DOI: 10.7251/JTTTP1701028P
UDC: 656.1.08:613.81

PROFESSIONAL PAPER

Analisys of the influence of alcohol on the motor skills and attention of a driver

- simulation of alcohol intoxication in the testing system "Vienna test" -

Darko Petrović[1], Dragoslav Kukić[2], Nenad Džagić[3], Milan Lončar[4]

[1]Assistent director of the Research and Development Sector, AMSS Motor Vehicle Centre, Belgrade, Serbia , darko.petrovic@cmv.rs
[2]director of the Research and Development Sector AMSS Motor Vehicle Centre, Belgrade, Serbia, kukicdragoslav@cmv.rs
[3]leading engineer Professional Training and Certification Sector, AMSS Motor Vehicle Centre, Belgrade, Serbia, nenad.dzagic@cmv.rs
[4]engineer, AMSS Motor Vehicle Centre, Beograd, Srbija, lone@cmv.rs

Received: April 6, 2017
Accepted: October 18, 2017

Abstract: Alcohol is recognized as one of the factors in the occurrence of traffic accidents, which significantly affects the occurrence of accidents and the severity of their consequences. In this paper, the results of the pilot survey present the measures of influence of intoxicated drivers on the status of their motor skills and attention in traffic. The effect of alcohol is simulated using the "drunk glasses" that simulate the effects of the alcohol on the human body: reduced alertness, slowed reactions, confusion, distortion of the visual field, change of distance and depth perception, narrowing of peripheral vision, poor judgment and decision making, image duplication, lack of muscle coordination and the like. Motor skills were tested using the "Vienna test" system which measures the reaction speed, motor skills, attention, concentration and the assessment of traffic situations. For the purposes of this study the results of the "Vienna test" were analyzed-a driver without "drunk glasses" and wearing the glasses. Glasses for alcoholic level of 0,6- 0,8 ‰ were used in the study. Through a comparative analysis obtained by this research we point to the impact that alcohol has on the perceptual skills of drivers.

Keywords: alcohol, perceptual skills, attention, drivers, impact.

INTRODUCTION

Traffic participants who consume alcohol have significantly greater chance of being involved in a traffic accident. A research of the case study conducted in the countries with low and medium average incomes (a category also including the Republic of Serbia), stated that the alcohol content was present in the blood of 4% - 69% of injured drivers, 18% - 90% pedestrians injured in traffic accidents and 10% - 28% injured motorcyclists. The problem of traffic accidents that occurred as the consequence of driving while being intoxicated is addressed through the special programs insisting on more severe law provisions, their implementation and reinforcement of coercion. Global report on the prevention of injuries in traffic on the roads points out the influence of alcohol abuse and contribution of alcohol use to injuries and victims among the persons in vehicles (passengers), drivers and pedestrians [4] .

Irrespective of traffic system development and traffic safety system, the problem of driving while being intoxicated is always present and generally recognized as the element with the significant influence on traffic safety. Through development and establishment of traffic safety system, there is a constant presence of traffic safety measures and activities directed to combating driving under the influence of alcohol. Contemporary approach to this problem is successful to a certain extent and gives the results but nevertheless, complete overcoming of the problem is still not in sight. The combination of permanent public campaigns, high fines and the application of better and targeted repressive measures resulted in the fact that the majority of people treat driving under the influence of alcohol as a dangerous, selfish and socially unacceptable activity.

Alcohol consumption contributes to driver's false sense of confidence and reduces:

- reaction time,
- coordination,
- estimation of speed, time and remoteness (distance) and
- concentration.

The expansion and presence of great number of campaigns and educational activities focused on drivers and influence of alcohol have contributed to the fact that the negative aspects of this problem are more transparent and familiar to the majority of traffic participants. Nevertheless, the problem of driving under the influence of alcohol is still present and despite the awareness of additional risks and dangers arising from driving under the influence of alcohol, drivers decide to drive while being drunk.

Campaigns and educational activities conducted are directed to the increase of awareness of dangers and risks of driving while being intoxicated. The examples from practice, studies and analyses theoretically indicate the accidents and their consequences which occurred due to significant contribution of alcoholic intoxication of at least one participant. This is a way to develop the awareness of people concerning the risks to which they are prone when being drunk. The activities are in the form of detailed explanation to the traffic participants how exactly the alcohol reduces their psychophysical abilities in traffic and to which extent this affects their estimations and behaviour in traffic.

The emphasis of great majority of measures and campaigns points out the situations which occur after a drunk driver gets into a vehicle, i.e. after making decision to drive a vehicle. Nonetheless, the influence of alcohol on drivers and traffic safety begins much earlier, when a driver makes the decision to drive a vehicle despite being drunk. Besides the influence on the psychomotor abilities in the course of driving, perhaps the greatest influence on making decision to drive has the presence of alcohol itself, since the driver undertakes a range of activities which are directed exactly to his plan to sit behind the wheel while being drunk.

Results of the anonymous research in which 600 drivers participated showed that the probability of driving under the influence of alcohol is mainly determined by the range of decisions taken long before it. The information, obtained by the phone, in which the respondents were driving a vehicle under the influence of alcohol were analysed in detail. The conclusions of this research are focused on the fact that in order to reduce the probability that a person will drive a vehicle under the influence of alcohol, it is necessary to change earlier estimations concerning the expected activities at the visited events, decisions taken regarding the way of transport and choice of a fellow traveller, encouragement of alcohol consummation and driving in the aftermath. Additionally, the key factors are planning the alcohol consumption and the influence of the environment on those who show readiness to drive despite alcohol consumption. In fact, redefinition of the "responsibility" regarding the acts which finally lead to driving under the influence of alcohol contributed to the decision in the greatest number of cases [1].

Aggravating circumstance of alcohol influence research i.e. the effect it has on the decision making in this process, is that the persons under the influence of alcohol change their consciousness, the way they perceive events and problems and even completely lose the awareness of their reactions. Due to this experience, driving under the influence of alcohol is not possible to be analysed from driver's perspective, in terms of their perception of the whole situation. The influence of alcohol on psychomotor abilities of driver is experimentally analysed on the basis of tests done by the persons under the influence of alcohol, by which the level of reduction of these abilities is determined. However, the influence of alcohol intoxication of a driver on the estimation of the concrete traffic situations is difficult to define due to risks of exposure to such situations.

Numerous researches indicate a significant increase of risks to which drivers under influence of alcohol are exposed while the influence of alcohol is explained through the reduction of psychomotor abilities. The possibility of simulation of traffic participation under the influence of alcohol has not been realized until now. Such simulation would introduce the unacceptable risk, while the results regarding participants would be modest due to change of consciousness under the influence of alcohol and inability to consider the situation in detail and realistically after a certain period of time [6].

In order show the effect of alcohol to psychomotor abilities of people, the glasses which simulate alcohol influence and unable exactly psychomotor abilities have been available in practice since 2012. In addition to the effect these glasses have on the eyesight, they also have a significant impact on the sense of balance. Intensity and the way in which these glasses have an impact are determined experimentally when working with people under the influence of alcohol. These exact glasses represent a great possibility to depict to sober people the effect alcohol has on their psychomotor abilities, whereby the effect on the user's consciousness is absolutely excluded. This proactive approach has created the connection between consciousness and manifestation of the alcohol effect on the psychomotor abilities when sober people have the opportunity to feel the way in which alcohol disturbs their perception.

MATERIALS AND METHODS

The primary aim of the research realized for the needs of this work is to indicate the influence of alcohol on the perceptive abilities of driver i.e. on the difference between relation and reaction of driver in traffic situations when the influence of alcohol on the concrete traffic situations is simulated. Simulators used for the needs of this research are simulators of alcohol effect on driver's perceptive abilities and simulator examining the psychomotor abilities of driver.

For the needs of this research, the effect of alcohol on the perceptive abilities of driver was simulated by application of special glasses which simulate the effects of alcohol influence on human organism (so called "drunk glasses"): reduced alertness, slow reactions, confusion, visual field distortion, change of perception of distance and depth, peripheral eyesight narrowing, poor judgement and decision making, duplication of images and lack of muscle coordination. The influence of alcohol on human organism is multiple while the intensity of influ-

ence is complex and depends on great number of parameters the most important of which are sex, body weight, consumption period, consumption speed and similar. By the application of these glasses, the effect of simulation is achieved through the sense of sight whereby the intensity of the effects is approximately the same for all respondents regardless of physical constitution, sex and similar. There are glasses in the market that perform simulation for 4 levels of alcohol intoxication and these are the following:

- 0,4 – 0,6 ‰, *State of transient intoxication*; In this phase of intoxication most people do not show visible signs of intoxication. Change of mood, emphasized communication and subjective pleasant feeling are characteristic for this state. Certain number of people are incapable of driving when it comes to this concentration of alcohol since it may result in attention decrease, hearing disorders and similar, to the extent which depends on personal psychophysical characteristics;
- 0,6 – 0,8 ‰, S*tate of slight intoxication;* Characteristics of this phase of intoxication are the excess of thoughts, poor memory, excessive self-confidence, the need to stand out, whereby the visual acuity is reduced, eyesight reactions (eye accommodation) become weaker by 30% and hearing reaction become weaker by 40% and it comes to the occurrence of pulse acceleration;
- 0,8 – 1,5 ‰, *State of heavy intoxication;* Characteristics of this phase of intoxication are walking difficulties and limb movements, frequent occurrence of nausea, reduction of intellectual functions and similar. Alcohol intoxication becomes obvious and clearly identifiable in this phase;
- 1,5 – 2,5 ‰, *Drunken State;* An extremely discernible effect in this phase of intoxication is the effect on motor abilities, i.e. the centre of balance, to the extent of being unable to stand in upright position which leads to staggering while cognitive functions are significantly reduced. The loss of consciousness, instability and irritability of a person as well as increased aggressiveness are discernible in this phase.

Figure 1. Glasses for simulation of four intoxication levels

So far there have been numerous examples of the use of these glasses through tests related to motor abilities involving simple activities such as catching a ball, handshaking, walking the line and the like. For the needs of this work, a pilot research has been realized in which the used glasses were those simulating the state of slight intoxication (0,6 – 0,8 ‰). This category is chosen as most frequent intoxication category among drivers since the oversight of alcohol influence is most easily made and drivers frequently estimate that they are completely ready to drive.

Simulation of drivers' perceptive characteristics was done by the application of "Vienna Test System". This device is intended for the estimation of psychomotor skills of drivers through realization of 8 types of tests. This device consists of hardware and software components which check all the parameters of driver's psychomotor characteristics. Hardware part represents the computer to which a console enabling the use of arms and legs when checking capabilities. The console consists of response panels (7 coloured keys, 10 numeric keys, 2 castors, 2 analogue joysticks, 2 joystick routers, jack for connection with pedals, speaker and 2 headphone jacks) and pedals (left and right pedal). On this console it is possible to realize all 8 types of tests, that is tests regarding the estimation of safety on the road (5 tests) and tests regarding the estimation of personal characteristics related to driving (3 tests).

Figure 2. Vienna Test system for examination of psychomotor skills of drivers (Schuhfried, 2014).

- Tests which could be realized at the Vienna Test system:
- *Reaction Time Test;* Measures the abilities of respondents to react quickly and precisely to a certain combination of stimulants. It shows the average reaction time, time covering the period from the beginning of signal stimulant (colour and/or tone) until the beginning of reaction;
- *Determination Test;* Represents a complex multistimulant reaction test which measures the abilities of quick and precise reaction under the conditions of significant sensory stress. It measures the accurate reactions through elasticity of reaction capabilities under the conditions of sensory stress;

- *Cognitive Ability Test;* Represents a test which is used for the estimation of alertness and concentration ability. Test assesses the average time of accurate rejection: time starting from stimulant beginning until the beginning of reaction, i.e. the provision of correct answer concerning the lack of concurrence among figures;
- *Traffic situation overview test;* Represents an adaptable test of nonverbal estimation of traffic situation overview. The test represents a number and type of traffic participants as well as the traffic elements detected correctly in the photographs, the change of reaction speed and gaining an insight into the situation;
- *Adaptive matrices test;* Represents a test of nonverbal type which is used for the estimation of logical reasoning skills. Basically, it represents an intelligence test i.e. test of logical skills of drivers;
- *Environmental Attitude Test;* Measures personal and emotional characteristics of a person which can indicate the inclination to risky behaviour during the drive. It assesses the tested drivers within three categories: emotional stability, self-control and sense of responsibility;
- *Test of attitude to other traffic participants;* This test is used for the prediction of behaviour while driving and relation to other traffic participants. On the basis of testing, a driver is assessed in terms of aggressive interaction and emotional attitude to driving ;
- *Risk acceptance test;* This test measures a subjective acceptable level of risk in traffic situations, i.e. degree to which a person is ready to be involved or to bear a certain level of risk in driving. The results analyses if the level of acceptable risk in driving is increased.
- This device is usually used for checking the capabilities of professional drivers.

Test of visual orientation ability and perception skill (ATAVT test) is used for the needs of this research. ATAVT test checks the observational skill by promptly showing the photograph of traffic situation. The test is based on detailed analyses of cognitive processes, taking into account the research results related to the perception of scenes and objects so that it simply determines the abilities of driver to recognize a certain traffic situation through recognition of the object shown in the photograph. This serves to gain an insight into the abilities of a tested person to perceive the complex traffic situation in a quick and accurate way.

Test contains the photographs of traffic situations (image no. 3) which are shown to a respondent within the short time interval (2s). After having seen the photograph, a respondent should tick the objects spotted on the observed photograph from the offered list of all objects.

Figure 3. An example of one of traffic situations shown to respondents

The test begins with simple situations shown in the photographs while the complexity of situation gradually increases during the test. A respondent has ten minutes to complete the test. In addition to the ability of spotting the object precisely, an element also measured and quantified is the speed of response. A respondent responds in the test by selecting a key with the right number whereby each key indicates one of 5 categories of objects that could be spotted in the shown photographs of traffic situations. These photographs are offered to a respondent in order to recognize the following:

- pedestrians,
- automobiles (passenger cars, buses and trucks)
- bicycles, motorcycles, scooters
- traffic signs and
- traffic lights.

The test results are presented through a number of objects spotted in the photographs shown (a number of true, i.e. false answers) and speed of identifying the situation (the speed of answering).

Pilot research realized for the needs of this work covered 30 respondents. All respondents are drivers who have passed "B" category and have a permanent driver's license (there were no drivers with a probationary driver's license).

The testing was conducted in a way that each respondent:

- was introduced to the aim and point of the research,
- has undergone probationary tests which involved the use of at least two categories of glasses for simulation of alcohol effect while performing simple activities such as: handshaking, passing the ball, moving between the pins and similar and
- was tested on a console with and without the glasses for alcohol intoxication simulation. >The glasses used for the realization of testing

were those simulating "the state of slight intoxication" (0,6 – 0,8 ‰). Before the test commencement, a respondent is introduced to the test on console and each respondent has undergone a short introductory test in order to get acquainted with the content and way of implementation of the test on console.

All respondents used console for the first time within this pilot research, thereby ensuring the objectiveness from the eventual practising of motor skills. The number of photographs and gravity of the situation, which were shown to the respondents, were defined by software whereby the age of respondent was taken into account.

RESULTS OF THE RESEARCH

By processing the results of respondents' perceptive skills when spotting the objects in different traffic situations, it is observed that the respondents without the use of glasses for simulation of alcohol intoxication (image no. 4) made the lowest number of mistakes when spotting the pedestrians and motorcyclists, while the greatest number of mistakes referred to spotting light traffic signals (traffic lights).

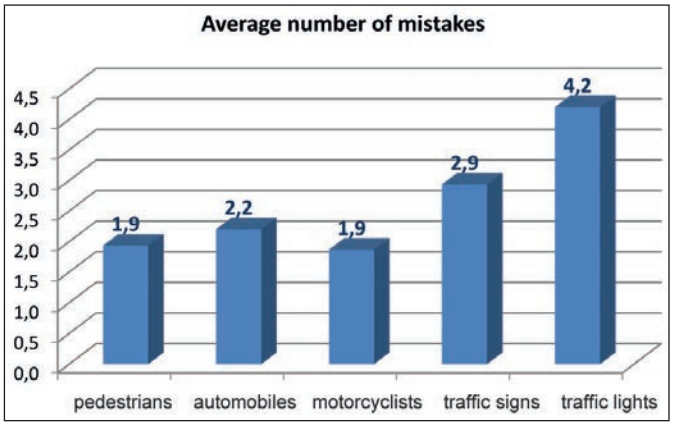

Figure 4. Average number wrongly spotted objects without the use of "drunk glasses"

The use of "drunk glasses" contributes to the fact that the most "evident" objects in traffic are - automobiles, while the most frequent oversights are made when spotting traffic signs (Figure no. 5).

When comparing the average number of mistakes with and without the"drunk glasses", it can be noticed that the number of mistakes when "drunk glasses" are used i.e. in the state of slight intoxication is by 18,5% higher than in case when a driver "in a sober state" does the test, without the use of glasses. (Figure no. 6).

Scores in per cents (PR) and T-score represent the indicators of successfully spotted objects in relation to the total number of objects which appear, taking into account that T-score represents the indicator in relation

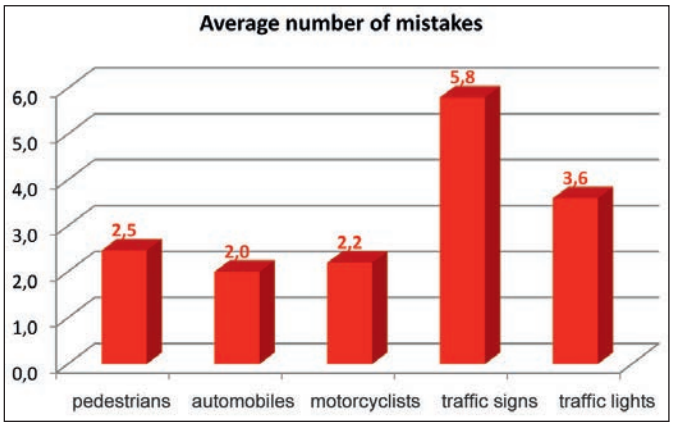

Figure 5. Average number of wrongly spotted objects during the use of "drunk glasses"

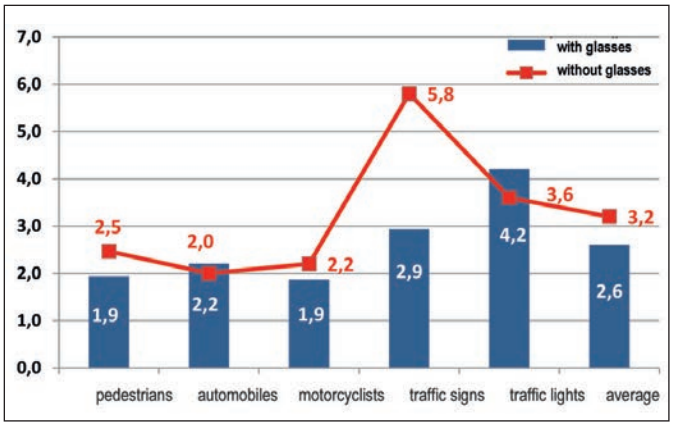

Figure 6. Average number of wrongly detected objects without and with the use of "drunk glasses"

to the tested population of 1190 respondents for which the values are entered into the existing software. A high score indicates the ability of quick and complete overview of the situation, as well as the ability of a person participating in traffic to detect all the essential elements of a traffic situation in the short period of time and estimate and plan further course of action on the basis of the given. People who have not developed this skill (people with low score) miss the details in traffic situations and thereby cannot adequately estimate and plan their activity in a given moment.

Values <16 are treated as the skills below average, 16-24 lower level of average skills, 25-75 average skills, 76-84 higher level skills and above 84 extraordinary skills.

In addition to this there is also a value of adjusted results which also takes into account the age of respondent. (PR (2) i T-score (2)).

It can be seen in the figure no. 7 that on the basis of PR indicator, the skills of respondents without the use of "drunk glasses" are in the range 24-75, which means that they are classified in the average group of skills unlike the case when the glasses are used and this indicator is less than 16, which means that the respondents possess

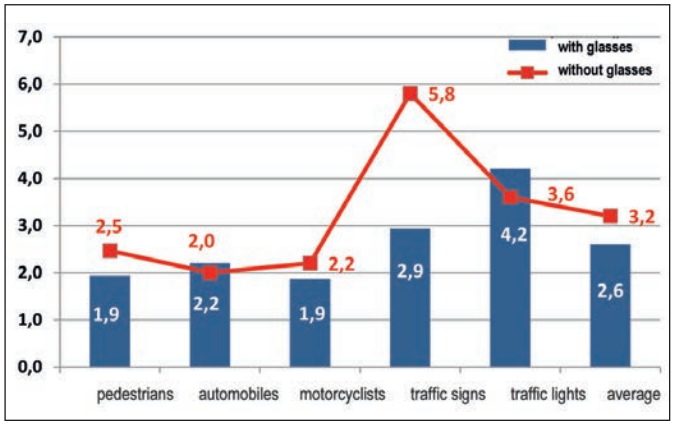

Figure 7. Skills of the driver expressed through PR and T-score

the skills which are below average for the proper identification of traffic objects.

In the end, it is also interesting to point out the indicator of the speed of responding to the asked questions. Without the use of glasses, the average speed of responding to the complete set of questions was 3 min and 22 sec, while during the use of "drunk" glasses that time is for about 11% shorter and amounts to 2 min 59 sec.

CONCLUSION

On the basis of the realized pilot research, it can be concluded that the effect of simulation of alcoholic intoxication achieved the significant impact on the results of testing. During the realization of the test under normal conditions, respondents showed significantly higher results than while doing the test with the use of "drunk glasses".

Besides the presented results, this research also achieved the impact on all persons who participated in the research and who personally had the possibility to feel alcohol effect and its influence on the perception and reactions in traffic situations. In this research, the state of slight intoxication was also simulated while research was planned for all levels of alcohol intoxication. The effect of intoxication and the influence alcohol has concerning the basic reactions and perceptions in traffic have been achieved by the application of these two simulators and their combined effect on the respondents who are completely sober. Based on this pilot research, there are grounds for implementation of significantly broader research according to the similar model which would encompass professional drivers and wider age structure.

REFERENCES

[1] AJ. McKnight, E.A.: The bases of decisions leading to alcohol impaired driving, National Public Services Research Institute, USA, Langston 2006.

[2] Vožnja u alkoholisanom stanju: prirucnik za donosioce odluka i strucnjake iz bezbednosti saobracaja 2. Međunarodni seminar bezbednost saobraćaja u lokalnoj zajednici, 2007.

[3] Allen, J. P., & Brown, B. B. Adolescents, peers, and motor vehicles: The perfect storm? American Journal of Preventive Medicine, 35, 2008, pp. 289–293.

[4] Alvarez, F. J., & Fierro, I.: Older drivers, medical condition, medical impairment and crash risk. Accident Analysis and Prevention, 40, 2008, pp. 55–60.

[5] Amado, S., Koyuncu, M., &Kaça, G.: Comparison of three systems for psychotechnical assessment used in Turkey. Transportation Research Part F, 2015, pp. 32.

[6] Anitei, M., Charaif, M., &Sandu, M. C.: Gender differences in traffic risk assuming and short term memory related to traffic situations. Procedia – Socialand Behavioral Sciences, 127, 2014, pp. 907–912.

[7] Anitei, M., Charaif, M., Schuhfried, G., &Sommer, M.: The validation of Expert System Traffic psychological assessment to Romanian Driving Schools.Procedia – Social and Behavioral Sciences, 30, 2011, pp. 457–464.

[8] Bachoo, S., Bhagwanjee, A., &Govender, K.: The influence of anger, impulsivity, sensation seeking and driver attitudes on risky driving behavioramong post-graduate university students in Durban, South Africa. Accident Analysis and Prevention, 55, 2013, pp. 67–76.

[9] Braitman, K., & Williams, A.: Changes in self-regulatory driving among older drivers over time. Traffic Injury Prevention, 12, 2011, pp. 568–575.

[10] Bucchi, A., Sangiorgi, C., &Vignali, V.: Traffic psychology and driver behavior. Procedia – Social and Behavioral Sciences, 53, 2012, pp. 973–980.

[11] Cai, H., & Lin, Y.: Modelling of operators' emotion and task performance in a virtual driving environment. International Journal of Human–ComputerStudies, 69, 2011, pp. 571–587.

[12] Cestac, J., Paran, F., & Delhomme, P.: Drive as I say, not as I drive: Influence of injunctive and descriptive norms on speeding intentions among youngdrivers. Transportation Research Part F, 23, 2014, pp. 44–56.