INFLUENCE OF VIRTUAL SIMULATOR ON THE CHANGE OF VIEWS ON BEHAVIOUR IN TRAFFIC CASE STUDY

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ABSTRACT

Many studies have been conducted focusing on the use of virtual simulators in training in various scenarios, ranging from life and threats to situations in recreational activities. This study follows the direction of the discussion on the use of some virtual simulators that can be successfully exploited in the activities of training of drivers with the task of perception of reality and understanding of risk and threats with the goal to enable the change of attitude regarding the behaviour in traffic. In that sense, the virtual reality simulator can be used for the change of attitude on a concrete case of non-usage of safety belt and improper speed in driving. This application was created using 5D video materials in order to efficiently use the training simulators. Therefore in our project the individuals are put in a virtual world in which they can practice and improve their driving skillset with the acceptance of new and real attitudes on the risk and threats that those imply. Used in the work was an questionnaire method, with three levels of experimental simulation being applied, lasting 10 minutes each. After the conducted simulation, the questionnaire was repeated. After that, a comparative analysis has been carried out before and after, with the goal to establish the influence of virtual simulators on the change of attitudes on behaviour in traffic.

KEYWORDS

Virtual Simulators, Questionnaire, Training, Drivers, Attitudes, Behaviour

1. INTRODUCTION

According to the data of the World Health Organisation around 1.3 million people die in traffic accidents every year, while around 30-50 million people get injured. Traffic accidents top the list of death causes in the age group of 15 to 29 years (WHO, 2009).

The man is the most important, but, also, the most complex factor of traffic safety. Apart from the direct influence on the appearance of traffic accidents, as road user, the man also largely impacts other factors of the traffic process. It is believed that the attitudes are a key determinant of behaviour (Hatfield et al., 2008). Over last few years interest particularly focused on the impact of attitudes on the behaviour of road users in the segment of traffic safety. The development of theoretic models that found a very important implementation in practice stimulated many researchers to realise a research explaining the behaviour of traffic participants. Attitudes are a very important determinant of the behaviour of people in traffic. Attitude is one of factors having an influence on the behaviour in traffic and is, therefore, important in the process of creating a base for the knowledge and the final outcome of the behaviour of traffic participants. The man does not possess all required instincts, knowledge and capabilities to be able to survive in traffic without the support of the society. Therefore, the society intends to provide support through various institutions (family, educational institutions, training centres for drivers etc.) by carrying out various activities. Within the social-cognitive approach, the models like Theory of reasoned action - Planned behaviour (Ajzen & Fishbein, 1980; Ajzen, 1988) and the health model (Rosenstock, 1974), were often implemented to study the determinants of risky behaviour during driving (Parker et al., 1992; Parker et al., 1995; 1998). Based on these

models, the variables such as attitudes, comprehension of risks, social norms and understanding of behaviour control represent the central behaviour variables. The evidence of the possible values of these variables have been found in many studies. It was discovered that the attitudes concerning traffic safety correlate with the aggressive behaviour in driving, fast drive and the self-reported involvement in traffic accident. The comprehension of risk also seems to be of great importance as younger drivers, when compared to other groups, stand bigger chances of underestimating certain risk caused by a situation in traffic (Brown & Groeger, 1988; Deery, 2000). They also perceive traffic risks as less dangerous (Milech et al.,) and overestimate their own driving skills (Moe, 1986).

Based on this knowledge, one of the most popular strategies of promotion of safety on roads is aimed at the change of attitudes of adolescents concerning the perception of driving related risks.

Since fast driving is considered to be the key form of risky behaviour, special attention should be paid to attitudes on fast driving. Though 39% of respondents find that it is dangerous to drive at a speed higher than limited (Department for Transport, 2008) it is clear that the majority of drivers continue to drive fast. Driving fast seems to be perceived differently in different individuals. For instance, 33% of respondents in one research believed that fast driving is the one that is 1 mph in excess of the speed limit, 33% thought it was driving at speed 5 mph over the limit, while 33% of respondents were of opinion that the fast driving means to drive 6 mph or more in excess of the speed limit (Higginson, 2005). Furthermore, people have a "normative" view on fast driving and they decide what is illegal and dangerous fast driving for them. As many as 76% of respondents fully agreed that too fast driving for certain road conditions is dangerous (Angle et al., 2007). Attitudes on fast driving are often accompanied by the opinion that the speed limit was established in an arbitrary manner and that it is OK not to obey that authority if the road conditions, experience and competence allow for such a behaviour (Flamingo Research, 2008). Drivers find there is a lot of vagueness concerning the setting of speed limits, because, sometimes, similar roads have very different speed limits and such an inconsistency results in the non-observance of the existent system (Silcock et al., 1999). Furthermore, modern technology has resulted in drivers believing that the speed limits are outdated and unreliable; today's vehicles are constructed much better than ever before which is why they can stand much greater challenges. Corbett proved in his study (Corbett, 2001) that the drivers tend to perceive the driving at a speed over 10 mph in excess of the allowed speed as fast driving and that they drive within the framework of their own definition.. Drivers believe, also, that the most of people drive 10 mph in excess of the speed limit on average (Stradling & Campbell, 2003). Fuller and others (Fuller et al., 2008) established that drivers find that it is acceptable to breach the speed limit by around 35 mph in a 30 mph zone.

The viewpoint on fast driving also depends on the type of the road. According to Stradling and Campbell study (Stradling & Campbell, 2003), majority of drivers find that it is normal to breach the speed limit by 30 to 35% on motorways; when it comes to 2-lane roads in suburban areas, main roads in towns and wide roads in settlements, up to 18% is perceived as an acceptable breach of speed limit, while up to 10% is acceptable on roads in rural areas. Furthermore, on the roads with higher speed limits, the limits are more frequently breached by men than by women, but the situation is similar on slower roads as well. Drivers of the age group 21-29 represent the group with the largest part of those who breach the speed limit.

Most of studies had similar results: Breaching of speed limits on motorways is deemed to be much more acceptable than is the case with other roads. Breaching of speed limit is the least acceptable on the roads in populated places.

The results obtained in the SARTRE 3 study (SARTRE, 2004) show that the majority of drivers agree that the safety belt reduced the risk of hard injuries in most of traffic accidents. Yet, there were huge differences among countries as regards the assessment of the need for safety belt in case of cautious driving. Around 20% of drivers find that the safety belt is not necessary in case of cautious driving. In addition to underestimating the benefits of the use of safety belt, many drivers point to the treat of remaining "captured" in vehicles in emergency situations due to safety belt. In some countries (Portugal, Holland, France and Poland) the percentage is even over 60%.

In general, almost all drivers have positive opinion on the use of safety belt. Yet, the results show that the frequency of usage does not depend on the attitude only. The traffic enforcement proved to be a good mechanism to make drivers use the safety belt. Besides, it is obvious that too many drivers underestimate the necessity of the use of the safety belt in the case of cautious driving and overestimate the danger of remaining "captured" in the vehicle in emergency situations. This results indicate the need for a better educational and informational campaigns that would enable better understanding of the important benefits of the use of the safety belt.

Training is a vital requirement in the professional world and in life in general. Driving schools spend a considerable time on the training of candidates for drivers to make them behave in accordance with the Law and regulations with adequate knowledge and attitudes. A quality training contributes to improvement, reliability and safety of traffic participants. Through quality training and criteria, weaknesses and drawbacks can be identified so that certain improvements can be made whereas fault frequencies can be minimised (Acem,2004).

So, how do VR simulators appear? They become tools that transport the user to an environment where all conditions and circumstances can be controlled and monitored without leaving the laboratory or testing area. The VR strength is the capability to completely analyse the user in VR surrounding that proves to be exceptional and effective in the cases such as extreme situations in traffic (Aslandere et al,2015).Historically speaking, VR isn't anything new, its concept dates back to 1950 (Brake, 2006). Yet, technologically, it brings a great promise and deserves a research. The context of this work reveals several applications for VR training, including those connected with driving, aimed at improving the attitudes on driving at an improper speed and driving without safety belt.

2. METHODOLOGY

The training is carried out through a presentation which shows a vehicle movement with real view of a road in 5D technology, roadway, road width, road infrastructure, traffic surrounding.

The training is done through a presentation that shows the vehicle movement with a real view of a road in 5D technology, roadway, road width, road infrastructure and traffic surrounding. The driver is positioned in the seat of a simulation vehicle with control devices - cockpit identical to that in a passenger vehicle.

Special attention is paid to the applications including the training of drivers, focusing on the assessment of risk from collision and studying of faults.

Thanks to the artificial intelligence (AI) the simulator records and evaluates the habits of the driver. Driver percentage is used, with adjustment to every traffic situation (Blender, (2017).

This helps the user improve their skills without risking their life or damaging the car, but, at the same time, to realise the importance of risk in a real situation that will influence on the change of the attitude that it is not a thing that happens to others only.

The only purpose of every of the applications mentioned above is to perceive the real risk situation in traffic that will influence on the improvement of attitudes on behaviour in traffic.

This project is aimed at creating real situation scenarios in traffic that would help the users to become more realistic and properly perceive the reasons in favour of the observance of traffic regulations. There are various other simulators supposed to facilitate the same, such as the simulators using VR for assistance in the treatment of patients suffering from phobias (Vaughana et. al.2015). There is a huge versatility, from racer games to F1 games and the open world of driving simulators, as well as swimming and flight simulators (Logitech). Most of those were made for the purpose of amusement, which is different from everything that this project is supposed to achieve. The intention is to offer the best experience in the sense of reality, so that the application will be a lot more useful than the entertaining one.

In the experimental part, the game application Skoda Superb RS-Euro track simulator 2V1.25 ETS2 was used, with visual and video effects in addition to the usual driving program, as well as a dynamic-vibration simulation of action and reaction in two situations of unavoidable contact, i.e. Impact. In both situations, vibration effect is achieved with the safety belt tightening with a bigger intensity for body action and reaction in the seat.

The purpose of the project is to enable the candidates to experience real risk feeling in crisis and dangerous situations in traffic.

The user can be exposed to the given situation in the previous examples without the risk of actual injury and damage to themselves or others, enabling that in a VR surrounding. These simulators help improve their skills and give an insight into what can be achieved with VR.

This study mainly focuses on the steps to develop the application that will help the people improve their knowledge and understand the consequences of non-observance of traffic regulations, i.e. the change of mind on behaviour in traffic.

The goal of the application is to assess the mistakes that the driver makes in a simulated driving from the aspect of the attitude on behaviour in traffic.

The application tries to create a real driving experience, but it also adapts to different driving experiences.

The car driven by the user has all details required for a realistic drive, such as the external rear view, mirror, steering wheel and paddles. At the same time, the audio and vibration effects respond when it comes to impacts, collisions with facilities or driving on rough surfaces. The simulator and the view of the screen are shown on figure 1.

Figure 1. Appearance of the simulator and display

2.1 Experimental Part

The experiment was conducted in the following way:

Three groups of respondents were tested in the experiment.

I- The first group included the candidates for training of drivers that passed the theoretic and practical part of training - total of 50 candidates of the age group from 18 to 30 years, namely 25 male candidates and 25 female candidates.

II- The other group of candidates comprised the drivers who were never involved in a traffic accident and who possess driver's licence of B category for passenger vehicles, total of 50 candidates of the age group of 18-30, namely 25 male candidates and 25 female candidates with minimal driving experience of one year.

III- The third group of respondents comprised the drivers who participated in traffic accidents with casualties, severely injured and lightly injured persons, i.e. 40 candidates namely 30 male candidates and 10 female candidates of the age group 18-30 with minimal working experience of one year.

The questionnaire involving all respondents was conducted before the simulation drive.

Following the questionnaire, the simulation drive took place.

These tests comprise 3 levels, each of which represents a different scenario such as the driving:

- at high speed and collision with the cars coming from the opposite direction in the case of an inadequate assessment of overtaking - driving time 10 minutes,
- impact of vehicle into an obstacle in a situation when the safety belt response intensity is simulated - driving time 10 minutes with visual, audio and vibration effects,
- safe driving - driving lasting 10 minutes.

The stated levels are inspired by the real-life traffic situations. During the driving, the driver is inspired to increase the speed, through the simulation with an adequate music. After conducting the simulation driving test, the questionnaire was repeated. Experimental place - Driving school "RU 22"-Ruma and Driving School "Zeleni signal" – Smederevo.

3. RESULT AND DISCUSSION

Out of total 140 respondents that used the VR simulator, 8 respondents did not continue the experimental testing after the first level of testing - high speed and collision with a car coming from the opposite direction with inadequate overtaking assessment, namely 1 female respondent from first group, three respondents from the second group, of whom one female and 2 male respondents, and 2 female respondents from the third group.

The mentioned 8 respondents felt anxiety and poor concentration so that gave up further testing. This can be ascribed to the vibration effects of the uncontrolled head movement in respondents, as well as visual and strong audio effects of the collision simulation. The results of the questionnaire conducted with these 8 respondents before conducting the experiment were not analysed in the further procedure. The questionnaire results showed the following situation:

Table 1. Results of the poll carried with 1st group of respondents before and after the driving simulation experiment

1St st group of respondents - 49		**Before exp.**		**After exp.**	
		YES	NO	YES	NO
1.	Do you consider the driving of vehicle at illegal speed as a dangerous driving?	**16**	33	**25**	24
2.	Have you experienced dangerous situations in drive caused by high speed?	11	38	X	X
3.	Do you think that you have good skills of managing a vehicle at high speed?	38	**11**	30	**19**
4.	Do you drive vehicle at improper speed?	34	15	X	X
5.	Do you think that driving a vehicle at improper speed is safe?	**20**	29	**13**	36
6.	Do you think that you can always stop your vehicle on time?	**35**	14	**28**	21
7	Do you use safety belt when driving?	25	24	X	X
8.	Do you think that the safety belt provides protection in accidents?	**28**	21	**37**	12
9.	Do you think that an accident can happen to you too?	**22**	27	**39**	10
10.	Do you think that this simulator could affect your attitude to drive?	**18**	31	**29**	20

Table 2. Results of the poll carried with 2nd group of respondents before and after the drive simulation experiment

2nd group of respondents - 47		**Before exp.**		**After exp.**	
		YES	NO	YES	NO
1.	Do you consider the driving of vehicle at illegal speed as a dangerous driving?	**20**	27	**31**	16
2.	Have you experiences dangerous situations in drive caused by high speed?	25	22	X	X
3.	Do you think that you have good skills of managing a vehicle at high speed?	**30**	27	**24**	23
4.	Do you drive vehicle at improper speed?	29	18	X	X
5.	Do you think that driving a vehicle at improper speed is safe?	**16**	31	**12**	35
6.	Do you think that you can always stop your vehicle on time?	**24**	23	**11**	36
7	Do you use safety belt when driving?	35	12	X	X
8.	Do you think that the safety belt provides protection in accidents?	**31**	16	**44**	3
9.	Do you think that an accident can happen to you too?	**29**	18	**43**	4
10.	Do you think that this simulator could affect your attitude to drive?	**24**	23	**34**	13

The results of the poll and the comparison after conducting the experiment for all three levels of driving with the first group of respondents indicated the change in the poll results. The changes are obvious in almost all questions of the poll. The attitude that driving at illegal speed represents dangerous driving reflects the

change of opinion in 9 respondents. Also, 8 respondents changed their opinion as regards the driving skills. 7 respondents changed their opinion on driving at improper speed as safe driving.

The problem with the majority of respondents in almost all accident situations is that the accidents do not happen to us but to somebody else. Positive response on a concrete question in this study occurred with 17 respondents changing opinion - increase from 22 to 39 respondents. Also, the positive results encourage further implement this simulator and continuation of the experiment. Change of opinion that this simulator can bring about the change in attitude and opinion on driving was seen in 11 respondents - increase from 18 to 29. The results are presented in table 1.

Table 3. The results of the poll of the respondents of the third group before and after the drive simulation experiment

3rd group of respondents - 40		**Before exp.**		**After exp.**	
		YES	NO	YES	NO
1.	Do you consider the driving of vehicle at illegal speed as a dangerous driving?	**30**	8	**35**	3
2.	Have you experiences dangerous situations in drive caused by high speed?	38	0	X	X
3.	Do you think that you have good skills of managing a vehicle at high speed?	**6**	32	**4**	34
4.	Do you drive vehicle at improper speed?	5	33	X	X
5.	Do you think that driving a vehicle at improper speed is safe?	**2**	36	**2**	36
6.	Do you think that you can always stop your vehicle on time?	**8**	30	**6**	32
7	Do you use safety belt when driving?	38	10	X	X
8.	Do you think that the safety belt provides protection in accidents?	**30**	8	**33**	5
9.	Do you think that an accident can happen to you too?	**38**	0	**38**	0
10.	Do you think that this simulator could affect your attitude to drive?	**29**	9	**34**	4

Improvement of attitudes and change of opinions concerning certain questions of the questionnaire is obvious in the first and second groups of respondents. The questionnaire results show that 11 respondents changed their opinions after the experiment, as regards the question - Do you consider the driving of vehicle at illegal speed as a dangerous driving. The changes are obvious in almost all questions of the poll. Also, the opinion on the skill of driving the vehicle changed in 6 respondents. 7 respondents changed their opinions on driving at improper speed as safe driving.

Opinion prevailing regarding this group of respondents as well, is that the use of virtual simulator can change opinions, which was confirmed in as many as 10 respondents, increase from 24 to 34 respondents. The results are presented in table 2.

The analysis of the 3rd group of respondents who have experience a traffic accident is interesting. Out of total 38 respondents, before the experiment, as many as 30 responded that driving at an improper speed is a dangerous driving, while, 5 more respondents were of the same opinion after the experiment.

Not many among them, only 6, were of the opinion, before the experiment, that they were skilful drivers, while 2 respondents changed their opinions after the experiment. This group also finds that the virtual simulator would yield results in education and change of attitudes about the behaviour of participants in traffic. The results are presented in table 3.

The comparison of the stated results shows that the poorest results, that is effects of the experiment were recorded with the 3rd group of respondents. This was logical to expect, because the goal of the simulation was the effect of experiencing a real traffic accident, with vibration, visual and audio effects and the respondents of this group experienced that in reality.

4. CONCLUSION

Our experiments with VR application are aimed at using the VR technology for the change of attitudes on the behaviour of participants in traffic. The following can be concluded from the results of the experiment and the analysis of the results of respondents:

- The participants of the experimental study demonstrated a positive attitude toward this experiment.
- The VR application had positive results, i.e. it brought about the change of attitudes on behaviour in all groups of respondents.
- The VR application creates an opportunity to simulated dangerous situations making an impact on awareness, changes of opinions and attitudes in a concrete case of fast driving and non-usage of safety belts.
- The obligation of the usage of simulators in driving schools during the training of candidates should be introduced with the above stated goals.
- The VR application should be adjusted to the requirements of driver training.

With the help of all this, a candidate is enabled to virtually participate in traffic accidents, so that they will forget that they are in the simulator.

In the upcoming period, it is necessary to continue the research with the goal to establish whether the change of opinion after the conducted experiment, i.e. drive simulation, will enable keeping a positive attitude on the behaviour of traffic participants in the future.

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