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Searching for Predictors of Safe Driving Behaviour as an Important Activity in Achieving an Integrated Traffic System. Research on the Behavioural Criterion of the Psychometric Test Validity for Drivers

ABSTRACT

Safety in road traffic as a system in which there are dynamic interactions between its different users depends on how integrated it is. In this system, drivers are a favoured group of users. Unfortunately they are also the most dangerous group, as research shows. Studying the causes of dangerous driving behaviour is still important.

The paper aims to present the psychometric methodology to define the diagnostic and prognostic validity of some psychometric tests used by transport psychologists. Our statistical analysis included the four experimental groups of professional drivers with motor vehicle accident and one control group of drivers whose road performance had no motor vehicle accident recordings.

The novelty of the study presented here is in linking the psychometric tests outcomes of professional road drivers (city bus drivers, school bus drivers, taxi

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drivers, ambulance drivers, fire trucks drivers, police drivers, military vehicle drivers, special vehicle drivers etc.) and their behavioral safety performance on public roads (i.e. causing road accidents, road collisions, participating in accidents but not causing it, and participating in road collision but not causing it) – which aims to indicate the diagnostic and prognostic validity of these tests for drivers.

Discriminatory analysis based on Fisher $\hat{g}$-function was used to find discrepancies between the specific test outcomes of the road drivers in the control group and the four risky behaviour groups. The identified discrepancies are interpreted in terms of equivalence between the diagnostic and prognostic validity of the taken into consideration psychometric tools used by psychologists for diagnosing road drivers.

KEYWORDS: safety road performance; road drivers behavioural scale; psychometric tests diagnostic and prognostic validity; discriminatory analysis; integrated traffic system.

INTRODUCTION

Sustainable development of cities and rural areas in terms of achieving a higher and higher level of road safety is one of the main contemporary challenges in the field of transport. The car revolutionized human civilization significantly increasing the quality of human life. Unfortunately, its worldwide popularity has also resulted in severe changes to the spatial development of the land. In order for cars to fulfil their role completely, the development of road infrastructure had to follow their improvement. This process has been continuing till present day. The road system – as an integrated system – has been designed mainly for cars and even today most investments in the area of transport are still focused on supporting the use of this mode of transport.

As a result of the development of the automotive industry and the extensive road infrastructure following it, a number of negative phenomena can be observed in contemporary cities: congestion, smog, increasing road aggression. The enormous amount of exhaust fumes emitted by cars contributes not only to the increased risk of diseases for urban and rural residents, but also to high CO_2 emissions to the atmosphere. According to a WHO report, in Poland alone, approx. 40,000 people die annually from pollution with suspended dust PM10 and PM2.5, of which car exhaust fumes account for about 30%. There are more and more voices that the development of road transport should consider not only the comfort of modern people's life, but also take into account their health and safety. In order for the road traffic system to be fully integrated, it must consider the interests of all groups of road users. Therefore, the policy of many countries and the conducted research promote the model of using public transport and active transport (on foot or by bike) (Hirst, 2020). Meanwhile, so far road transport has been subordinated mainly to drivers and taken into account the expectations of other groups only slightly: pedestrians, cyclists, motorcyclists – the unprotected groups of users (Lyons et al., 2020). Such integrated transport mobility of modern people will allow a greater reduction of not only the emission of exhaust gases into the atmosphere, but also an increase in the level of road safety.

In road traffic as a system, there is an interaction between its various links. The central figure in this system is the human (driver, pedestrian, cyclist). He or she constantly analyses not only passive links such as a road or a car, but most of all the behaviour and conduct of other users. If the road traffic system is fully integrated, the functioning of all user groups will also be safe and effective. Therefore, the causes of its dysfunction should be investigated, including the dangerous behaviour of drivers.

Some studies indicate that road users differently assess traffic situations in terms of their safety (Salmon et al., 2009; Walker et al., 2011; Salmon et al., 2013). Cyclists are afraid not only of cars driving from the opposite direction, being overtaken in close proximity, but also of the damaged road surface (Panek & Benediktsson, 2017). Much less anxiety is experienced by motorcyclists and the least by vehicle drivers. Motorcyclists react exceptionally emotionally in road traffic. Their emotional reactions result from fear for safety and frustration with the dangerous behaviour of drivers (Samuel et al., 2019). On the other hand, for cyclists and motorcyclists, the bad quality of the road is also a frequent cause of strong emotions in road traffic: potholes, other deformations, and slipperiness of a drainage cover (Chang, 2014; Elliott et al., 2007; Habib et al., 2014). For drivers, these factors are of secondary importance.

Many studies show that cyclists find it difficult to accept such behaviours of drivers as having a car door suddenly open in one's path of travel or rubbish in the roadway (Johnson et al., 2013; Munster et al., 2001; Lawrence et al., 2018). Drivers are also the lowest-rated road user category for cyclists and pedestrians (Schachter & Singer, 1962; Zillmann, 1978); also poorly developed bicycle infrastructure (Aldred et al., 2019). It is also worth noting that in a recent study the authors noted that their respondents considered cycling as the "happiest" of transport modes (Zhu & Fan, 2018) .

The aspect of cognitive functioning of various road users is much less well-known. The analyses carried out so far show that car drivers mainly focus on tracking their speedometers to adjust the speed of the vehicle, motorcyclists on shifting the vehicle to neutral to avoid hand fatigue caused by holding the clutch while stationary, and cyclists on physical fatigue of various parts of their body (Plant & Stanton, 2015; Cox & Mutel, 2018; Götschi et al. 2016; Neun & Haubold, 2016). Still other studies have shown that the problem of perception of road traffic danger is most strongly perceived by cyclists, then by motorcyclists, and the least by drivers (Salmon at al., 2014; McIlroy et al., 2021). Motorcyclists are extremely prone to the observation of their surroundings. As they are less visible in traffic and move quickly, therefore they are at risk of suffering severe or fatal injuries if involved in a collision. They must protect themselves by carefully observing the behaviour of other (larger) road users (Mannering & Grodsky, 1995; Clarke et al., 2007; Crundall et al., 2012). Various cognitive and emotional experiences related to road traffic indicate different narratives of perception of the traffic situation by particular groups of road users. In turn, the small and poorly popularized knowledge of the society on this subject means that the road traffic system is still poorly integrated and its development is mainly subordinated to the goals of one of the groups – drivers. Despite the fact that enormous progress in building safe roads and vehicles has been observed recently, the driver is still the most dangerous link in the system. Understanding the reasons for their behaviour will make the system more integrated.

The literature has provided several explanations for drivers' accident involvement. Firstly, one of these explanations is that drivers are overconfident in their own skills (Gregersen & Bjurulf, 1996; OECD-ECMT, 2006). Adapting the behaviour to the demands of the task requires an accurate assessment of one's own driving skills and the complexity of the situation. Research has suggested that drivers tend to overestimate their ability (Dunning et al., 1989). Studies indicate that novice drivers accurately assess their driver competence when assessing specific competences, rather than comparing their general driving skill to that of the average driver (Mynttinen et al., 2009). These studies have been suggested that the self-report instruments of assessed perceived driver competence are very important (Sundström, 2011).

Secondly, important drivers' competency is the perceptual ability which is commonly referred to as drivers' hazard perception skill. Drivers' hazard perception has been defined as the ability to anticipate dangerous situations on the road ahead (Horswill & McKenna, 2004). Hazard perception is the only skill specific to driving that has been found to correlate with crash risk (Darby et al., 2009; Horswill et al., 2010; McKenna & Horswill, 1999; Pelz & Krupat, 1974).

Thirdly, a recent overview of research on driving shows clearly that it involves not only perceptual-motor skills, but a range of cognitive and personality variables (Groeger & Rothengatter, 1998). Driving is a complex task requiring integration of a number of visual, cognitive, personality and psychomotor skills. Many of the skills needed to operate a motor vehicle safely may be compromised with age or as a consequence of the various medical conditions that often accompany aging. Cushman (1992) examined the relationship between visual, cognitive, and driver knowledge measures and on-road driving performance. The largest differences between the groups that passed and failed the on-road test were found in the Vigilance task and the Trail Making. Despite what we know about driving ability, little research has addressed the role of personality in age-related assessment, driving performance, driving cessation and transitioning from driving to non-driving especially among older drivers (De Raedt & Ponjaert-Kristoffersen, 2006; Owsley et al., 2003; Schwebel et al., 2007; Strahan et al., 1997). However, personality traits like impulsivity, neuroticism, extraversion, conscientiousness, sensation-seeking, type A behaviour, aggressive behaviour and internal locus of control have been extensively studied and have been linked to risky driving behaviour among young and middle-aged drivers (Arthur & Graziano, 1996; Dahlen et al., 2005; Garity & Demick, 2001; Iversen & Rundmo, 2002; Jonah et al., 2001; Lajunen, 2001; Miles & Johnson, 2003; Özkan & Lajunen, 2005; Renner & Anderle, 2000; Taubman-Ben-Ari et al., 2004; Benfield et al., 2007; Bone & Mowen, 2006; Dahlen & White, 2006).

One of the main streams of research in traffic and transport psychology is the psychometric approach where psychologist have developed tests to diagnose drivers abilities, skills and competencies for efficient and safety road performance. The research design concerning the psychometric approach calls for elaboration of the following stages: (1) to find out what the fundamental work position requirements are for road drivers by providing them with their tasks and routine job analysis; (2) to construct psychometric tools for diagnosing actual drivers and candidates for drivers in terms of their abilities, skills and competencies enabling them to cope with the road driving safety requirements; (3) to state how far the psychometric tests outcomes are able to predict the real life safety performing of the road drivers. In the context of research on differences in the cognitive and emotional experience of traffic situations by cyclists, motorcyclists and drivers the question arises about the competence of drivers themselves to behave safely. That is why there are well-developed methodologies of drivers' work analysis concerning specific professional categories of vehicle drivers, such as: city bus drivers, school bus drivers, taxi drivers, ambulance drivers, fire trucks drivers, police drivers, military vehicle drivers, special vehicle drivers etc. Each of the professional groups of drivers have their own specific level of driving performance requirements at the particular chapters of work analysis. This means that the defined requirements profiles differ on the assessed rating scales as far as the particular categories of vehicle drivers are considered.

There is no doubt that the above-listed psychometric tools for diagnosing psychological potentiality of drivers have the assumed ecological validity and the theoretical base as well. However, the methodological problem is that the tests used by transport psychologists in Poland have no well-defined and empirically investigated connection with the external criterion of drivers road efficiency performance which is safety in the roads. Therefore, we can ask the following question in order to articulate the mentioned above research problem: How to define empirically the diagnostic and prognostic validity of psychometric tests commonly used by transport psychologists to diagnose road drivers' abilities for public roads and traffic performance?

The aim of the present study is to examine whether the psychometric methods and self-report instruments for psychological assessment of professional drivers (bus drivers, truck drivers, taxi drivers, ambulance driver, etc.) used by transport psychologists in Poland validly measure drivers' abilities, skills, and competence. For 40 years, the same psychological methods have been used to assess professional drivers' competence. Projections of demographic changes in Poland continue to show an increase in the older population, especially those over 55 and 75 years of age. The ability of these people to drive can be an object of public debate influenced by accounts in the media concerning neurological, behavioural and psychological conditions of this particularly hazardous group.

Secondly, the aim was to discuss the methods used for measuring drivers' fitness. The most important question is how to link the outcomes of psychometric tests of road drivers to the safe performance of these drivers. In a psychometric sense, we want define empirically the diagnostic and prognostic validity of self-report instruments used in the transport psychologist's practice.

Thirdly, the practical aim of this paper is to develop some psychometric methodology to define diagnostic and prognostic validity of the psychometric tests in their routine diagnostic practice with road drivers or the candidates for driver license in Poland.

We can, therefore, state the following hypothesis:

> The drivers, whose road performance is completely safe (no accidents or collisions record – the control group) reach better scores in psychometric tests measuring their abilities for safety road performance than the drivers from the risky road performance groups (i.e. who had accidents or collisions).

METHOD

Measurements

Nine typical tests used in Poland by transport psychologists were selected to diagnose the psychometric skills of professional road drivers. These tests could be systematized into the five psychometric tools. Personality traits were measured using the Eysenck Personality Questionnaire (EPQ-R) in Polish adaptation by Jaworowska (2011) and the Personality Inventory (NEO-FFI) in Polish adaptation by Zawadzki, Strelau, Szczepaniak, and Śliwińska (1998). In order to measure visual perception accuracy we used the Stereoscopic Vision Test and the Dark Room Test. The ability to focus attention was measured by the Poppelreuter Test. To measure mental abilities we used the Raven Matrices Test (Jaworowska & Szustrowa, 2000). Loco-motoric skills were tested by the Piórkowski Apparatus, Measure of Reaction Time MRK-433, the Kinestezjometr Apparatus. More detail information about the measured variables, their indicators and the abbreviations used in the text for their designation includes Table 1.

Table 1. Particular tests scores reached as outcomes of testing professional road drivers in safety performance validity research.

Variables	Diagnostic tests / indicators	Abbreviation
Stereoscopic vision	Stereometr: Stereoscopic Vision Test	SVT
Vision in the dark	Dark Room Test: vision in the dark	VD
Sensitivity to glare	Dark Room Test: sensitivity to glare	SG
Noticing continuous patterns	Raven's Progressive Matrices: Test Series A	RA
Noticing analogies between pairs of figures	Raven's Progressive Matrices: Test Series B	RB
Noticing progressive alterations of figures	Raven's Progressive Matrices: Test Series C	RC
Noticing permutations of figures	Raven's Progressive Matrices: Test Series D	RD

Variables	Diagnostic tests / indicators	Abbre-viation
Resolution of figures into constituent parts	Raven's Progressive Matrices: Test Series E	RE
Logical induction	Raven's Progressive Matrices: Test Sum of all Series	RS
Scope of attention	Poppelreuter Tables Test: longest series of correctly written numbers	LSCR
Lack of mental alertness	Poppelreuter Tables Test: number of mistakes made in series of numbers written	M
Correctness of attention	Poppelreuter Tables Test: total number of correctly written numbers	CR
Neuroticism	NEO-FFI: scale NEU	NEU
Extraversion	NEO-FFI: scale EXT	EXT
Openness to experience	NEO-FFI: scale OPN	OPN
Agreeableness	NEO-FFI: scale AGB	AGB
Conscientiousness	NEO-FFI: scale CON	CON
Neuroticism	EPQ-R: scale N	N
Extraversion	EPQ-R: scale E	E
Psychoticism	EPQ-R: scale P	P
Social desirability	EPQ-R: scale L	L
Disposition for simple reactiveness	Reaction Time Meter: simple reaction time	SRT
Frequency of potentiality for the particular simple reactiveness	Reaction Time Meter: distribution of simple reaction time	D-SRT
Disposition for complex reactiveness	Reaction Time Meter: complex reaction time	CRT
Frequency of potentiality for the particular complex reactiveness	Reaction Time Meter: distribution of complex reaction time	D-CRT
Ability for correct complex reactiveness	Reaction Time Meter: mistakes of complex reaction	M-CRT
Eye–hand coordination	Piórkowski Apparatus	PA
Kinesthetic sensitivity	Kinestezjometr Apparatus	K

Subjects and research design

The subjects were the professional drivers aged from 21 to 65 who were tested by the above-listed standard set of 9 psychometric methods which are used in Poland to diagnose the basic abilities required for safe functioning on public roads. They were tested individually in a standard way at the Psychological Centre for Drivers at Biłgoraj (Poland) by the transport psychologist specialists who obtained a Polish license for diagnosing road drivers. 250 drivers were chosen randomly from the total number of the Subjects Pool of the professional Drivers Testing Outcomes Recordings available at the Psychological Centre for Drivers in Biłgoraj (i.e. from 620 completed recordings of the individual professional drivers). The random selection was made in equal numbers of 50 into five groups of professional drivers, according to the research design as: A1 – the risky behaviour groups (experimental groups), where 4 behavioural criteria were used:

– A1(a) causing a road accident,
– A1(b) causing a road collision,
– A1(c) being involved in a road accident without causing it,
– A1(d) being involved in a road collision without causing it.

The control group consisted of drivers who were involved neither in a road accident nor in a collision situation.

The above four experimental groups are characterized by the following contextual definitions:

- A1(a), drivers who caused a road accident: a motor vehicle accident in which one or two vehicles and other road users are involved in a traffic conflict and someone was injured or killed. The professional driver was here the perpetrator of the accident.
- A1(b), drivers who caused a road collision: a motor vehicle accident in which one or two vehicles are involved in a traffic conflict but nobody was killed or suffered injuries. Included in this category are run-off-road collisions, collisions with fallen rocks or debris in the road, rollover crashes within the

roadway. The professional driver here is the perpetrator of the collision.

- A1(c), drivers who were involved in a traffic conflict with a car in which someone was injured or killed and the driver of the vehicle is not the perpetrator of the accident but its victim.
- A1(d), drivers who were involved in a traffic conflict with a car in which nobody was killed or suffered injuries and the driver of the vehicle was not the perpetrator of the collision but its victim.

The above-mentioned four risky behaviour groups (experimental groups), i.e. as far as the safe behaviour criterion is concerned, the professional drivers were randomly selected from a subjects' pool of drivers, where the professional drivers were sent for obligatory testing by the employing company. The subjects recruitment for the control group comes from the rudimentary periodical psychometric diagnosing of the professional drivers employed by companies, as an obligatory duty requirement by law in Poland. This means that the subjects, in order to continue their employment as drivers, had to come to the Psychological Centre for Drivers to be diagnosed as still possessing the psychological abilities required for safety behaviour on public roads.

However, in order to be quite clear about safety behaviour within this groups of requirements for driver diagnostic tests, the drivers were checked whether they had never been in a road accident or collision situation and also whether they had ever been inspected by the road police as not being in a road collision.

From the schema presented in Table 2, we can see that the variable explained in our research is drivers' safe behaviour. Moreover, this means that these variables were measured as external criteria of an evident intersubjectively controlled verification which results from routine road police analysis and classification of the drivers' behaviour as causing a road accident or collision, or determined with regard to circumstances of an accident or a collision.

Table 2. The schema of explained variables (A1(a), A1(b), A1(c), A1(d), all versus A2) as measured and operated in discriminatory analysis of the road drivers diagnostic tests outcomes.

Experimental groups (risky behaviour groups of road drivers)				Control group
Accident cause	Collision cause	Accident involvement	Collision involvement	Completely safe road behaviour
A1(a)	A1(b)	A1(c)	A1(d)	A2

Considering the above-mentioned behavioural criteria of drivers' safe performance, the order of the four risky behaviour groups of drivers is defined in terms of increasing safety behavioural scale of drivers safety performance in public roads. This is a 5-point rating scale which starts from the most dangerous and risky drivers' behaviour of the A1(a) – range 1 – and goes through A1(b) – range 2, A1(c) – range 3, A1(d) – range 4, and reaches finally the A2 – range 5, i.e. the completely safe road behaviour drivers.

As safety performance is recommended to be treated in literature as efficiency external criterion (McCormick & Tiffin, 1980), we can interpret the bottom row in Table 2 just as the external criterion expressing the order type of 5-point behavioural scale of safety performance of the subjects in our research. The safety performance order of the drivers road behavioural groups is as follows from the most risky behaviour group to the completely safety group: (1) group of drivers who caused a road accident, (2) group of drivers who caused a road collision, (3) group of drivers who were involved in a road accident, (4) group of drivers who were involved in a road collision, and (5) group of road drivers whose road behaviour is completely safe.

RESULTS

The analytical procedure in our research aims to compare each risky group of professional road drivers with the control group in order to identify the test outcomes which differentiate all groups of the subjects under consideration. A discriminatory analysis based on Fisher ĝ-function was used to find out the discrepancies between the particular tests outcomes of the road drivers belonging to the control groups and to the four risky behaviour groups. Therefore, the two stages of our analysis of psychometric tests outcomes of the road drivers will be undertaken: (1) identification of explanatory variables (i.e. diagnostic tests outcomes) which differentiate control group from the high-risk groups of professional drivers, and (2) a discriminant function analysis of belonging to groups with varying degrees of risk of injury in road traffic.

Identifying explanatory variables (i.e. diagnostic tests outcomes) which differentiate control group from the high-risk groups of professional drivers

At the very beginning, with all pairs of drivers' groups under comparison, variables were collected where earlier statistically significant differences had been found among the cognitive-decisional variables, the personality traits, and locomotoric dispositions. Taking into account the research hypothesis formulated earlier, we can assume that all statistical hypotheses were one-sided and that is why also one-sided tests were used in our study. The appropriate analysis which can be used in order to reduce the number of variables to ones which allow (in a non-redundant way) prediction of group membership is the discriminant function analysis. It permits a reduction of the number of variables that differentiate groups in a statistically significant way.

Further, a logistic regression analysis will be calculated using the forward selection method (likelihood ratio function). This analysis answers the following questions:

(1) Which explanatory variables allow isolation of the control group from the high risk groups of professional drivers?

(2) What is their discriminating power in groups distinction: from the most discriminating to the least differentiating the groups?

(3) What is the explained variance of the variable discriminated against?

(4) What is the accuracy of prediction of group affiliation?

(5) What is the a mathematical model for predicting group affiliation?

The order of the variables in the stepwise logistic regression analysis determines the order of measures in terms of their selection power. Altogether the variables that were included in the models define the test battery as the aim is to assess the probability of finding a person in a group with a given level of risk of injury in road traffic.

The identification of explanatory variables (i.e. diagnostic tests outcomes) which differentiate control group from the high risky groups of professional drivers will follow with pair comparison of the control group with the particular risky groups whose order depends on their position on the road safety performance scale: 1) drivers who participated in a road collision, 2) drivers who participated in a road accident, 3) drivers who caused a road collision, and 4) drivers who caused a road accident.

Each of our pair comparison analyses will consist of three sections: (a) identifying the explanatory variables (i.e. diagnostic tests outcomes), (b) stating the order of input variables to the logistic regression model, (c) presenting the descriptive mathematical model of logistic regression function and its outcomes concerning the accuracy of classification total in percentage, including the control group percentage, and the percentage for the group of participants taking great risks in road traffic as compared with baseline *a priori* 50% accuracy.

Control group vs. drivers who had a road collision

As for the controls compared with the drivers who participated in a road collision, the statistically significant outcomes of the one-side planned tests are collected in Table 3.

Table 3. Outcomes of the contrast tests of the control drivers in comparison with those who participated in a road collision.

Explanatory variables differentiating the compared drivers groups	Control group drivers		Drivers involved in collision		1-ANOVA: One-side planned test			Effect size
	M	*SD*	*M*	*SD*	*t*	*df*	*p* <	Cohen's *d*
Noticing analogies between pairs of figures (RB)	10.48	1.49	10.98	0.98	–1.98	85	.025	0.40
Number of mistakes made in series of number written (M)	0.12	0.33	0.36	0.75	–2.07	67	.021	0.41
Extraversion (E, by EPQ-R)	15.24	3.66	13.88	4.05	1.85	294	.033	0.35
Social desirability (L)	17.06	3.58	14.78	4.85	2.68	90	.004	0.53

The data from Table 3 indicates that only four out of 28 test outcomes differentiate the drivers who have performed in road traffic quite safely from those who have had a road collision without causing it: cognitive ability (RB: noticing analogies between pairs of figures), loco-motoric abilities (M-CRT: mistakes of complex reaction), extraversion (E), and social desirability (L).

The logistic regression analysis calculated using a method of forward selection (function of likelihood ratio) with positive results in the introduction of the social desirability as the last variable in the model showed that all four variables are found in the model explaining membership in the discriminatory groups. The model consisting of all four previous variables (i.e. the four drivers' dispositions for safety road performance) differentiates significantly statistically belonging of the tested drivers to the control group rather than the group of drivers who participated in a road collision without causing it ($c^2 = 23.83$, $df = 4$, $p < .001$). This model explains 28.3% of variance possible to be explained under the analyzed conditions (R^2 Nagelkerke = 0.283, R^2 Cox&Snell = 0.212). The detailed data concerning the order of introducing the particular variables into the model and the values of the coefficients of the regression function are collected in Table 4.

Table 4. Data concerning the order of introducing the particular variables into the logistic regression model and the values of the coefficients of the regression function in comparison between the control group and the group of drivers participating in collision.

Variables/Order	*b*	*SE*	Wald coeff.	*df*	*p* <	Exp (*b*)
Noticing analogies between pairs of figures (RB)	0.644	0.222	8.411	1	.004	1.905
Number of mistakes made in series of number written (M)	0.869	0.460	3.570	1	.059	2.384
Extraversion (E, by EPQ-R)	–0.147	0.064	5.329	1	.021	0.863
Social desirability (L)	–0.159	0.056	8.228	1	.004	0.853
Constant	–2.463	2.203	1.249	1	.264	0.085

The mathematical model of logistic regression function of the obtained tests outcomes for the compared two groups can be presented in the following way:

$$P(X) = \frac{e^{0.644RB+0.869M-0.147E-0.159L-2.463}}{1+e^{0.644RB+0.869M-0.147E-0.159L-2.463}}$$

The summary validity of classification is 63%, where for the control group it is 64%, and for the drivers participating in collision it is 62%, while the baseline a priori accuracy is 50%.

Control group vs. drivers involved in a road accident
The statistically significant contrast tests outcomes between the control group of drivers and the group of drivers who participated in road accidents are collected in Table 5.

Table 5. Outcomes of contrast tests of the control group drivers compared with those who had a road accident.

The explanatory variables differentiating the compared drivers groups	Control group drivers		Drivers participating in collision		1-ANOVA: one-side planned test			Effect size
	Mean	*SD*	*Mean*	*SD*	*t*	*df*	*p* <	Cohen's *d*
Sensitivity to glare (SG)	9.78	2.35	11.06	4.07	–1.93	78	.029	0.39
Noticing continuous patterns (RA)	11.46	0.68	11.68	0.62	–1.69	97	.047	0.34
Attention abilities (CR)	24.92	4.23	23.32	5.32	1.66	93	.050	0.33
Mental alertness (M)	0.12	0.33	0.38	0.92	–1.88	61	.033	0.38
Neurotism (N, by EPQ-R)	3.60	2.30	4.52	2.89	–1.76	93	.041	0.35
Social desirability (L)	17.06	3.58	14.84	3.69	3.05	98	.001	0.61
Distribution of simple reaction time (D-SRT)	0.099	0.029	0.118	0.043	–2.15	294	.016	0.52
Kinesthetic sensitivity (K)	2.08	0.53	2.30	0.61	–3.11	98	.001	0.39

The data collected in Table 5 indicate that only the eight out of 28 tests outcomes differentiate the drivers who have performed in road traffic quite safely from those who were involved in road accidents without causing it: mental ability (RA: Noticing continuous patterns, M: Mental alertness, CR: Attention abilities, D-SRT: Distribution of simple reaction time, K: Kinesthetic sensitivity, N: Neuroticism, and L: Social desirability).

For the compared two groups of drivers, the four-variable-model (i.e. the four drivers' dispositions for safety road performance measured by our test) appeared to differentiate significantly statistically belonging of the tested drivers to the control group rather than to the group of drivers who participated in road accidents although they did not cause this accident ($c^2 = 18.54$, $df = 3$, $p < .001$). This model explains 31.5% of variance possible to be explained under the analysed conditions (R^2 Nagelkerke = 0.315, R^2 Cox&Snell = 0.236). The detailed data concerning the order of introducing the particular variables into the model and the values of the coefficients of the regression function are presented in Table 6.

Table 6. Data concerning the order of introducing the particular variables into the model of logistic regression and the values of the coefficients of the regression function in comparison between the control group and the group of drivers participating in an accident not caused by them.

Variables/Order	*b*	*SE*	Wald coeff.	*df*	*p* <	Exp (*b*)
Kinaesthetic sensitivity (K)	1.372	0.505	7.378	1	.007	3.944
Distribution of simple reaction time (D-SRT)	16.852	6.942	5.893	1	.015	2.083
Social desirability (L)	–0.148	0.070	4.435	1	.035	0.862
Sensitivity to glare (SG)	0.165	0.088	3.515	1	.061	1.180
Constant	–3.990	2.160	3.411	1	.065	0.018

The mathematical model of logistic regression function of the obtained tests outcomes for the compared two groups of drivers can be presented in the following way:

$$P(X) = \frac{e^{16.852DSRT+0.165SG+1.372K-0.148L-3.990}}{1 + e^{16.852DSRT+0.165SG+1.372K-0.148L-3.990}}$$

The summary validity of classification is 73%, where for the control group it is 76%, and for the drivers participating in accident it is 70%, while the starting level of validity is 50%.

Control group vs. the drivers who caused road collision

The statistically significant contrast tests outcomes between the control group of drivers and the group of drivers who caused road collision are collected in Table 7.

Table 7. Outcomes of the contrast tests of the control drivers in comparison with those who caused a road collision.

Explanatory variables differentiating compared drivers' groups	Control group		Drivers who caused road collision		1-ANOVA: One-side planned test			Effect size
	M	*SD*	*M*	*SD*	*t*	*df*	*p* <	Cohen's *d*
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Correctness of attention (CR)	24.92	4.23	21.84	6.10	2.93	87	.002	0.59
Lack of mental alertness (M)	0.12	0.33	0.28	0.45	–2.02	89	.023	0.41
Scope of attention? (LS)	25.48	4.34	23.24	5.47	2.27	93	.013	0.45
Agreeableness AGB)	34.28	4.12	32.46	4.18	2.03	294	.022	0.44
Logical induction (RS)	37.48	5.60	35.76	3.99	1.72	294	.043	0.35

1	2	3	4	5	6	7	8	9
Social desirability (L)	17.06	3.58	14.56	4.33	3.15	95	.001	0.63
Complex reaction time (CRT)	0.396	0.029	0.413	0.036	–2.71	94	.004	0.52
Mistakes of complex reaction time (M-CRT)	1.18	0.80	1.66	1.222	–2.32	84	.011	0.46
Eye-hand coordination (PA)	89.92	6.23	85.34	10.84	2.60	78	.006	0.52
Kinaesthetic sensitivity (K)	2.08	0.53	2.12	0.52	–1.67	97	.050	0.08

The data collected in Table 7 indicate that only 10 out of 28 tests outcomes differentiate significantly statistically the drivers who have perform road traffic quite safety from the drivers who caused road collision: cognitive ability (logical induction – RS), attention abilities (LSCR – scope of attention, CR – correctness of attention, M – mental alertness, loco-motoric abilities (CRT – complex reaction time; M-CRT: mistakes of complex reaction time, K – kinaesthetic sensitivity; PA – eye–hand coordination), agreeableness (A), and social desirability (L).

For the compared two groups of drivers, the three-variable-model appeared to differentiate significantly statistically belonging of the tested drivers to the control group rather than to the group of drivers who caused road collision ($c^2 = 23.01$, $df = 3$, $p < .001$). This model explains 27.4% of variance possible to be explained under the analysed conditions (R^2 Nagelkerke = .274, R^2 Cox&Snell = .206). The detailed data concerning the order of introducing the particular variables into the model and the values of the coefficients of the regression function are presented in Table 8.

Table 8. Data concerning the order of introducing the particular variables into the model of logistic regression and the values of the coefficients of the regression function in comparison between the control group and the group of drivers who caused a road collision.

Variables/Order	*b*	*SE*	Wald coeff.	*df*	*p* <	Exp (*b*)
Correctness of attention (CR)	–0.138	0.049	8.141	1	.004	0.871
Social desirability (L)	–0.174	0.061	8.217	1	.004	0.841
Kinaesthetic sensitivity (K)	1.177	0.517	5.179	1	.023	3.246
Constant	3.652	1.615	5.112	1	.024	38.550

The mathematical model of logistic regression function of the obtained tests outcomes for the compared two groups of drivers can be presented in the following way:

$$P(X) = \frac{e^{1.177K - 0.138CR - 0.174L + 3.652}}{1 + e^{1.177K - 0.138CR - 0.174L + 3.652}}$$

The summary validity of classification is 74%, where for the control group is 80%, and for the drivers participating in accident is 68%, while the starting level of validity is 50%.

Control group vs. the drivers who caused road accident

The statistically significant contrast tests outcomes between the control group of drivers and those who caused road accidents are collected in Table 9.

The data collected in Table 9 indicate that only 15 out of 28 tests outcomes differentiate significantly statistically the drivers who have perform road traffic quite safety from the drivers who caused road accident: such mental abilities as: logical induction (RS), attention (CR: correctness of attention), visual perception (SVT – stereoscopic vision; VD – vision in the dark; SG – sensitivity to glare), loco-motoric abilities (CRT – complex reaction time;

Table 9. Outcomes of the contrast tests of the control group drivers in comparison with the drivers who caused road accident.

Variables significantly differentiating compared groups of drivers	Control group		Group of drivers who cause accident		1-ANOVA: one-side planned test			Effect size
	M	*SD*	*M*	*SD*	*t*	*df*	*p* <	Cohen's *d*
Stereoscopic vision (SVT)	0.41	0.11	0.58	0.69	–1.71	52	.047	0.34
Vision in the dark (VD)	11.88	2.29	13.94	5.82	–2.33	64	.012	0.47
Sensitivity to glare (SG)	9.78	2.35	12.88	5.52	–3.66	66	.001	0.73
Correctness of attention (CR)	24.92	4.23	22.58	7.16	1.99	79	.025	0.40
Extraversion (EXT)	30.98	5.01	29.12	6.40	1.74	294	.041	0.32
Agreeableness (AGB)	34.28	4.12	32.44	4.17	2.05	294	.021	0.44
Logical induction (LS)	37.48	5.60	35.32	5.68	2.16	294	.016	0.38
Neuroticism (N)	3.60	2.30	4.82	3.51	–2.05	85	.022	0.41
Social desirability (L)	17.06	3.58	13.70	4.67	4.04	92	.001	0.81
Distribution of simple reaction time (D-SRT)	0.099	0.029	0.127	0.053	–3.62	294	.001	0.66
Complex reaction time (CRT)	0.396	0.029	0.417	0.047	–2.69	82	.004	0.54
Distribution of complex reaction time (D-CRT)	0.288	0.042	0.320	0.082	–2.51	294	.006	0.49
Mistakes of complex reaction time (M-CRT)	1.180	0.800	1.780	1.314	–2.76	81	.004	0.55
Eye–hand coordination (PA)	89.92	6.23	84.98	12.81	2.45	71	.009	0.49
Kinaesthetic sensitivity (K)	2.08	0.53	2.22	0.62	–1.68	98	.049	0.24

D-SRT – distribution of simple reaction time; D-CRT – distribution of complex reaction time, M-CRT – mistakes of complex reaction; K – kinaesthetic sensitivity; PA – eye-hand coordination), and some personality traits (N – neuroticism; EXT – extraversion; AGB – agreeableness, and L – social desirability).

For the compared two groups of drivers, the four-variable model appeared to differentiate significantly statistically membership of the tested drivers in the control group rather than the group of drivers who caused road accident ($c^2 = 36.11$, $df = 4$, $p < .001$). This model explains 40.4% of variance possible to be explained under the analyzed conditions (R^2 Nagelkerke = 0.404, R^2 Cox&Snell = 0.303). The detailed data concerning the order of introducing the particular variables into the model and the values of the coefficients of the regression function collects Table 10.

Table 10. Data concerning the order of introducing the particular variables into the model of logistic regression and the values of the coefficients of the regression function in comparison between the control group and the group of drivers who caused road accidents.

Variables/Order	*b*	*SE*	Wald coeff.	*df*	*p* <	Exp(*b*)
Social desirability (L)	–0.207	0.067	9.488	1	.002	0.813
Sensitivity to glare (SG)	0.247	0.094	6.963	1	.008	1.281
Kinaesthetic sensitivity (K)	1.232	0.570	4.668	1	.031	3.428
Distribution of simple reaction time (D-SRT)	7.619	4.032	3.571	1	.059	2036.319
Constant	–4.217	2.295	3.378	1	.066	0.015

The mathematical model of logistic regression function of the obtained tests outcomes for the compared two groups of drivers can be presented in the following way:

$$P(X) = \frac{e^{0.247SG+7.619DSRT+1.232K-0.207L-4.217}}{1+e^{0.247SG+7.619DSRT+1.232K-0.207L-4.217}}$$

The summary validity of classification is 79%, where for the control group is 88%, and for the drivers who caused the accident is 70%, while the starting level of validity is 50%.

Discriminant function analysis of belonging to groups with varying degrees of risk of injury in road traffic

A discriminant function analysis based on Fisher $\hat{g}$-function makes sense when the researcher aims to answer the question which variables enable us to identify belonging to the particular groups of subjects.

This kind of discriminatory analysis requires to undertake the following stages: a) to construct a descriptive model differentiating the tested road drivers from the drivers behavioral groups varying in degree of safety behavior; b) to state the non-standardized coefficients of canonic al discriminant function; c) to find out the functions in the centers of gravity of the drivers' groups, i.e. non-standardized canonical discriminant functions evaluated at group means; d) to define the classification function coefficients based on discriminatory Fisher linear functions; e) to estimate the final results of the classification based on discriminatory Fisher functions.

In order to find out what kind of psychological dispositions (variables), measured by psychometric tests, can effectively (i.e. using the least number of indicators and in a non-redundant way) describe the groups of risky drivers, a stepwise discriminant function analysis was used.

The outcomes of discriminant function analysis to determine the belonging to groups of various levels of road performance safety are collected in Table 11. In each step of this analysis, one explanatory variable was introduced into the descriptive model of forecasting road safety behaviour of the driver who reached the defined test outcome (i.e. the particular road safety driving ability measured by the particular psychometric instrument).

Each of the introduced variable minimizes a general coefficient of Wilks' lambda.

The four variables listed in Table 11 entered the descriptive model differentiating belonging of the tested road drivers to the drivers groups varying in degrees of safety behaviour. These variables are: sensitivity to glare (SG), social desirability (L), mistakes of complex reaction time (M-CRT), and kinaesthetic sensitivity (K). The defined in this stage descriptive model reached the statistical significance in classifying the psychometrically tested road drivers in terms of their belonging to the considered safety behaviour groups: Wilks' l (4, 4, 245) = .784, $p < .001$. The discriminant analysis finally identified the four canonical functions but only the two of them, i.e. F1 and F2 appeared statistically significant differentiating the tested drivers in terms of their belonging to the safety performance groups (see the function's tests in Table 11).

Table 11. Canonical discriminant functions: standardized coefficients and functions' tests.

	Variables/statistics	Functions			
		F1	F2	F3	F4
Standardized coefficients	Sensitivity to glare in the dark (SG)	.581	.099	.793	–.284
	Social desirability (L)	–.623	–.096	.607	.489
	Mistakes of complex reaction time (M-CRT)	.366	–.712	–.276	.584
	Kinestezjometr (K)	.335	.727	–.089	.595
Test of functions	Wilks' l	.784	.93	.975	.996
	c^2	59,389	17,768	6,143	1,085
	df	16	9	4	1
	$p <$	.001	.038	.189	.298

Ends of a continuum defined by the first function (F1) shows: the Social desirability (L) vs. Sensitivity to glare (SG). In turn, the ends of the continuum defined by the second function (F2) determined the Mistakes of complex reaction (M-CRT) vs. kinaesthetic sensitivity measured by the Kinestezjometr Apparatus (K).

For a more detailed characterization of the statistically significantly differentiating functions, their centres of gravity groups are illustrated in Figure 1. This is evidently seen that the function F1 allows making an order scale from the completely safe behaviour group (control group drivers) through the groups of drivers who were involved in a collision and then in an accident but did not cause it, to the drivers who caused road collision and finally the drivers who caused accident. This function really ordered the tests outcomes of the drivers according to their safety road behaviour: from completely safe behaviours to the most dangerous ones.

Fig. 1. Statistically significant discriminant functions in the centres of gravity groups.

The Tukey's test post-hoc showed that the safety road behaviour group significantly statistically differs in amount of this function from the group of drivers who were involved in an accident ($p < .01$), who caused a collision ($p < .001$), and who caused an accident ($p < .01$). In turn, the function outcome for the group of drivers who caused accident differs significantly statistically from the outcome of the drivers' group who were determined with collision ($p < .001$) and who were determined with accident ($p < .05$).

In turn, function F2 permits a differentiation of the group of drivers who were involved in an accident but did not cause it from the others analysed risky groups. The drivers who were involved in an accident differ significantly statistically both from the drivers who caused a collision ($p < .05$) and from those who caused an accident ($p < .05$). However, they did not differ significantly from those who were involved in a collision ($p = .246$). This means that this function is pretty well discriminating only for the drivers who were involved in an accident but did not cause it from the drivers who really caused an accident or collision by themselves.

The defined discriminant functions allow a meaningful increase in the classificational validity of professional drivers into the groups differing in their level of risky behaviour on public roads (see Table 12).

Table 12. Accuracy of classification (%) based on discriminant functions, where the initial random probability is 20%.

Actual group affiliation	Predicted group affiliation					Total
	SRB	DC	DA	CC	CA	
1	**2**	**3**	**4**	**5**	**6**	**7**
Safety road behaviour (SRB, $n = 50$)	**68**	10	16	2	4	100
Determined with collision (DC, $n = 50$)	44	**12**	20	16	8	100

1	2	3	4	5	6	7
Determined with accident (DA, $n=50$)	28	8	**40**	10	14	100
Cause collision (CC, $n=50$)	30	12	16	**16**	26	100
Cause accident (CA, $n=50$)	24	12	14	10	**40**	100

The classificational validity of safe road behaviour group increased from 20% (initial random probability) to 68%; the classificational validity of the drivers group who were determined with accident group increases from 20% up to 40%, and similarly increases the classificational validity of the drivers group who do cause accidents (from 20% to 40%). However, this must be underlined here (see Table 12), that the stated discriminant functions do not identified the drivers who cause or are determined with less serious road performance disturbances (i.e. collisions).

DISCUSSION

In the first part of our discussion we will present a kind of comparative view of what is known in research on road drivers in relation with our research procedure and the outcomes. Next we will discuss our contribution to the diagnostic and prognostic validity of psychometric instruments used by transport psychologist for testing professional drivers.

Much of the research on driver behaviour has been dominated by attempts to understand accident involvement using concepts such as accident proneness (McKenna, 1983). In this study we realized the same approach which offers a greater potential for understanding accident involvement (Elander et al., 1993; McKenna, 1982). These include, for example, the use of contrasting groups which differ in their likelihood of accident involvement and exploration of the relationship between driving ability and various task indices (e.g., practice on task, task complexity). The use of this model to explain the behaviour of professional drivers has not produced the expected results. Consideration of the reasons for this lack of progress will help to identify issues which are also fundamental to the development of tools for the assessment of capacity to drive among professional drivers in Poland.

Firstly, serious road traffic accidents are rare events, often brought about by a range of aspects of the situation in which the accident occurs (e.g., presence of other vehicles, weather, vehicle condition, etc.) as well as the characteristics of the driver involved. Secondly, this psychological study measures accident involvement by drivers' self-report of the number of accidents or near accidents in which they have been involved in a given period. Self-reports as a method of studying driver behaviour have many advantages compared to other methods of assessing traffic behaviour. Some traffic researchers, however, have questioned self-reports as measures of real driver behaviour, because of possible unreliability related to self-reports. Surveys of self-reported accidents suggest that respondents apparently forget approximately one-third of their road accidents each year (Maycock et al., 1991). For near-accidents, the forgetting rate has been reported to be considerably higher, with up to 80% of near-misses being not reported after a delay up to two weeks (Chapman & Underwood, 2000).

In the present study, the effect of social desirability on self-reported driving was maximized by altering the degree of publicity and benefits of embellishing the answers. The result obtained in the psychological assessments decides whether a professional driver will be able to pursue their profession driver. The situation of assessment is highly stressful for them, which can make them choose their responses in accordance with public expectations.

As regards the suitability of self-report test to estimate the safety behaviour regression, the analysis showed a relationship common to all groups for the scale of social desirability. The results of the present study support the notion that a reporting bias for self-reports of accidents may be apparent and that this can be identified by the social desirability scale. Perhaps the most telling effect is that of mainly negative correlations for the self-reported accidents. This lack of effect could be expected from the presently tested hypothesis is consistent with another research. Donovan et al. (1985) did not find any differences in social desirability between groups contrasted by accidents from state records, and Williams et al. (1974) also reported no effect for traffic offenders (data from records). Social desirability (i.e. a tendency to report in a way that make the respondent look good) is one instance of a group of social/cognitive biases (af Wåhlberg et al., 2010). Although using self-reported collisions as dependent variables is not the optimal method for predicting road accidents, in the absence other precise data it is the only solution.

One of important personality traits which is positively correlated with risky driving is Extraversion. People with a high score on the extraversion scale are active, impulsive, talkative, optimistic, cheerful; they enjoy excitement and stimulation, and are full of energy. Research has shown that extraversion is positively correlated with risky driving (Renner & Anderle, 2000; Smith & Kirkham, 1981; Lev et al., 2008). Extraversion has also been shown to be connected with motor vehicle accidents, traffic mortalities, violation of traffic regulations (Lajunen, 2001; Renner & Anderle, 2000). In the presented study extraversion as personality and temperament traits has proved to be an important predictor of safe behaviour but only of the professional drivers who participated in a road collision. This result can be explained by extra behavioural trait of this professional group of drivers which can be called dysfunctional impulsivity. This explanation, however, requires empirical verification.

The purpose of this study was to examine validity and predictability of the psychometric methods for psychological assessment of fitness to drive professional drivers. The findings yielded strong evidence for validity indicating that the some practical methods as the Kinestezjometr Apparatus which measures kinaesthetic sensitivity on road and the Reaction Time Meter measure, especially the distribution of simple reaction time are predictive of driving safety. The high validity was obtained by examining the drivers also using other instrument like the Dark Room Test, including examination of sensory functions: vision in the dark and sensitivity to glare. Unfortunately, we were not able to determine which of these three instruments is the most valid in identifying professional drivers who are the most prone to accidents. The best predictor of logistic regression analysis is suggesting that for drivers who participated in a road accident but did not cause it, could be the outcome of the Kinesthetic sensitivity (K) while for the drivers who caused road collision – the most predictive is correctness of attention (CR), and for the drivers who caused road accident – of the most prognostic validity is sensitivity to glare (SG). The stepwise regression analysis did not identify any predictor of instruments of driver ability for drivers who participated in a road collision.

Concluding our discussion on logistic regression analysis we could find out which diagnostic tests outcomes distinguished safe drivers from those in specific risk groups. The summary validity ranged as substantially higher from 63% to 79%, where for the safety group drivers jumps from 64% to 88%, and for the drivers belonging to risky groups ranges from 62% to 70% – depending on which the level of risky behaviour group of drivers is compared with safe-behaviour drivers. The validity coefficients of diagnostic test are higher, the level of safe behaviour discrepancy is larger between the drivers.

In our study we wanted to find out which psychometric tests can assign the tested road drivers to specific road-safe groups. And, moreover, there is still a valid psychometric question: what is the validity of such diagnosing-forecasting?

The outcomes of our discriminant function analysis evidently pointed out that the four variables (indicating the following drivers' dispositions) entered the descriptive model of driver groups of varying degrees of safe behaviour. The analysis finally identified the two canonical functions F1 and F2 which appeared statistically significant differentiating the tested drivers in terms of their safety performance. How to interpret the identified functions?

The continuum of the first function F1 can be defined as *susceptibility to errors*. This continuum really gives a monotonically increasing order of the tests outcomes of the drivers according to their safety road performance 5-ranking scale: from the completely safety behaviours to the most dangerous ones. However, susceptibility to errors measured by this function appeared to be not differentiating the two neighbouring rank-scale positions (i.e. between completely safe drivers and the drivers' group who were involved in a collision but did not cause it; between the drivers who were involved in a collision but did not cause it and those who had an accident but did not cause it; between the drivers who were involved in an accident but did not cause it and the drivers who caused a collision; between the drivers who caused collision and the drivers who caused) but only is differentiating each two the following one by one rank orders on this scale: i.e. the completely safe drivers from the drivers who were involved in an accident but did not cause it and the more risky drivers groups; the drivers who were involved in a collision but did not cause it from the drivers who caused collision or accident; the drivers who were involved in an accident but did not cause it from the drivers who caused an accident. Therefore, as an outcome of our analysis we reached a confirmation of diagnostic validity of four out of nine presented above psychometric tools used by transport psychologists for diagnosing professional drivers abilities for safety road performance. Moreover, we can formulate a hypothetical statement that identified four diagnostic tests which constituted a descriptive model of drivers' abilities and competencies in our analysis. They appeared to have a prognostic validity in forecasting safety performance of the tested drivers on public roads.

In order to check the predictive value of this model-tools it has to be tested in a new sample of drivers. Membership of drivers in particular groups predicted on the basis of this model should be compared with the real risk performance groups.

CONCLUSION

Traffic safety is usually assessed on the basis of the number of accidents an individual has been involved in, related to the amount and type of driving undertaken accident risk is an inherently unstable and of unreliable index. Thus, because safety is very difficult to measure reliably, relationships between individual characteristics and accident risk will inevitably be small, and are likely to be inconsistent.

It has been shown that there is psychometric linkage between some tests outcomes of the tested professional drivers and their safety road performance. It was proved by the discriminant function analysis that for the four of the already existing psychometric tools (measuring: kinaesthetic sensitivity (K), mistakes of complex reaction time (M-CRT), sensitivity to glare in the dark (SG), and social desirability (L)), their diagnostic validity is equivalent to their prognostic validity in predicting the drivers' safety behaviour. This means that diagnosing professional drivers and candidates for drivers by the diagnostic test of higher prognostic validity we can contribute more into increase of safety performance in public roads than when testing them by tools of weaker or unknown prognostic validity.

However, the present study has some limitations, and caution should be taken in generalizing the findings. Although we have considered the age of the tested subjects, it was not possible to control it as an independent variable in our research.

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