RESEARCH ARTICLE

An Analysis of the Driving Behaviours of Professional Truck Drivers: A Pilot Study in Turkey

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ABSTRACT

Regulation (EC) No 561/2006 consists of various rules regarding the working hours of drivers, breaks and resting periods for truck and bus drivers to enhance working conditions and road safety. As of 15 July 2020, several changes have been made that might endanger road safety. The objective of this study is twofold. First of all, the study aims to explore various physical and phycological factors where the impact of these regulations is assessed. Secondly, it aims to observe the reasons behind truck drivers' fatigue behaviour. To achieve these objectives, a literature review is conducted to investigate the important features impacting truck drivers while driving. The data gathering process is carried out by using GPS data, digital tachograph data and drivers' video records monitored while they are driving. Lastly, the data is evaluated in cooperation with our partners from the University of Zilina. The pilot study is conducted in Turkey, Istanbul. Firstly, the results show that ten hours of driving does not cause any serious signs of fatigue behaviour in truck drivers. Secondly, the majority of the errors are in fact due to distractions, such as phone calls or SMS messages, rather than the result of exhaustion. Future studies will focus on increasing the number of drivers and working days to explore the behaviours of drivers thoroughly.

Keywords: Driving Regulations, Road Transport, Traffic Safety, Driver Awareness

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1. Introduction

An unexperienced driver can cause various minor and/or major accidents on highways which might lead to many unintended outcomes, namely, financial loss, injury, and even loss of human life (Ghole et al., 2020). Fatigue is a more common cause of accidents than driving under the influence of alcohol. Drivers may feel drowsy due to a lack of sleep, constant driving, drugs, and medication. Especially in road transport, a driver has a big impact on road safety. In the case of falling asleep for a couple of seconds while driving, this might cause a severe accident and put many lives in danger. At high speed, a crash is likely with a high risk of death or severe injury. Around 20% of fatal road accidents involve driver fatigue. Fatigue is a major cause of crashes in the state of Victoria (Australia) resulting in some 50 deaths and approximately 300 serious injuries each year (Transport Accident Commission, 2021). As we have successfully demonstrated that drowsiness is a major cause of accidents, we also need to solve this problem (Apoorva et al., 2020). The objective of this study is to identify various risk factors associated with fatal crash severities. The second part of this study explores various aspects of truck-involved fatal crashes, namely, environment-related, road-related, vehicle-related, and driver-related variables. In the European Union, the rules on driving times, breaks and rest periods for drivers engaged in road haulage and passenger transport are laid down in Regulation (EC) No 561/2006 of the European Parliament and of the Council. The purpose of this regulation is to improve working conditions, to enhance road safety as well as to promote better monitoring and enforcement by Member States, and to improve working practices in the road transport sector. We believe that we will be able to confirm or contribute to the improvement of current legislation, especially in the field of international road freight transport by planning the measurement of driver drowsiness during real situations in traffic. In the first part, measurement is performed, the results of which are then evaluated in the second part and finally the research findings are presented. Several measurements are carried out in real traffic, where the face of the selected driver is monitored by cameras while driving for one day.

1.1. Regulation regarding the changes of excess time of driving (EC) No 561/2006

Regulation (EC) No 561/2006 has undergone a significant amendment that may jeopardize traffic safety. On the other hand, it may assist with issues such as vehicle route optimisation, driving and working hours of truck drivers, which will, in turn, affect duration of journey and arrival times (Goel, 2012). It is possible that, depending on the steps taken, drivers will be permitted to drive for up to 12 hours. The following lines outline the amendments to the Regulation and provide examples to illustrate them. Regulation (EC) No 561/2020, which came into force on August 20, 2020, also specifies the driving distance to the company's registered office. If a weekly rest period follows, the driver may travel to the employer's operating centre or his current address by exceeding the daily or weekly driving time if it does not jeopardise road safety (Poliak & Gnap, 2020). It is possible to exceed the daily or weekly driving time.

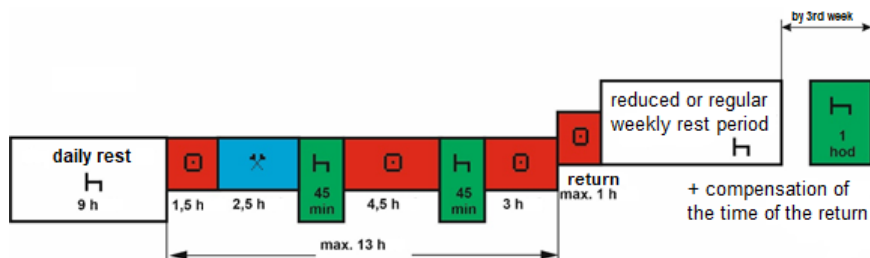Figure 1 shows the case when driving time is exceeded by one hour.

Figure 1. Exceeding driving time by one hour (Poliak & Gnap, 2020).

Figure 2 below shows the case when driving time is exceeded by two hours. In this example, the driver needs to have a break of at least 30 minutes before driving.
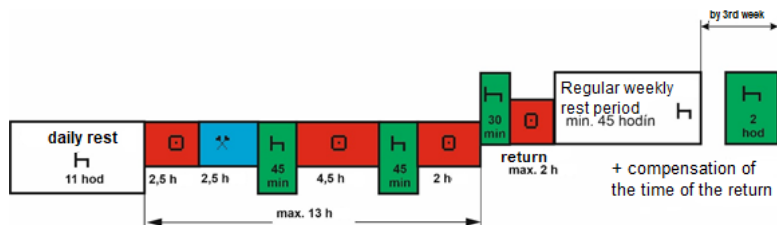

Figure 2. Exceeding driving time by two hours (Poliak & Gnap, 2020).

2. Literature review

The main objective of this paper is to investigate several risk factors that can be linked to fatal crash severity. Thereby, the literature review consists of factors which might be linked to sociodemographic characteristics such as age, gender as well as the behaviour of truck drivers.

The literature engaging with fatal crashes in the domain of road traffic safety demonstrates that truck drivers can be divided into several sociodemographic and personal categories, namely, gender, age, experienced or unexperienced (Kim et al., 2012; Lombardi et al., 2017; Morgan & Mannering, 2011; Yuan et al., 2019a; Yuan et al., 2019b). However, it is important to notice that truck drivers have many other characteristics. A single attribute being used to categorised them might result in biased evaluations (Yuan et. al., 2021).

Due to the fact that truck-involved fatal crashes lead to severe damage, studies have placed considerable attention on these crashes (Brodie et al., 2009; Lombardi et al., 2017; Gates et al., 2013). Several research findings show that the severity of truck-involved crashes depends on various factors such as driving behaviours, weather conditions and the number of vehicles involved (Khorashadi et al., 2005; Xie et al., 2012; Zhu & Srinivasan, 2011).

Khorashadi et al. (2005) show that area type is closely related to the severity of the crash. As expected, a crash which might happen in urban areas would be more serious than one in rural areas. With respect to the collision-related risk factors, several studies shed light on the fact that safety belt usage, weight and body types of vehicles and curviness of the road would have a considerable impact (Xie et al., 2012; Islam et al., 2014). Similarly, a

recent study shows that the characteristics of the crash might be different depending on the manners of collision (Guo et al., 2019).

Several studies explore the importance of vehicle-related risk factors. According to Chen & Chen (2011), it can be safer if a single-unit vehicles are used instead of non-single-unit vehicles. However, the research also highlights that single-unit trucks might cause severe driver injury in the case of multi-vehicle crashes. Zhu & Srinivasan (2011) point out that weight of the cargo might also impact on the severity of injury. They state that a trailer that transports lightweight cargo might lead to minor injuries compared to a trailer transporting heavy cargo.

Lastly, driver-related risk factors are investigated in several studies. Sociodemographic characteristics appear to be one of the most important aspects which might affect the injury severity. Specifically, the impact of age and gender is studied to explore the driver-related risk factors. Several studies indicate that the possibility of being involved in a crash is higher in older drivers (Lombardi et al., 2017; Kim et al., 2012). Another aspect which might originate directly from the driver is driving behaviour. In this context, traffic rule violations, drink driving and not wearing a seat belt are some of the factors which might impact on the severity of the injury Sullman et al., 2017).

3. Methodology

In this study, measurements are carried out in a real vehicle with a professional driver from Turkey. The measurement is based on several sources, namely, GPS data collection, data from a digital tachograph and also driver's video data which is collected while he is driving. Data is collected over the course of one day and includes various journeys made by a truck driver from Turkey in domestic transport. During different journeys, drivers may behave differently in terms of driving safety. We do not expect to only extract video data of the driver's face while driving but also information such as atmospheric conditions (rain, cloudy, snow, ...), land use, day of week, time period (morning, evening), season, number of lanes, surface type, and speed limit. Additionally, vehicle-related variables such as truck type, truck weight, vehicle age and vehicle trailering are also available. Finally, the aim of the data collection is to assess to what extent existing regulations and the adopted changes support traffic safety.
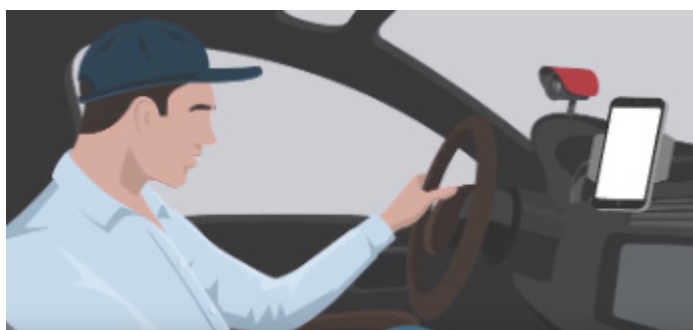

Figure 3. Camera location (Ghole et al., 2020)

At the completion of the proposed technique, it is important to clarify that the subjective method will be applied to analyse drivers' awareness because software with PERCLOS is not yet available. Authors are aware of possibility that this evaluation could lead to different results to the PERCLOS method, which was, and is also planned to be used for future measurements. However, using a subjective technique can be considered as accurate as PERCLOS due to rigorous evaluation of the authors.

3.1. Characteristics of the camera- Dual Sony IMX323

Based on the powerful Novatek 96 663 processor, the dual lens simultaneously records the front camera and the interior camera of a part of the vehicle in 1080P 30P + 1080P 30P / 720P 30P + 720P 30P resolution. There is an option to only use the front camera to record from the front at 4K 2160p 24P / 1440p 30P / 1080P 60P / 1080P 30P / 720P 60P / 720P 30P. The exceptional low-profile design allows the on-board lens to be well hidden. Both cameras can be rotated 180 degrees forward and backward, and 50 degrees left and right. The GPS module accurately records the position, speed, and route of vehicles. Moreover, it can be viewed using a GPS player on your computer (WINDOWS systems).

Figure 4. Dual Sony IMX323 (prepared by the authors)

A super night vision, Sony IMX323 1 / 2.9-inch light-sensitive image sensor, 4 infrared lights, f / 1.8 aperture, and 6-lens lens, can produce clear videos and photos even in low light conditions. WDR technology automatically compensates for light / dark spots and balances exposure, allowing all details of a scene to be recorded live. The built-in super capacitor prevents the battery from exploding during use. The on-board camera should be connected to a car charger.

4. Result

We conducted a pilot experiment to determine drivers' attention while driving in regular traffic. With a maximum driving time of ten hours each working day, the driver obeyed all applicable regulatory rules. We looked for indicators of exhaustion such as yawning, sleepy behaviour, loss of concentration, and shaking hands behind the wheel. The driver was a forty-one year old man with fifteen years of truck driving experience.

The driver initially drove for one and half an hours from the company's registered office to the loading point. He took a thirty-minute break while ten tons of cargo was being loaded. After completing loading of the cargo, he started his journey South to the unloading point. He drove 247.86 kilometres before taking a second obligatory break of thirty minutes according to social regulation. The driver then drove for one more hour to reach the

unloading point. After the cargo was unloaded, the driver started his return journey back to the company's registered office. After three hours of driving, his last forty-five minutes break was taken. The driver then drove for less than one hour back to the company's registered office. The total driving time of the driver on the analysed day was about ten hours, it took place on a sunny day from seven in the morning till early evening -7 p. m. and a distance of 807.79 kilometres was driven.

Figure 5. Route of the experiment (prepared by the authors)

During the whole journey, the driver was observed by means of a camera that recorded his face and a portion of his body from the waist up, but the camera was switched off during the driver's breaks. During the whole trip, we evaluated notable indicators of fatigue behaviour. We can see that before the last hour of driving, indicators of exhaustion such as yawning and head dropping began to appear in the second portion of the assessment, but after a 45-minute rest before the last hour of driving, all symptoms had disappeared. Evaluations of driver errors and fatigue behavioural symptoms are shown below in Figure 8. We can also see that there is no fatigue behaviour and yawning observed between the 6 and 8th hours that explains the break in between these lines.

However, we can detect multiple errors in the second portion of the assessment that could have resulted in traffic accidents. The majority of these errors were due to distractions, such as phone calls or SMS messages, rather than indicators of exhaustion. The driver had stopped paying attention to the traffic conditions as a result of this major problem present when using a cell phone, and this might jeopardise traffic safety, as is shown in the Figure 9.
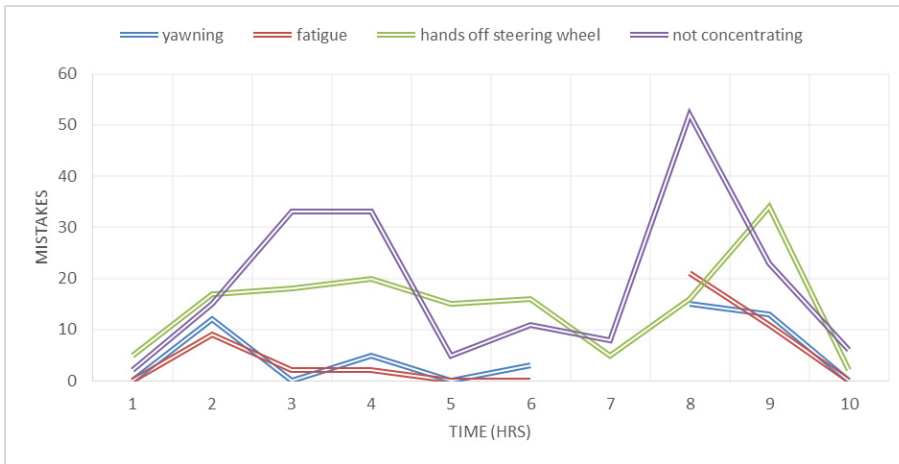
Figure 6. Signs of fatigue behaviour

Figure 7. Signs of dangerous behaviour

5. Conclusion

Due to the seriousness of the driver fatigue issue, there are several types of research which could prevent sleepiness in drivers while driving a motor vehicle. One solution is to educate drivers about the adverse conditions while driving when sleepy. This approach means realising the effects of lack of sleep, fatigue caused by long monotonous driving (Williamson et al., 2014). We would like to prepare educational material for training centres implementing training for professional drivers on the impact of fatigue and rest on drivers while driving by implementing individual measurements and their detailed documentation, and evaluation. Our aim is to verify the driver's awareness condition while driving a lorry during a 12-hour working day, which was made possible by an amendment to Regulation 561/2006 adopted on 20 August 2020. In this experiment, one driver was recorded for one working day. The findings showed that fatigue behaviour can be prevented with the help of regulatory breaks during the drive. Surprisingly, there is no sign of exhaustion leading to driving errors. In future studies, the same experiment setting would be applied for longer time periods by increasing the number of truck drivers in order to explore driver fatigue. We believe that as the number of observed operation days

and truck drivers increases, the outcomes of the study will be validated. In addition, the research outcomes can be used in the future to improve the teaching process of drivers and update the current legislation dealing with the working shifts of drivers in road freight transport. As we can see from the result of this conducted experiment, there is a big possibility to prove that drivers are capable of driving safely for ten hours as allowed in current legislation. In further research, we would like to explore to what extent drivers are able to drive safely when driving for longer than allowed in the current legislation. Compared to the current social legislation in force in the United States of America, European Union drivers can drive 4 to 10 hours less in one week, and in two weeks this can be a difference of up to 30 hours (FMCSA, 2020). We believe that detailed research could provide a useful basis for a possible change in current legislation that would not result in an increase in the number of traffic violations and accidents.

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