Transport and Communications, 2022; Vol. II.
ISSN: 1339-5130

A Review of Selected Factors Affecting Driver Distraction

Katarzyna Haberka[1*], Rafał Jurecki[1]

[1]Kielce University of Technology, Al. Tysiąclecia Państwa Polskiego 7, 25-314 Kielce, Poland
[*] Corresponding author: khaberka@tu.kielce.pl

Abstract Man is the most unreliable and at the same time the least understood element in the driver-vehicle-environment system. Many of the factors affecting the driver have been identified in detail. Taking into account the social and mental changes in societies, however, it turns out that what once could be considered harmful, today thanks to new solutions is acceptable. At the same time, due to the dynamics of technological development, new solutions continue to emerge, which, in a situation of improper use, may carry new, hitherto unrecognized dangers in traffic. Therefore, tests related to the determination of factors determining driver behavior are still described in the literature. They are made for different nations, ages and genders of drivers. This article reviews the basic selected factors affecting driver behavior. These factors can directly affect the risk of a traffic collision or accident. While driving, a driver is exposed to a number of stimuli that cause him to become distracted.

Keywords safety, accidents, drivers' distraction

JEL R41

1. Introduction

Road accidents and collisions are a constant problem in road safety. According to data [1], in 2021 in Poland there were 22,816 road accidents occurring on public roads, in residential zones or in traffic zones. As many as 20,623 of them were caused by the driver. This represents as much as 90.4% of the total. As a result of road accidents caused by the driver's fault, 1,909 people died (85% of the total fatalities). In accidents, 26,415 people were injured (including 8,276 seriously injured), of which 24,307 were victims of accidents caused by the driver's fault. This is as much as 92% of the total. In 2021, 422,627 traffic collisions were reported to police units. These data illustrate the unreliability of the human-vehicle-environment system. It is the behavior of the various groups of road users that most influences the occurrence of traffic accidents [1]. Since, as the statistics indicate, the driver's actions can determine the occurrence of traffic accidents, various studies have been undertaken for many years to qualitatively and quantitatively determine the influence of various factors having on the driver.

While driving, the driver is affected by various types of stimuli. Naturally occurring signals in the environment, the effect of which is negligible over short distances, can, over time, negatively affect the driver and his behavior. The life and health of traffic participants depend on the driver's reaction in various traffic situations. A fairly large number of different factors reach the driver while driving. However, the number of stimuli received and analyzed by drivers is limited. The distraction that occurs under the influence of the stimuli affecting the driver can result in, among other things, increased reaction time, its omission or incorrect assessment of danger. In the research and analysis discussed in the paper [2], it was estimated that driver distraction can cause up to 11% of traffic incidents. A report by the National Highway Traffic Safety Administration (NHTSA) [3] estimated the contribution at up to 78% of accidents and 65% of "near misses." Driver distraction is one of the most common causes of traffic accidents, and a distracted driver has a two to nine times greater risk of being involved in an accident [4].

Internal factors that can compound a driver's distraction include his or her fatigue, alcohol consumption or the use of a narcotic or psychotropic drug, and the driver's health, among others. Given the multitude of vehicle equipment with various driver assistance or multimedia systems, in-vehicle factors such as using a cell phone or other electronic devices, listening to music, chatting with fellow passengers, etc. are also significant. Distracting circumstances beyond the driver's control include: constant personal characteristics, changes in the driver's mental state, driving time, biometeorological conditions, noise, involuntary distraction of concentration by elements of the road environment, such as advertisements along the road travelled by the driver [5].

Thus, undertaking work in this area is still widespread, as it can indicate how to eliminate hazards, which can significantly increase the level of safety on the roads.

2. Factors affecting driver distraction

2.1. Fatigue

Fatigue is a state of reduced mental alertness that leads to impaired performance on many cognitive and psychomotor tasks performed, negatively affecting safe driving [6]. A fatigued driver is slower to respond to stimuli. This can be crucial in an emergency situation when an immediate response is required. In the case of fatigue, a driver may notice a hazard present on the road much later. The American Automobile Association reported that as many as 7% of all accidents and as many as 21% of fatal accidents are caused by fatigued drivers [7]. The process of falling asleep in a vehicle is gradual. It is influenced by monotonous driving conditions and the environmental factors present [8]. The driving process taking into account fatigue can be analyzed using questionnaires or reaction tests on simple test benches or visual tests [9,10].According to the article [11], the first problem to be analyzed in the case of driver fatigue is how to accurately and early detect drowsiness.

2.2. Alcohol

Driving under the influence of alcohol or drugs affects the driver's risk-taking behavior and manual dexterity. Alcohol worsens divided attention, increases perceptual errors, impairs eye-hand coordination, reduces mental performance, increases reaction time and interferes with behavioral behaviors [12]. In 2021, road users in Poland (drivers, pedestrians, passengers) under the influence of alcohol were involved in 2,488 road accidents (10.9% of the total number of accidents), 331 people died in them (14.7% of the total number of deaths), and 2,805 people were injured (10.6% of the total number of injuries). Compared to last year, this is 52 fewer accidents (-2.0%), with an increase in the number of people killed by 4 (+1.2%) and people injured by 82 (+3.0%) [1]. Drivers under the influence of alcohol may drive in a brash manner, and the correctness of their maneuvers may also be affected Drunk drivers are seven times more likely to cause a fatal accident than sober drivers. Drivers who exceed the blood alcohol limit of 0.10 are at least 13 times more likely to cause fatal accidents [13,14]. A study on the simultaneous effects of alcohol and fatigue was described in a publication [15]. The study involved 71 young drunk drivers who were divided into three groups: rested, tired and very tired. The very tired group was significantly slower to respond than the other two groups. Drunk driving research is being carried out in many research settings, and is an important social problem [16,17,18].

2.3. Intoxicating substances

In addition to alcohol, there are also factors such as various types of intoxicating substances. Numerous simulator studies have shown the negative impact of drivers' use of narcotics, amphetamines and related compounds Many drivers under the influence of alcohol are simultaneously under the influence of various drug mixtures [19]. This poses an additional danger in traffic. In addition to drivers who have intentionally taken drugs, equally dangerous are those who have used legal drugs without reading the warnings on the packaging. According to various studies, up to 50% of drivers are unaware of the limitations of drug use [20]. Drivers under the influence of these compounds may drive bravado, tend to disobey traffic laws, greatly exceed the speed limit, fail to stop at red lights, etc. [21]. A tendency to improperly signal traffic maneuvers has also been observed. High doses of amphetamine and its derivatives combined with alcohol significantly increased the risk of drivers engaging in behaviors that pose a potential risk of road accidents [22,23,24,25].

2.4. Mobile devices

The constant use of device-type devices (e.g. smartphone, smartwatch) by users while driving a vehicle is becoming an increasingly frequent and common phenomenon. These devices require momentary engagement of the driver's attention. In addition to the standard use of the phone to receive and make calls or write and receive messages, it has also become popular to use social media or take videos or photos from behind the wheel [26]. Using navigation installed on a smartphone is also popular [27]. It should be noted that most of the actions taken by drivers towards operating such devices most often require engaging his attention which can have negative consequences in relation to his reaction time in case of an emergency on the road. Even a simple reading of a notification displayed on the screen of a smartphone or smartwatch, despite the fact that it does not require taking one's hands off the wheel, requires momentary engagement of the driver's attention [28]. A study discussed in the article [29] showed that using cell phones while driving is one of the leading causes of traffic accidents. In response to this problem, many countries around the world have introduced regulations banning the use of cell phones while driving [30]. Studies performed using simulators to test the effects of mobile devices on driving behavior have shown that phone calls and sending and receiving text messages while driving cause a significant decrease in speed and distance [31,32,33,34]. At the same time, drivers' ability to recognize signals deteriorated in these situations and their reaction time increased [29,35,36,37]. According to a study [38], among drivers who used cell phones up to 10 minutes before an accident, the risk of an accident was more than 4 times higher. A study by [39] analyzed the impact of using a smartwatch and smartphone to initiate calls. The study was conducted in a driving simulator on a group of 36 participants. It was found that call-in methods based on voice commands were better than basic eye-hand calling [39].

2.5. Multimedia systems and controls

In-vehicle technologies such as infotainment, telematics systems, as well as so-called nomadic systems (including cell phones, portable ADAS systems), which are available in an increasing number of vehicles, allow the driver to obtain various types of information while driving. Obtaining this

DOI: 10.26552/tac.C.2022.2.1

information is most often associated with the driver undertaking activities that engage his or her attention. Both the information mentioned and the activities performed are very often not necessary or even related to driving, so they are a kind of distraction [2]. An increasing number of vehicles are equipped with built-in multimedia systems, through which various vehicle functions, including navigation, can be controlled using a touchscreen [40].

2.6. Noise in the cabin and listening to music

A study conducted on a group of young drivers by [41] using a vehicle simulator illustrates the impact of various factors on young drivers. The aforementioned studies were conducted under varying conditions such as driving in silence, driving while talking loudly next to the driver, driving while talking to the driver, while listening to quiet, monotone music, and driving while listening to loud, rhythmic music. After the tests, it was found that drivers are most focused and pay attention to the traffic situation while driving in silence. The value of the driver's reaction during the conducted studies was most influenced by the driver's conversation on the cell phone [41]. The purpose of the research conducted and analyzed by [39,42], was to examine the influence of musical characteristics (i.e., the presence of text and volume) in the context of simulated urban driving. The potential distracting effects of song lyrics processing were investigated by conducting trials on young drivers while playing the same musical tracks with and without lyrics. To optimize their emotional state while driving in the city, drivers should consider using soft, non-lyrical music. The findings show that listening to familiar music (such as classic hits on a radio station) did not cause significant decreases in simulated driving performance. Studies indicate that drivers have a preference for the style and rhythm of music, resulting in positive or no driver reception of the music [43,44,45].

2.7. Advertisements

Occurring along roads, advertisements of various kinds are designed to attract attention. The entity responsible for placing the advertisement strives to ensure that its content reaches the widest possible audience. To this end, it uses a number of procedures to catch the eye of the potential addressee. It uses, among other things, a large advertising area, the dynamics of the presented content, and high contrasts and luminosity [42,51]. Advertisements are placed in high-traffic areas, often directly in the driver's line of sight [42,46,51]For the driver, such acts can adversely affect driving depending on the degree to which the driver's attention is engaged with a particular advertisement. The location of an advertising medium near the road can have negative consequences for traffic safety [46,47,51]. An advertisement that catches the driver's eye can pose a real danger. It often happens that a driver fascinated by the advertising content for a given moment takes his or her eyes off the roadway for an extended period of time. Sometimes after seeing an ad, the driver begins a thought process about the content presented, which in turn engages his attention. Such a process can negatively affect when and how he performs defensive maneuvers. The properties of the human mind make it easy to change the object of interest. The authors of the report [47] proved during a specially designed experiment that the human eye can be attracted by other stimuli, even though the test subject/driver had no intention of looking away from the task at hand. Roadside billboards distracting the driver's attention not only increase his reaction time. They can also cause misjudgment of the traffic situation [48]. For commercial reasons, advertisements near the road will become more and more numerous year after year, hence legal measures are often taken in many countries to limit their occurrence. This can be seen especially from the example of highly developed countries. Analyzing the available studies, it can be concluded that the proximity of advertising near road infrastructure always adversely affects the driver's attention. This can be concluded, among other things, on the basis of statistical studies carried out on highway sections where advertisements first occurred, were later removed, and were eventually reinstalled [49]. The impact of the content of advertisements was also studied in [50]. In this experiment, the emotions occurring in drivers caused by the ads were analyzed. A car simulator and traffic images were used for the study. In the end, there was a strong correlation of the influence of visual stimuli loaded with negative emotion, among other things, the time and manner of reaction to traffic lights at the nearest intersection. According to [51, 52], a threatening sign can be an advertisement with a lot of content, as well as one that strongly engages attention, cognitive resources, and arouses emotions that affect information processing. Located near the road, signs with variable content, also have to transmit relevant to safety[53].

2.8. Eating meals while driving

According to [54], the driver of a motor vehicle who is transporting a person is prohibited from smoking or eating while driving. This regulation does not apply to the driver of a truck who is transporting a person in the driver's cab, as well as to the driver of a passenger car except for a taxicab. In a study [55], 186 participants were matched to determine the adverse effects of eating while driving behavior compared to texting and distraction-free behavior. The study was conducted on a driving simulator. The results showed that both texting and eating meals resulted in impaired driving ability, compared to the control group. Among other things, the test subjects missed more STOP signs than the control group while eating a meal. Eating while driving introduces many additional distractions. Manual activities, such as engaging attention to unscrew the cap from a bottle or unwrap a sandwich, are of great importance. Eating behaviors also involve engaging additional cognitive complexes to

effectively manipulate food/drinks to avoid spills, for example [56].

2.9. Smoking

Smoking cigarettes while driving engages the driver's attention. The study [57] focused on assessing the risk of distraction associated with the habit of smoking cigarettes while driving. During the experiment, the subjects' reactions were recorded. Ten smokers were tested while driving. The average measured distraction was about 12 seconds. During this time, the drivers were able to cover a distance of 150 meters at a speed of 50 km/h. These results were compared with data on drivers' deconcentration through the use of cell phones. In this case, the deconcentration time was 10.6 seconds. This means that cigarette smoking poses a real threat to traffic safety [57] In addition to the above-mentioned distractions, the driver's attention is also affected by elements such as fixed personal characteristics, changes in the driver's mental state, driving time, biometeorological conditions or noise [4]. Fixed personal characteristics determine a person's predisposition, regulating the expected reactions that person will perform in a given situation. Individual personality traits influence how a factor will affect driving. A driver's individual characteristics also affect his or her susceptibility to stress. A study [58] found that there are no universal stressors. In the case of drivers with a category B license who drive amateur, it was found that other drivers and other road users were the main sources of stress. Vulnerability and reactions to stressful situations depend on the individual characteristics of the driver. Driving time or biometeorological conditions affect a driver's decision-making. A different degree of driver attention involvement will occur when conditions are favorable, and another when there will be poor road conditions (e.g., rain, snowfall). For example, it has been noted that in fog, drivers usually try not to take their eyes off the roadway due to the fear of a sudden obstacle. Drivers then rely primarily on their own senses [59,60].

5. Conclusions

With the development of technology, there are more and more factors that engage the driver's attention. The driver is exposed to all kinds of stimuli that distract his attention. The occurrence of some of them is not dependent on the driver (for example, road advertisements can arbitrarily attract the gaze). A driver while distracted can pose a real danger to road users. Seemingly common devices or messages can become the cause of a collision or accident. The driver should be reasonably focused on the situation around the vehicle. Co-passengers should remember not to engage the driver's attention excessively, and not to encourage them to focus their attention on things that can have a negative effect on the traffic situation. Analyzing the available publications, it can be concluded that driver distraction is a factor of great importance in traffic safety. With the development of technology, studies conducted with the help of vehicle simulators are very important. They make it possible to create conditions appropriate to the situations under study and to introduce additional factors under laboratory conditions. The present work is a prelude to further survey research to determine situations and factors affecting driver behavior.

REFERENCES

[1] Komenda Główna Policji Biuro Ruchu Drogowego: Wypadki drogowe w Polsce w 2021 roku, Warszawa 2022

[2] Regan, M. A., Lee, J. D., & Young, K. (2008). *Driver distraction: Theory, effects, and mitigation*. CRC press.

[3] Dingus, T. A., Klauer, S. G., Neale, V. L., Petersen, A., Lee, S. E., Sudweeks, J., ... & Knipling, R. R. (2006). *The 100-car naturalistic driving study, Phase II-results of the 100-car field experiment* (No. DOT-HS-810-593). United States. Department of Transportation. National Highway Traffic Safety Administration.

[4] Kruszewski, M., & Nader, M. (2015). Projekt badań wpływu obciążenia poznawczego zadaniami dodatkowymi na prowadzenie pojazdu przez kierowcę. *Logistyka*, (4, CD 1), 519-525.

[5] Przybylska, K. (2022). Czynniki mające wpływ na spowodowanie niebezpieczeństwa w ruchu drogowym. *Kortowski Przegląd Prawniczy*, (3).

[6] Łuczak, A., & Zużewicz, K. (2006). Zmęczenie kierowców a bezpieczeństwo pracy. *Bezpieczeństwo Pracy: nauka i praktyka*, (4), 20-23.

[7] Tefft, B. C. (2016). Acute sleep deprivation and risk of motor vehicle crash involvement.

[8] Savaş, B. K., & Becerikli, Y. (2020). Real time driver fatigue detection system based on multi-task ConNN. *Ieee Access*, *8*, 12491-12498.

[9] Corfitsen, M. T. (1993). Tiredness and visual reaction time among young male nighttime drivers: a roadside survey. Accident Analysis & Prevention, 26(5), 617-624. https://doi.org/10.1016/0001-4575(93)90032-R

[10] MacLean, A. W., Davies, D. R., & Thiele, K. (2003). The hazards and prevention of driving while sleepy. Sleep medicine reviews, 7(6), 507-521, https://doi.org/10.1016/S1087-0792(03)90004-9

[11] Wang Q., Yang J., Ren M., and Zheng Y.:Driver fatigue detection: A survey, in Proc. 6th World Congr. Intell. Control Autom., pp. 8587–8591 2006

[12] Firestone, R. T., Mihaere, K., & Gander, P. H. (2009). Obstructive sleep apnoea among professional taxi drivers: a pilot study. *Accident Analysis & Prevention*, *41*(3), 552-556.

[13] Levitt, S. D., & Porter, J. (2001). How dangerous are drinking drivers?. Journal of political Economy, 109(6), 1198-1237.

[14] Horwood, L. J., & Fergusson, D. M. (2000). Drink driving and traffic accidents in young people. Accident Analysis & Prevention, 32(6), 805-814. https://doi.org/10.1016/S0001-4575(00)00005-1

DOI: 10.26552/tac.C.2022.2.1

[15] Corfitsen, M. T. (1982). Increased viso-motoric reaction time of young tired drunk drivers. Forensic science international, 20(2), 121-125.

[16] Fynbo, L., & Järvinen, M. (2011). 'The best drivers in the world': Drink-driving and risk assessment. The British Journal of Criminology, 51(5), 773-788. https://doi.org/10.1093/bjc/azr067

[17] Baum, S. (2000). Drink driving as a social problem: comparing the attitudes and knowledge of drink driving offenders and the general community. Accident analysis & prevention, 32(5), 689-694. https://doi.org/10.1016/S0001-4575(99)00106-2

[18] Bingham, C. R., Elliott, M. R., & Shope, J. T. (2007). Social and behavioral characteristics of young adult drink/drivers adjusted for level of alcohol use. Alcoholism: Clinical and Experimental Research, 31(4), 655-664. https://doi.org/10.1111/j.1530-0277.2007.00350.x

[19] Augsburger, M., Donzé, N., Ménétrey, A., Brossard, C., Sporkert, F., Giroud, C., & Mangin, P. (2005). Concentration of drugs in blood of suspected impaired drivers. Forensic science international, 153(1), 11-15. https://doi.org/10.1016/j.forsciint.2005.04.025

[20] Fukuda, Y., Ando, S., & Saito, M. (2020). Risk awareness, medication adherence, and driving behavior as determined by the provision of drug information to patients. Patient education and counseling, 103(8), 1574-1580, https://doi.org/10.1016/j.pec.2020.02.037

[21] Hingson, R. W., Heeren, T., & Edwards, E. M. (2008). Age at drinking onset, alcohol dependence, and their relation to drug use and dependence, driving under the influence of drugs, and motor-vehicle crash involvement because of drugs. Journal of Studies on Alcohol and Drugs, 69(2), 192-201. https://doi.org/10.15288/jsad.2008.69.192

[22] Drabek M, Andrysz A. Wpływ zażywania marihuany i amfetaminy (oraz jej pochodnych) na prowadzenie pojazdów na podstawie wyników badań symulatorowych. Med Pr 2011;62(5):551-63.

[23] Walsh, J. M., Gier, J. J., Christopherson, A. S., & Verstraete, A. G. (2004). Drugs and driving. Traffic injury prevention, 5(3), 241-253. https://doi.org/10.1080/15389580490465292

[24] Seppala, T., Linnoila, M., & Mattila, M. J. (1979). Drugs, alcohol and driving. Drugs, 17, 389-408. https://doi.org/10.2165/00003495-197917050-00008

[25] Penning, R., Veldstra, J. L., Daamen, A. P., Olivier, B., & Verster, J. C. (2010). Drugs of abuse, driving and traffic safety. Current drug abuse reviews, 3(1), 23-32.

[26] Rauniar, R., Rawski, G., Yang, J., & Johnson, B. (2014). Technology acceptance model (TAM) and social media usage: an empirical study on Facebook. Journal of enterprise information management, 27(1), 6-30.

[27] Bian, Y., Zhang, X., Wu, Y., Zhao, X., Liu, H., & Su, Y. (2021). Influence of prompt timing and messages of an audio navigation system on driver behavior on an urban expressway with five exits. Accident Analysis & Prevention, 157, 106155.

[28] Paefgen, J., Kehr, F., Zhai, Y., & Michahelles, F. (2012, December). Driving behavior analysis with smartphones: insights from a controlled field study. In Proceedings of the 11th International Conference on mobile and ubiquitous multimedia (pp. 1-8).

[29] Zhang, L., Cui, B., Yang, M., Guo, F., & Wang, J. (2019). Effect of using mobile phones on driver's control behavior based on naturalistic driving data. *International journal of environmental research and public health*, *16*(8), 1464.

[30] Dozza M., Flannagan C.A., Sayer J.R.: Real-world e_ects of using a phone while driving on lateral and longitudinal control of vehicles. J. Safety Res. 2015, 55, 81–87

[31] Haigney D.E.,Taylor R.G.,Westerman S.J.: Concurrent mobile (cellular) phone use and driving performance: Task demand characteristics and compensatory processes. Transp. Res. Part F Tra_c Psychol. Behav. 2000, 3,113–121.

[32] Caird J.K., Johnston K.A.,Willness C.R., Asbridge M.: The use of meta-analysis or research synthesis to combine driving simulation or naturalistic study results on driver distraction. J. Safety Res. 2014, 49, 91–96.

[33] Rakauskas M.E.,Gugerty L.J., Ward N.J.: Efects of naturalistic cell phone conversations on driving performance. J. Safety Res. 2004, 35, 453–464

[34] Strayer D.L. Drews F.A., Johnston W.A.: Cell phone-induced failures of visual attention during simulated driving. J. Exp. Psychol. Appl. 2003, 9, 23–32.

[35] Strayer, D.L.; Johnston,W.A. Driven to distraction: Dual-Task studies of simulated driving and conversingon a cellular telephone. Psychol. Sci. 2001, 12, 462–466

[36] Drews, F.A.; Yazdani, H.; Godfrey, C.N.; Cooper, J.M.; Strayer, D.L. Text messaging during simulated driving. Hum. Factors 2009, 51, 762–770.

[37] Žuraulis, V., Nagurnas, S., Pečeliūnas, R., Pumputis, V., & Skačkauskas, P. (2018). The analysis of drivers' reaction time using cell phone in the case of vehicle stabilization task. *International journal of occupational medicine and environmental health*, *31*(5), 1-16.

[38] Perlman, D., Samost, A., Domel, A. G., Mehler, B., Dobres, J., & Reimer, B. (2019). The relative impact of smartwatch and smartphone use while driving on workload, attention, and driving performance. *Applied ergonomics*, *75*, 8-16.

[39] Babić, D., Prelčec, I., Babić, D., Boroša, V., & Fiolić, M. (2022). The Impact of Mobile Phone Use on Young Drivers' Driving Behaviour and Visual Scanning of the Environment. Promet-Traffic&Transportation, 34(3), 431-441.

[40] Bian, Y., Zhang, X., Wu, Y., Zhao, X., Liu, H., & Su, Y. (2021). Influence of prompt timing and messages of an audio navigation system on driver behavior on an urban expressway with five exits. Accident Analysis & Prevention, 157, 106155

[41] Jurecki, R. (2014). Badania czasu reakcji młodych kierowców w różnych warunkach pracy realizowane w symulatorze jazdy. *Logistyka*, (6), 5003-5014.

[42] Karageorghis, C. I., Kuan, G., Payre, W., Mouchlianitis, E., Howard, L. W., Reed, N., & Parkes, A. M. (2021). Psychological and psychophysiological effects of music intensity and lyrics on simulated urban driving. *Transportation research part F: traffic psychology and behaviour*, *81*, 329-341.

[43] Brodsky, W., & Slor, Z. (2013). Background music as a risk factor for distraction among young-novice drivers. Accident

Analysis & Prevention, 59, 382-393. https://doi.org/10.1016/j.aap.2013.06.022

[44] Miao, L., Gu, Y., He, L., Wang, H., Schwebel, D. C., & Shen, Y. (2021). The influence of music tempo on mental load and hazard perception of novice drivers. Accident Analysis & Prevention, 157, 106168. https://doi.org/10.1016/j.aap.2021.106168

[45] Babić, D., Babić, D., Sucha, M., Stanić, V., & Toman, M. (2021). The influence of music genres on the driving behaviour of young drivers and their visual scanning of the environment. Transportation research part F: traffic psychology and behaviour, 81, 396-407.

[46] Zalesińska, M. (2013). Badania pilotażowe wpływu reklam elektronicznych na wydolność wzrokową kierowców w warunkach laboratoryjnych z wykorzystaniem symulatora pojazdu. *Poznan University of Technology Academic Journals. Electrical Engineering*.

[47] Karageorghis, C. I., Payre, W., Howard, L. W., Kuan, G., Mouchlianitis, E., Reed, N., & Parkes, A. M. (2022). Influence of music on driver psychology and safety-relevant behaviours: a multi-study inductive content analysis. *TheoreTical issues in ergonomics science*, *23*(6), 643-662.

[48] Theeuwes, J., Kramer, A. F., Hahn, S., & Irwin, D. E. (1998). Our eyes do not always go where we want them to go: Capture of the eyes by new objects. *Psychological Science*, *9*(5), 379-385.

[49] Bendak, S., & Al-Saleh, K. (2010). The role of roadside advertising signs in distracting drivers. *International Journal of Industrial Ergonomics*, *40*(3), 233-236.

[50] Gitelman, V., Zaidel, D., & Doveh, E. (2012, August). Influence of billboards on driving behaviour and road safety. In *18th international conference on traffic and transport psychology ICTTP, Groningen, The Netherlands*.

[51] Megías, A., Di Stasi, L. L., Maldonado, A., Catena, A., & Cándido, A. (2014). Emotion-laden stimuli influence our reactions to traffic lights. *Transportation research part F: traffic psychology and behaviour*, *22*, 96-103.

[52] Tarnowski, A., Gąsiorek, K., Olejniczak-Serowiec, A., Maliszewski, N., Tomczuk, P., Chrzanowicz, M., ... & Mackun, T. (2019). Projekt ROADVERT. Wpływ reklam na poziom bezpieczeństwa ruchu drogowego. *Transport Miejski i Regionalny*, (1), 26-31.

[53] Wu, Y., Zhao, Z., Wu, F., & Rong, J. (2022). Information Volume Threshold for Graphical Variable Message Signs Based on Drivers' Visual Cognition Behavior. Journal of Advanced Transportation, 2022.Volume 2022 | ArticleD 7693492 | https://doi.org/10.1155/2022/7693492

[54] Ustawa z dnia 20 czerwca 1997 r. Prawo o ruchu drogowym: Warunki użytkowania pojazdów w ruchu drogowym

[55] Alosco, M. L., Spitznagel, M. B., Fischer, K. H., Miller, L. A., Pillai, V., Hughes, J., & Gunstad, J. (2012). Both texting and eating are associated with impaired simulated driving performance. *Traffic injury prevention*, *13*(5), 468-475.

[56] Rektor, I., Brázdil, M., Nestrašil, I., Bareš, M., & Daniel, P. (2007). Modifications of cognitive and motor tasks affect the occurrence of event-related potentials in the human cortex. *European Journal of Neuroscience*, *26*(5), 1371-1380.

[57] Mangiaracina, G., & Palumbo, L. (2007). Smoking while driving and its consequences on road safety. *Annali di igiene: medicina preventiva e di comunita*, *19*(3), 253-267.

[58] Tokarczyk, E. (2011). Źródła stresu kierujących pojazdami w miejskim ruchu drogowym. *Autobusy: technika, eksploatacja, systemy transportowe*, *12*, 380-391.

[59] Snowden, R. J., Stimpson, N., & Ruddle, R. A. (1998). Speed perception fogs up as visibility drops. *Nature*, *392*(6675), 450-450.

[60] Zaleski M. Pozyskiwanie, przetwarzanie i analiza danych w kontekście bezpieczeństwa drogowego.