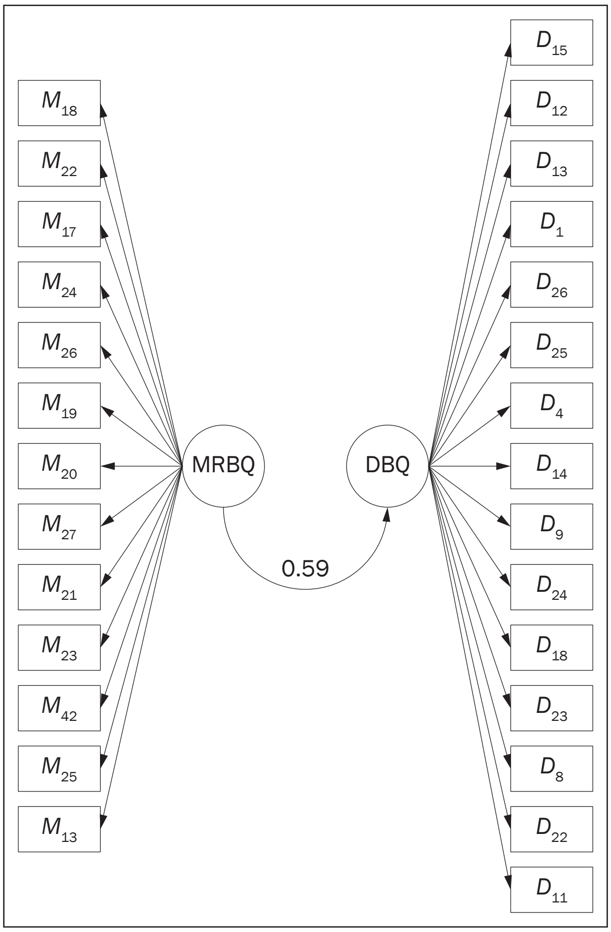

Figure 3 – The standardized estimated SEM model

el fit, since their achieved values were: $\chi^2 = 389.978$, $\chi^2/df = 1.226$, GFI = 0.975, AGFI = 0.941, NFI = 0.908, NNFI (TLI) = 0.954, CFI = 0.962, RMSEA = 0.036, SRMR = 0.0694, and finally, Bollen's Incremental Fit Index (IFI) was 0.968.

Figure 3, which corresponds to the conceptual framework in *Figure 1*, illustrates the standardized estimated SEM model with the estimates significant at $p \leq 0.05$ level. Besides the addressed factors MRBQ and DBQ, their retained items (introduced in *Table 3*) are also shown in *Figure 3*. Since the causal path from factor MRBQ to factor DBQ is statistically significant with regression weight 0.59, our main hypothesis H_1 introduced in *Figure 1* is obviously confirmed. Thus, it can be concluded that in our study the factor MRBQ indeed has a certain positively directed impact on the factor DBQ. From this, it might be also supposed that there is some truth in the subjective opinion of the target population, who claimed that they actually behave in a different way when driving a motorcycle or a car.

5. DISCUSSION

The results presented in the previous section revealed that there indeed exists a certain difference in the driving behaviour when the drivers' population drive a car or a motorcycle. The major reason is probably in their psychological awareness that the risk-taking when driving a motorcycle can cause much more tragic consequences than when driving a car. Thus, they are obviously familiar with the statistical facts that the chance of survival in severe accidents is much lower for the riders if compared to the drivers. Additionally, they probably subconsciously feel safer surrounded by the car "armour" than when they have no physical protection as a motorcyclist. So, they drive safer when using a motorbike, particularly in the sense of no alcohol drinking, avoidance of control and traffic errors, and rigorous use of the safety equipment.

All this was also subjectively confirmed by the population drivers. As they said, the only exception is about speed violations, which sometimes occur due to the lack of objectivity about the actual speed. Also, they admit that while driving a bike, they feel more courageous in the case of seemingly non-dangerous situations (flat road, etc.). However, on the other side, while driving a car, they claim that they behave more nonchalant, superficial, and routinely.

The findings of this study thus imply that the behaviour of the road users should be perhaps treated differently and more sensibly from a traffic regulations' point of view if the person is a rider or a driver. The Slovenian traffic laws, namely, determine that the person is disciplined by losing all driving licenses in case of serious violation. So, if they are punished as a driver, then they are penalized by the cost of the motorbike license as well. But, is this fair, since they presumably drive safer as motorcyclists? Naturally, this law specifics are characteristic only for Slovenia, and most likely the punishment is not so strict in other countries.

In the future work, our attention will be focused on extending the research to some other countries since now the findings have only a local character. Maybe in other countries the road users, who are drivers as well as riders, behave completely differently. Perhaps they are not so cautious when driving a motorcycle and are not so aware of all tragic implications which can occur with too risky behaviour. Thus, when further, internationally based study is applied, our findings will be hopefully more generalized and will reveal possible cultural differences in conclusions about driving behaviour as a rider or a car driver.

6. CONCLUSION

The present study has dealt with the investigation of possible differences in drivers' behaviour when they drive a motorcycle or a car. For this purpose, the MRBQ and DBQ questionnaires were applied in a survey among the same population of interviewed motorcyclists.

On the basis of collected survey data, the structural equation model with two factors, MRBQ factor and DBQ factor, has been developed. The SEM model has revealed positively directed, significantly weighted causal path from the MRBQ factor to the DBQ factor. So the model's performance statistically confirmed our main hypothesis, which implies that the motorcyclists behave differently when they are driving a motorbike or a car.

This finding might be a serious warning for the legislature to rethink about the fairness of existing laws, which penalize the offender by confiscation of all driving licenses in case of serious violation. We think that such a rigorous measure is not proportionate to the seriousness of the particular offense, especially with non-fatal events or accidents with minor damage.

It is believed that the main conclusions of this research might represent a significant contribution of this paper. In addition, since there are practically nocomparable papers detected which could report a similar type of research, the results of this study could help to fill the gap in the existing literature on the topic.

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PRIMERJAVA VEDENJSKIH RAZLIK MOTORISTOVPRI VOŽNJI Z MOTORNIM KOLESOM ALI AVTOMOBILOM: RAZISKAVA NA OSNOVI MODELA STRUKTURNIH ENAČB

POVZETEK

Glavni namen raziskave je preučevanje morebitnih vedenjskih razlik motoristov pri vožnji z motornim kolesom ali avtomobilom. V ta namen je izvedena anketa v obliki dveh vprašalnikov med isto populacijo motoristov. Prvi vprašalnik zrcali motoristične vedenjske, drugi pa avtomobilistične vedenjske vzorce. Na osnovi zbranih podatkov ankete je razvit model strukturnih enačb z dvema faktorjema, eden se nanaša na vedenjske lastnosti vožnje z motorjem, drugi pa na vedenjske lastnosti vožnje z avtom. V procesu razvoja modela sta uporabljeni tudi eksploratorna in potrditvena faktorska analiza. Rezultati kažejo, da dejansko obstajajo določene razlike v voznem obnašanju. Glavni razlog za to je verjetno v mentalnem zavedanju motoristov, da rizična vožnja z motorjem lahko vodi do mnogo hujših posledic v primerjavi z vožnjo z avtom. Motoristi namreč posebej izpostavijo tovrstno dojemanje razlik pri vožnji z motorjem ali avtom, kar naš model tudi statistično potrdi. Implikacije teh ugotovitev so soočene z morebitno neustreznostjo obstoječe prometne zakonodaje.

KLJUČNE BESEDE

vprašalnik motorističnih vedenjskih vzorcev; vprašalnik avtomobilističnih vedenjskih vzorcev; prometne nesreče; modeliranje strukturnih enačb; vozne kršitve; vozne napake;

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