

## SELF-REPORTED DRIVERS' BEHAVIOUR: AN APPLICATION OF DBQ IN POLAND

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### **Abstract**

*Most of road accidents are caused by human error. To study these errors road safety researchers developed self-reported measures. DBQ (Driver Behaviour Questionnaire) is one of the most frequently used tools for studies carried out in scope of traffic psychology. It has become an international standard which is used by driver behaviour researchers, yet it is still quite unknown in Poland. The questionnaire describes aberrant behaviour of the drivers in two basic dimensions: errors and violations. The main purpose of following article is to present the theoretical principles underlying the human error model, structure of this tool and polish adaption of the questionnaire. Polish version of the DBQ has 32 items in total. Another aim of the study was to investigate the factorial structure of the DBQ presented in previous studies. The reported data included a sample of 467 drivers. Reliability coefficients were calculated for each scale and their value were around .80 representing high overall reliability. Our analysis indicates that the DBQ construct was fairly congruent with the one presented in the Swedish study. Behaviours were classified due to their factor loadings in following dimensions – violations, mistakes, inattention and inexperience. Seven behaviours have different factor loading, which indicates different psychological mechanism underlying these aberrations. Issues related to these findings are discussed.*

**Keywords:** DBQ, driving behaviour, traffic psychology

### **1. Introduction**

According to World Health Organization, Road traffic injuries are one of the leading causes of death, taking 10<sup>th</sup> place in the whole world ranking [1]. In Poland alone, in 2012 nearly 40 000 road traffic accidents took place, taking toll of over 3 500 deaths and about 46 000 injuries [2]. Comparing with the previous year a slight improvement of road safety has been observed, still Poland obtains too high ratings – 96 deaths due to road accidents per 1 million citizens.

A road traffic accident is defined as an event which was caused by a group of different factors. When dividing road system into three basic elements: driver, vehicle and environment; human errors are concerned to be the main cause of all accidents. According to data collected by Polish Police, the five basic causes of road traffic accidents are: inappropriate speed in certain road and traffic conditions, not respecting right-of-way, wrong behaviour in the presence of pedestrians, risky overtaking and close following. There seems to be a strict correlation between drivers' behaviour and occurrence of road accidents. Therefore traffic psychology plays an essential role in the road accidents prevention, giving tools to analyse drivers' behaviour.

In the early 90's Reason, Manstead, Stradling, Baxter and Campbell [3] introduced a Driver Behaviour Questionnaire (DBQ), which is today one of the most frequently used tool in researches on driver behaviour. It has been used in almost 200 researches the results of which were published in prestigious Scopus and Web of Science. There are different versions of Driver Behaviour Questionnaire – from ones covering only 10 basic questions [4] to ones consisting of over 100 items [5]. In DBQ participants are asked to indicate how often certain traffic situations happen to them. Meta-analysis conducted by de Winter and Dodou [6] with dataset of 45 thousands drivers showed that behaviours reported by drivers can be treated as predictors of traffic accidents. In this meta-analysis violations are predicted collisions with a correlation of .13 and errors with overall correlations of .10.

The standard version of Driver Behaviour Questionnaire – developed by Reason in 1990 – consists of 50 questions, which cover four classes of aberrant behaviour: slips and lapses, mistakes, unintended violations and deliberate violations. Slips are defined as “actions-not-as-planned” while lapse is a term reserved for more covert memory failures. Mistakes arise from deficiencies in the judgmental and/or inferential processes involved in the selection of an objective, or of the means to achieve it, or both. Violations are deviations from the practices believed to be necessary to maintain the safe operation of a potentially hazardous system. For the purpose of DBQ, violations were divided into two groups – unintended and deliberate. We can distinguish violations caused by lack of experience from ones made deliberately [3]. Driver Behaviour Questionnaire studies have been conducted in several countries e.g.: Finland, Netherlands [7], New Zealand [8], China [9], Turkey [10] and Sweden [11]. The factorial structure of DBQ varies between countries and studies. It can be explained by cultural differences, differentiated items description and analysis methods. Nevertheless, in most cases authors report three or four factors structure of DBQ. The basic distinction between factors consists of errors and violations [6]. This distinction is in different studies extended with other contributing factors. There is exhaustive terminology for these factors e.g. errors can include factors like lapses, slips and inexperience errors, while violations can be defined as aggressive violations, interpersonal violations or highway violations. Therefore, some studies can report the same number of factors in DBQ but the terminology used and underlying definitions can be completely different. Another issue related to factorial structure of DBQ is the variation of behaviours between different subgroups differentiated by age, experience and gender [3].

Despite the fact that Reason published his article more than two decades ago to the best of authors' knowledge, there were no publications on psychometric evaluation of this research tool in Poland. The aim of this study is to present the basic assessment of DBQ-SWE by reporting reliability and factor analysis. We also provide comparison of our assessment with the analysis conducted in other studies and driving cultures.

## **2. Method**

In the present study we have used Swedish version of the DBQ called DBQ-SWE [11]. The questionnaire was translated into Polish. It consisted of 32 items that were reported by authors as items with the highest factor loading for four factors solution – violations, mistakes, inattention and inexperience. These factors explained 44% of total variance. Aberg and Rimmo in their first study have used significantly modified questionnaire that included 104 items with aberrant behaviours, where only 44 were taken from original DBQ developed by Reason. The results reported by Swedish authors supported the four factors structure with violations, mistakes, inattention and inexperience.

In the Polish questionnaire all items were validated by the road safety experts in terms of their compliance with national regulations and standards. In the first part of the questionnaire respondents indicated how often they commit each of 32 errors. Items were described on six points Likert response-scale, where 0-never, 1-very seldom, 2-rather seldom, 3-sometimes, 4-often, 5-

very often. Moreover, subjects reported additional information about their driving experience, traffic collisions and their demographics.

The questionnaire was completed by 467 drivers with an “amateur” B driving license ( $n=467$ ). All subjects were recruited through announcements during studies conducted at the University of Warsaw and Motor Transport institute. The average age for participants was 31.37 ( $SD=11.21$ , range 18-75). Mean number of kilometres driven annually was 18 083 ( $SD=17 650$ , range 1000-90 000) and mean number of years holding driving license was 11.35 ( $SD=9.37$ , range 1-52). This set of participants was represented by 260 females and 207 males.

We used several statistical methods to analyse our results. Firstly, to determine number of dimensions underlying aberrant behaviours we used principal component analysis (PCA) with varimax rotation. Secondly, we analysed reliability using Cronbach's alpha reliability coefficients. All statistical analyses were performed with the PASW Statistics Software 18.0.

### **3. Results**

Most frequently reported drivers' behaviours can be classified as typical violations. Polish drivers reported that they deliberately speed when overtaking (Mean=3.63), deliberately exceed speed limit on main roads during low traffic (Mean=3.56), deliberately disregard speed limit to follow traffic flow” (Mean=3.44) and accelerate at green/yellow phase (Mean=3.02). First two behaviours were also indicated by Aberg and Rimmo [11] as most frequent in the sample of Swedish drivers. On the other hand Polish drivers reported as least-frequently occurred behaviours: “forget lights on full beam” (Mean=0.54), “Enter road in front of other vehicle” (Mean=0.72), “wrong gear trying to reverse” (Mean=0.73) and “misjudge distance to oncoming car” (Mean=0.73).

Screen plot was used to indicate how many factors should be extracted to describe different groups of aberrant driving behaviours. Most viable solutions were the one with two and four factors. Consistently with Swedish study we performed Principal Component Analysis with varimax rotation and four factors analysis. These four components accounted for 48.39% of total variance. First factor including 11 items was defined as Inexperience and it explained 14.5% of variance. Second factor named “violations” accounted for 12.87% of variance with 7 items. Third factor consisting of 7 items explained 11.81% of variance and it was called “mistakes”. Inexperience factor was the last fourth factor and it explained 9.21% of variance with 7 items.

In this study seven items had significantly different factor loadings comparing to Swedish results. It was found that other 25 factors had similar psychological origin. These seven items can be associated with different dimensions of drivers' aberrations. Forgetting where car is parked in the Polish study had higher loading in inexperience component than in inattention. Another investigated behaviour “Stop distance longer than expected” is more likely to be linked to inexperience than to mistakes or inattention. Two behaviours described as failing to notice green arrow and failing to notice green light in our study had higher loading in mistakes dimension than in inattention. Reported behaviours on illegal parking were found to have stronger associations with inattention errors than violations. Last difference, which was revealed in our analysis, indicates that among Polish drivers “cutting the bends” is a violation. Factor loadings, means and standard deviations for DBQ items are listed in Tab. 1.

Alpha's reliability coefficients were calculated for all four scales – violations, mistakes, inattention and inexperience. All scales were internally consistent. The one with the highest alpha value was violations scale ( $\alpha=0.851$ ). Other scales like mistakes ( $\alpha=0.828$ ) and inexperience ( $\alpha=0.834$ ), had also acceptably high alpha values. The least consistent scale was the one associated with inattention errors ( $\alpha=0.773$ ).

Tab. 1. Descriptive statistics of DBQ items and factor loadings calculated with Principal Component Analysis with varimax rotation. E-Inexperience, V-Violations, M-Mistakes, A-Inattention

Item no	Item description	Component				Mean	Std Deviation
		E	V	M	A		
23	Have to check gear with hand	.729				1.34	1.293
21	Shift into wrong gear when driving	.707				1.05	1.009
22	Switch on wrong appliance in car	.689				.82	1.057
15	Wrong gear trying to reverse	.599				.73	.965
4	Forget parking brake	.563				1.08	1.186
14	Forget where car is in a car park	.527			.330	1.49	1.398
6	Forget lights on full beam	.472				.54	.805
20	Stop distance longer than expected	.446		.365	.314	1.08	.882
27	Try to shift into gear already in	.432				1.03	1.272
13	Driving in too low gear	.400				1.34	1.345
3	Fail to notice green arrow	.340				.85	1.151
12	Deliberately disregard speed limits		.841			3.56	1.371
1	Disregard speed limit to follow traffic		.805			3.44	1.464
16	Deliberately speed when overtaking		.799			3.63	1.449
2	Overtaking vehicle slowing down		.699			2.09	1.645
7	Accelerate at green/yellow phase		.690			3.02	1.492
5	Drive close to car in front		.508	.383		1.52	1.577
30	Cut the corner turning right		.480	.384		1.55	1.418
25	Misjudge speed of oncoming vehicle			.756		1.18	1.114
31	Misjudge distance to oncoming car			.717		.73	.898
26	Turn into vehicle's path	.314		.699		.81	.881
32	Misjudge interval turning left			.686		1.13	.987
24	Enter road in front of other vehicle			.567		.72	.964
29	Misjudge speed at main road exit	.322		.503		1.20	1.003
11	Fail to notice green light			.359	.357	.82	.992
28	Illegal parking		.357		.664	1.56	1.427
8	Park illegally		.362		.634	1.62	1.439
9	Fail to notice new sign				.611	1.62	1.270
10	Misread signs, and yourself lost	.424			.502	1.47	1.132
19	Miss exit on motorway	.472			.499	1.12	1.085
17	Fail to notice closed road sign	.404			.490	.80	.991
18	On usual route by mistake	.414			.469	1.07	1.180

#### 4. Discussion

Self-reported behaviours are still one of the most important sources of knowledge about driving. After twenty years Driver Behaviour Questionnaire is still one of the most popular survey instruments to measure driving behaviour. Reason et al. [3] in their first DBQ studies suspected that driving behaviours has different underlying psychological mechanisms. Over last years there were many studies investigating structure of human error in the driving context. This study showed that different dimensions of aberrant driving behaviour reported by Polish drivers were quite congruent with the structure indicated by Aberg & Rimmo [11].

First identified dimension was inexperience component, which consisted of behaviours like have to check gear with hand, shift into wrong gear when driving or switch on wrong appliance in car. This factor proved to be correlated with number of kilometres driven annually and number of years licensed. Second reported factor was called violations and it included behaviours like deliberate disregarding speed limits, dangerous overtaking, driving too close to vehicle in the front

and accelerating at green yellow/phase. Some studies reported that high violations score is usually associated with young age and male gender [11, 13]. Third factor was identified as mistakes, it can define as departure of planned actions towards desired goal. It included behaviours like misjudging speed of oncoming vehicle and distance to this vehicle or entering road in front of other vehicle. Fourth factor was inattention and it captures items like failing to notice new sign, missing exit on motorway and misreading signs. Inattention errors increase with age.

There were seven behaviours, which haven't fit the structure. It can be explained by the fact that the distinction of aberrant driving behaviours might be in some cases not very clear. Many studies produced different factors structure of the questionnaire and reported different factor loadings for the same items [11, 12, 14]. According to Roca et al. [15] and Martinussen et al. [12] most broadly replicated factor structures in DBQ consists of three (lapses, violations, errors) or four factors (additional aggressive violations factor). However, the only thing that seems consistent and stable in DBQ is the basic two dimensions of intentional violations and unintentional errors. Remaining factors are very dependent on the respondents groups, their age, gender and cultural context. There are also some differences among researchers whether DBQ can be fully trusted in the context of its relationship with traffic accidents [16]. Researchers criticize the favourable interpretation of self-reported measures of driving behaviour. Some of the arguments state that DBQ measure can distort real driving behaviours. It can be caused by the fact that DBQ provides self-reported information on driving, which is prone to different types of response biases and therefore might not be reliable. This critic is caused by several biases such as social desirability, pessimistic self-evaluation, scale anchors, consistency motif and unconsciousness of some errors. Moreover, there are many of studies that have used different number of items and differently described behaviours. Therefore, researches analysing different DBQ studies should take into consideration the fact that it might not be a fully consistent measure, with the one used in other studies. Translations and local context can also lead to misinterpretations of original items, which also in this study can be acknowledged as methodological limitation.

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