ROAD SAFETY AND NOVICE DRIVERS IN BULGARIA

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Contents

I. Introduction

The problem of injuries and deaths as a result of road accidents has been discussed ever since the car was invented (Papadimitroum et al. 1994). The topic received significant amount of attention in the past half-decade and currently it has become a global phenomenon, mostly impacting low- and middle-income countries (Jacobs, et al. 2000). In almost every country there are authorities who are concerned about the growth in the number of road users killed or injured on their roads. The severe negative economic and emotional consequences that are the result of road accidents necessitated for effective measures to be implemented, generally named road safety policies. Two of the most prominent such policies are the Swedish 'Vision Zero' and the Dutch 'Sustainable Road Safety'. The former policy addresses road infrastructure and the vulnerability of the human body, aiming no one to be killed or seriously injured due to road accident. The Dutch policy has for its building-block the road infrastructure and the fact that humans tend to make mistakes and the system should be built to minimize them.

For the year 2015 road traffic accidents took the life of more than 1.2 million people globally and left tens of millions injured (WHO, 2015). Road accidents are the leading cause of death among the group of people aged 15 – 29 years. The statistics show that except the unmeasurable human toll, the fatalities cost roughly 3% of a country`s GDP. These morally and economically unacceptable losses led to the introduction of the 'European Union Road Safety Strategy 2011-2020'. The Union committed to the goal of halving the road deaths by the year 2020 compared to 2010 levels. Currently only 2 countries out of the 28 EU member states are on track, while the others fail to meet the pre-set goals (ETSC, 2018). Among the worse-performing countries is Bulgaria. Being one of the newest members of the European Union Bulgaria experiences three times more road fatalities per million inhabitants than Norway and Sweden. The Government has prepared a road safety strategy for the period 2011-2020 which aims to halve road fatalities and to decrease road injuries with 20% by the year 2020. At the time of writing the fatalities have went down with only 13% while the injuries rose with 7.5%. The results present the poor road safety condition in Bulgaria and this paper aims to contribute towards solving this problem.

This paper investigates the topic of: '*Novice drivers and road safety in Bulgaria'* with a research question: *What measures have to be taken in order to ensure that novice drivers contribute positively towards the road safety in Bulgaria.*

From scientific point of view this paper aims to bridge the literature gap between the global research on the topic of young drivers` contribution to road safety and the lack of such investigation in Bulgaria. So far the scientific focus on this theme has been put on collecting and analyzing general accidents data while this paper addresses specifically the segment of young drivers in Bulgaria.

The current research is of a high social relevance because almost every citizen is in some way road user and he not only benefits from mobility but he also exposes himself to severe risks when undertaking journeys. According to the WHO (2016) about 45% of the victims of road fatalities on a global scale are cyclists, pedestrians and motorists. From this perspective the topic of road safety does not only concerns drivers but rather every road user. This paper would be valuable for the general public in terms of informing it on the most severe types of road accidents and giving suggestions how to prevent some of them.
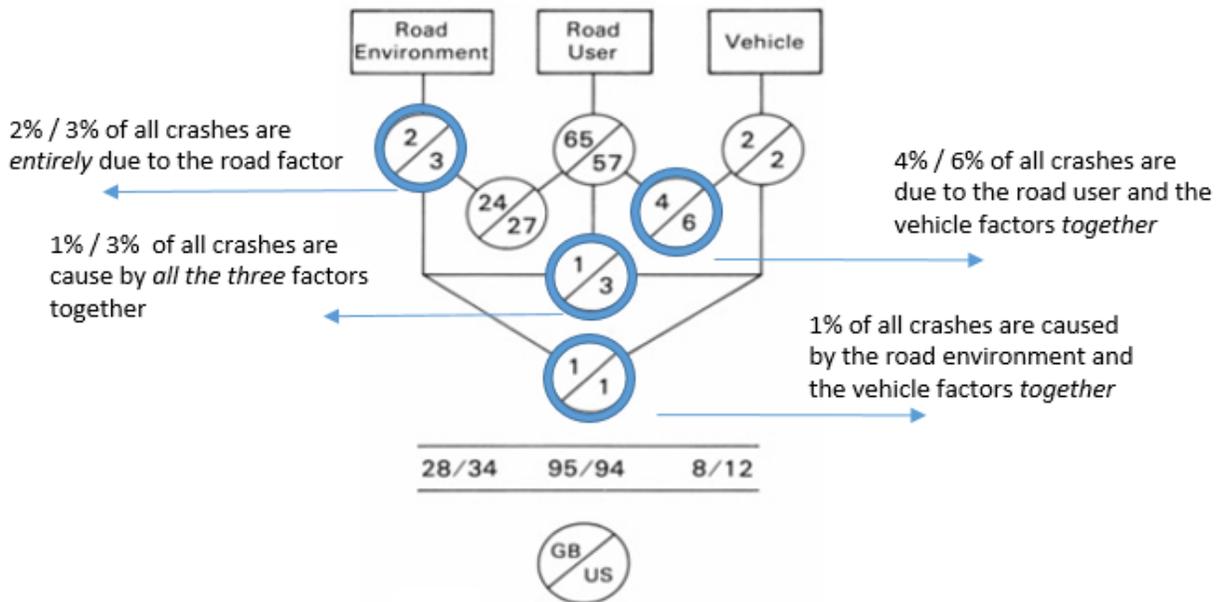
The findings of the paper show that majority of the novice drivers surveyed tend to speed, talk on the phone while driving and they are not theoretically well-prepared. Moreover the majority of them do not feel confident to drive in adverse weather conditions and do not keep safe distance with the vehicle in front. It was also found that there is relation between experience and self-assessed driving skills & gender and self-assessed confidence.

The paper is structured in the following manner: The next chapter discusses the literature review on the topic of road accidents and the role of novice drivers, followed by the Swedish and the Dutch road safety policies. The chapter continues with a discussion of the EU Road Safety Strategy and its results. Chapter three presents Bulgaria, its infrastructure, auto fleet and road users. The Road Safety Strategy of the country together with the achieved results is discussed. The paper continues by analyzing all available road accidents data for Bulgaria (Chapter 4), based on which a survey with 15 questions is prepared and distributed among Bulgarian drivers aged 18-25 years old. The analysis of the survey is followed by a methodology section which elaborates on the statistical model used in order to further analyze four main questions. Chapter 6 presents the results of the statistical tests. The conclusion (Chapter 7) and the policy recommendations (Chapter 8) summarize the main findings and provide policy recommendations and further research topics.

II. Literature review

In order a road accident to happen there must be present at least three factors which to some extent contribute towards the crash – the vehicle, the road user and the infrastructure. Treat (1980) conducted a research on the relative involvement of these three factors in a road accident in the USA. Similar study was done by Sabey and Staughton (1975) in Great Britain. Both papers find similar results, presented in figure 1. The numbers in the bottom show that in 95% / 94% of all accidents observed, there is a human error involved. The road environment factor contributes to an accident in 28% / 34% of the cases while mechanical defect of the vehicle is present in about 10% of the crashes.

Figure 1. Relative contribution of the road environment, the road user and the vehicle to road accidents, based on UK and USA researches.

Road Environment | Road User | Vehicle

2 / 3
65 / 57
2 / 2
24 / 27
4 / 6
1 / 3
1 / 1

2% / 3% of all crashes are *entirely* due to the road factor

1% / 3% of all crashes are cause by *all the three* factors together

4% / 6% of all crashes are due to the road user and the vehicle factors *together*

1% of all crashes are caused by the road environment and the vehicle factors *together*

28/34   95/94   8/12

GB / US

Source: Rumar, K. (1985)

Road infrastructure

   The importance of the road environment in road safety is discussed by many authors, one of which is Wegman (1995). According to the author proper road design is fundamental in order to prevent human errors and to decrease accident risks. Even when mobility grows, Wegman explains, a design which explicitly communicates with the users how to be safely utilized will lead to better safety. Miller (1992) also states that road surface quality, especially the presence of adequate road markings, is one of the main causes of road fatalities. According to him, roads with edge lines and centerlines experience 20% less accidents compared to roads where these markings are absent. Moses (1986) argues that if the visibility of the road markings is improved the single vehicle accidents such as rollover off the lane would drop by 34%. A research conducted by Horberry et al. (2006) concludes that on roads with enhanced road markings drivers tend to obey the speed limit more often. Furthermore they have a better control over the car proven by the relatively little deviation of the vehicle within the lane which was observed. These papers indicate that road infrastructure quality is a key factor in road safety. Addressing road design, will directly translate into addressing road safety.

Among all aspects of road safety literature that is available it can be noted that significant amount of attention has been put on researching the drivers and more specifically the group of 'novice drivers' (aged 18-25 years old, interchangeably called 'young drivers' in this paper). Scientific research on difference in experience, hazard perception and behavior between the novices and their older, more experienced counterparts is presented in the next section.

Novice drivers

According to Williams (1996) the accident risk of the group aged 15-25 is much higher than the risk of any other age group. According to OECD (2006) and Stopher & Stanley (2011) the road fatalities are the biggest cause of death in the group 15-29-year-olds in industrial countries (figure 2). Moreover a report prepared by the WHO (2015) indicates that road death rates of young men are almost three times those of young women (figure3). Research has revealed that the former group is generally more prone to risk-taking, speeding and anti-social behavior than the latter one, indicating that gender is a determinant of traffic accidents.

Figure 2. Road fatalities as a cause of death among 15-29-year-olds.
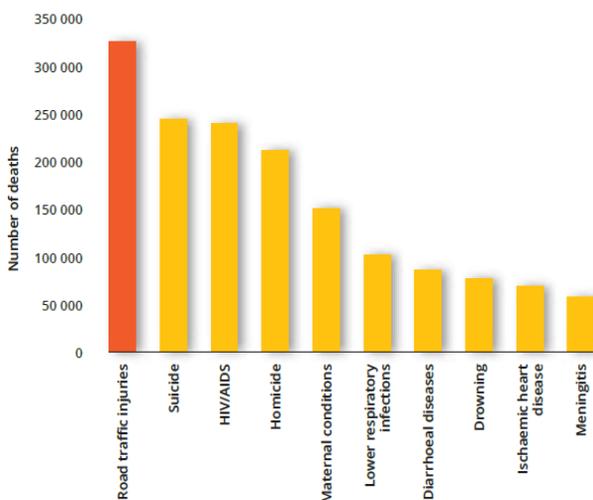
Figure 3. Road fatalities per million population by gender and age
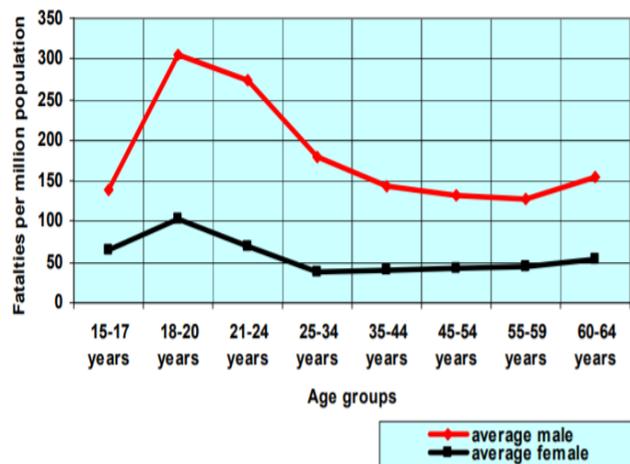
Source: WHO (2015)

Source: WHO (2014)

The high risk of involvement in an accident of novice drivers can be explained by a complex mixture of their age, experience and gender (Wilde, 2013). In the OECD countries the driving age group below 25 represents only 10% of the whole population but accounts for more than 25% of all driver fatalities. MacDonald (1994) shows that in Australia this group is also overrepresented in road fatalities - 16 to 24 year-olds represent 15% of all drivers while they account for 35% of all fatal crashes. Kinnear et al. (2013) give an example with UK, where in 1994 the risk of a young driver to die in a road fatality was 4.5 times that of a driver in the age group 30-59. By the year 2002 this figure rose up to 7 times. Such worrying findings signal that the group of novice drivers requires a special attention when road safety policy measures are being prepared.

In their paper McKnight & McKnight (2003) try to identify whether young novice drivers behave risky on the road due to lack of knowledge or purely due to their maturity level. The authors conclude that experience-related factors are much stronger during the first years of driving than maturity when it comes to driving performance. Twisk (1996) indicates that the learning curve of a driver is what leads to a decline in his/her accidents and on average in UK the likelihood of an accident drops 30% after the first year of experience, regardless of the initial age when the license was obtained. The overrepresentation of 16 year-olds drivers in fatal road crashes in the USA was discussed by Fisher et al. (2006). The findings indicate that the crash rates rapidly decline during the first 1000 miles after acquiring a license. The researchers use an indoor simulator test in order to 'create' risky conditions which most probably will not happen or will be avoided in advance during the learning process before acquiring a driving license. This way the novices could experience risky events and learn how to react on them. The results of the research indicate that compared to similar drivers without such simulator experience, the former group is able to indicate and act upon dangerous situation 52% of the time, while the latter does so only in 28% - a statistically significant difference.

Hazard perception is very important predictor of road accident, according to Brown & Groeger (1988). It represents the ability of the driver to detect hazards on the road and to quantify their dangerous potential. Mayhew & Simpson (1995) show that novices, compared to experienced drivers, perform general driving tasks much worse because they lack adequate hazard perception skills (searching for, recognizing and dealing with dangerous situations). Benda and Hoyos (1983) concluded that young drivers assess traffic hazards based on a single characteristic, so that all occasions that share this characteristic (e.g. wet roads) are considered equally dangerous irrespective of other factors. On the contrary the experienced drivers use a rather multiple characteristics base for assessing road environment which makes it less prone to mistakes. McKenna and Crick (1991); Grayson & Sexton, (2002); McGowan & Banbury, (2004) also researched the topic of hazard perception, arriving at the conclusion that experienced drivers have much faster reaction times to hazards detection due to their developed skills, compared to the novices. Wallis et al. (2007) show that the former group is trained to anticipate road hazards much better than the latter. The research used a hazard perception test in which the experienced drivers responded significantly faster than the young drivers group. The

authors conclude that hazard perception ability is a strong predictor of crash risk and it is susceptible to training.

Smith et al. (2005) research the effect of sleepiness on drivers` performance. The authors conclude that the lifestyle of novices leads them to be more often prone to driving at times that they feel sleepy, mostly during the night.

Warren and Simpson (1976) put forward the problem of experience and risk, named '*Young driver paradox'*. The authors argue that in order a novice driver to be less risky on the road he/she must spend more time behind the wheel, gaining more experience. But when doing so, they expose themselves and the other traffic participants at a higher risk of an accident involvement. A possible solution of this paradox, the authors suggest, is better practice courses and delayed solo-driving age.

The results of Treat et al. (1979) show that the younger and less-experienced drivers have a greater proportion of their accidents due to lack of visual search, distracted attention, speeding and failure to adjust speed to adverse road conditions. The authors conclude that any efforts to reduce road accidents via better initial experience would be far more effective than focus on accelerating maturation. According to Elander et al. (1993) young drivers lack attentional control (devoting the right amount of time to the right action) and they are unable to deal with changing workloads. Mayhew & Simpson (1995) researched the perceptual skill of the novice drivers. The authors found that young drivers display smaller range of horizontal scanning of the road setting, they look closer to the front part of the vehicle, utilize their peripheral vision inefficiently and glance at objects less frequently than experienced drivers.

Boyce and Geller (2002) concluded that a typical characteristic of young driver behavior is higher speeds and closer following when compared to the middle-aged group. According to Harrington and McBride (1970) young drivers receive, per distance travelled, more speeding tickets than do older ones because the former tend to take greater risks when driving.

Alam et al. (2009) state that novice drivers are riskier on the road compared to their experienced counterparts because the former group beliefs that its ability to handle dangerous situations – 'self-assessed driving ability' is higher than what it actually is. This leads to underestimation of hazardous situations and often to an accident (Deery and Love, 1996). According to Gusfield (1991) not only experience is a predictor of road accident but age too. The author discusses the fact that teenagers want to show their autonomy, adulthood and status in front of the opposite sex, leading to more opportunities to engage in risky behaviors.

Sheila at al. (2014) examine the thesis that one of the riskiest behaviors on the road is the performance of a secondary task which the novice drivers appear to be extremely prone to. The authors state that cell phone use or even communicating with a passenger while driving increases the risk of an accident by a factor of 4 because of the delayed reaction times it causes. McEvoy et al. (2005) found that any distracting activities such as

eating, texting, reaching for an object, drinking (non-alcoholic substances) or looking at near-road objects are associated with significantly higher accident risk especially among novice drivers.

Some studies research the topic of driving under impairment but they find contradicting outcomes. Carlson (1972); Lawson et al. (1982); Wolfe (1973) have conducted roadside surveys at night in order to investigate if there is an association between alcohol consumption before driving and the age of the driver. These authors found that young drivers (16-24) are not more likely to drive while impaired relative to their older counterparts. On the contrary Zylman (1975) states that young drivers engage in drink driving more often than the old drivers because the former have more opportunities to combine driving and drinking. In their research (McMillen et al. 1992) show that young drivers, which drive under influence of alcohol or other impairments tend to experience high levels of irritability, sensation seeking, competitive speed and driving-related aggression which further increases their riskiness on the road. The researchers conclude that such illegal behavior is attributable to the specific age of the drivers.

Wasielewski (1984) finds that drivers who do not wear seat belts tend to have more accidents and law violation per kilometer driven. Phillips (1983); Perkins et al. (1984) found that age is positively correlated with seatbelt usage but the results are not straightforward. On the contrary Stevenson et al. (1976) & Wilde (1977) do not find any relationship between seatbelt usage and age.

Auto fleet

The third key factor of road safety is the technical condition of the auto fleet. The topic of vehicle safety got more attention in the last two decades together with the rapid technological advancements in the industry which allowed for safer vehicles. Car occupants represent the single largest group, more than 50%, of all EU road deaths with the majority of fatalities occurring on non-motorway rural roads (EU Commission, 2015). Car-to-car collisions are the single most frequent category of crash. Frontal impacts, followed by side impacts are the two most severe types of accidents (Edwards et al., 2001). The pedestrians are the second largest group involved in traffic fatalities (EU Commission, 2018). According to the report pedestrian road deaths amount to about 20% of all road traffic deaths in the EU each year. Two-thirds of these fatalities happen on crosswalks in urban areas. Vehicle safety is highly correlated with road traffic safety (Thomas et al., 2009). Vehicle design is crucial because the car is the means which transforms the intentions and the abilities of the driver into actions, using the available road infrastructure. A vehicle, designed in accordance with the behavioral and physical limitations of the road users will lessen the probability of an accident taking place, or if it happens, the respective safety systems will alleviate the crash consequences and the injury severity (DaCoTA, 2012). When vehicle safety (vehicle design) is discussed it corresponds to the safety of all road users, not only the passengers of a vehicle. The auto

manufacturing industry heavily invests in safety technologies, which results in significant beneficial outcomes (ACEA, 2018).

Currently the vehicle safety systems are categorized under three groups:

- Preventive (proactive/primary)
- Passive (reactive)
- Post-crash (tertiary)

The crash-preventive devices are intended to avoid a possible crash before it actually happens. Such preventive approaches warn the driver in advance so that he reacts on the adverse situation. If he fails to do so the vehicle autonomously corrects the driving so that no accident takes place. Example of such systems are the daytime running lights, Alcolocks, Electronic Stability Control (ESC), pedestrian detection, Adaptive Cruise Control (ACC), auto braking, etc. (ACEA, 2018).

The group of reactive systems aims to lessen the consequences when a crash happens. Example of such devices are the seatbelts, different types of airbags (side, front and rear, pedestrian airbags) and the metal vehicle structure, which does not allow for the engine to move inside the passenger compartment or the car to bend and crumble during an accident. (DaCoTA, 2012).

The third group technologies, labeled tertiary, aim to help the injured in a car accident by minimizing the time between the crash occurrence and the informing of the rescue services. Such systems autonomously communicate to the respective services the need of help and the location of the accident, without requiring any manual intervention (EuroNCAP, 2018).

There are international safety standards which the majority of the car manufacturers utilize in order to offer their clients not only high quality but improved safety too. The most common vehicle safety rating system is the five-star European New Car Assessment Program EuroNCAP (ACEA 2017). It provides ratings based on the performance of the vehicle in variety of crash tests such as front, side and pole collision, as well as impact with pedestrians (Lie & Tingvall, 2000). The importance of vehicle safety among the car buyers made safety the leading priority when buying a new car (ANCAP, 2012). According to ACEA (the European Automobile Manufacturers Association) road safety is a complex phenomenon, which depends on the combination of various factors such as road user behavior, road infrastructure and vehicle fleet age and safety.
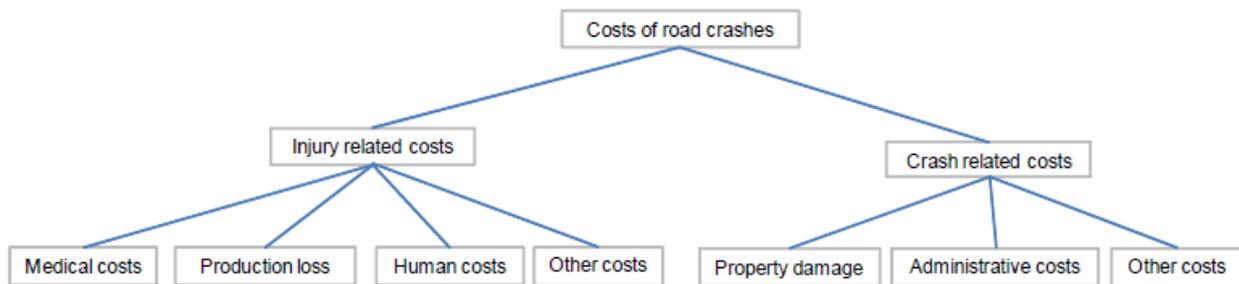
Costs

Jacobs and Aeron-Thomas (2000) evaluate the monetary costs of road accidents stating that on average in 1977 the amount was roughly 1% of the nation`s GNP. The authors

indicate that such cost figures are needed not only to present the economic losses caused by road accidents but also to ensure that appropriate cost-benefit analysis is performed so that resources are efficiently used for specific safety improvements. Although the number of lives lost in road accidents relative to motorization rates (cars per 1000 inhabitants) in high- and middle-income countries indicates a downward trend in recent decades, still the burden of road-fatalities in terms of societal and economic costs is rising (Ameratunga et al. 2006). Wijnen and Stipdonk (2016) conclude that the share of road fatalities` costs as a percentage of the national GDP ranges from 1.5% to 6% per annum. A report prepared by The World Bank (2017) roughly values the costs of road traffic crashes to be 1.5 – 2 percent of the GNP annually across all developing countries.

Hoen et al. (2016) elaborate on the cost calculation methods used in the majority of the European countries. The paper thoroughly analyzes each cost component of road accidents (figure 4). The costs are classified as injury-related and crash-related, further explained below.

Figure 4. Road accident cost components

Source: Wijnen et al. 2016. CE Delft

- *The medical costs* represent the medical treatment expenses needed for hospitalization and medical treatment of the injured;
- *The production loss* corresponds to the monetized loss of ability of the injured to be active on the labor market for the specific time period;
- *The human costs* represent the amount of money people are willing to pay in order to reduce the risk of getting killed in a road fatality;
- *The property damage* figure corresponds to all costs associated with bringing the damaged vehicles and other objects involved in an accident to the state they were before the crash;
- *The administrative costs* are the service costs of the police, ambulance or fire brigade per hour multiplied by the hours they are needed at an accident location;
- *The other costs* integrate the expenses related to congestion, vehicle unavailability, costs of adapting houses to specific needs, funeral arrangement if needed, etc.

The report shows what economic costs a single road accident may lead to, without even mentioning the unspeakable pain, grief and suffering of the relatives which cannot be expressed and evaluated in any monetary terms. In the Netherlands it is estimated that one road death costs €2.9 million and a serious injury costs roughly €310 000. Out of moral and economic perspective it becomes apparent that dedicated approaches towards lessening of the severity and eventually solving the problem are needed.

Table 1. Summary of the Literature review findings

Topic	Author	Year	Main findings
Road Infrastructure	Wegman	1995	High-quality road design can prevent accidents
	Miller	1992	Visible road markings may decrease accidents by 20%
	Horberry et al.	2006	Better road surface improves driver`s control over the vehicle
Novice drivers	MacDonald	1994	Young drivers are overrepresented in road fatalities
	Kinnear et al.	2013	
	WHO	2014	
	McKnight & McKnight	2003	Road accidents rapidly decline after the first years of experiecne, regardless of the age when the license was obtained
	Twisk	1996	
	Fisher et al.	2006	
	Mayhew & Simpson	1995	Novices lack hazard perception skills
	Benda & Hoyos	1983	Novices have worse hazard assessment than experienced drivers
	McGowan & Banbury	2004	
	Smith et al.	2005	Novices are more prone to driving while sleepy
	Warren and Simpson	1976	Novices should undergo better pre-exam training
	Treat et al.	1979	Novices lack adequate visual search and have worse attention control than experienced drivers
	Elander et al.	1993	
	Mayhew & Simpson	1995	
	Boyce and Geller	2002	Novices drive above the limit more often than older drivers
	McBride	1970	
	Alam et al.	2009	Novices are riskier and more agressive on the road
	Deery and Love	1996	
	Sheila et al.	2014	Novices are worse at performing second task while driving
	McEvoy et al.	2005	Novice drivers are easily distracted
	Lawson et al.	1982	Novices are not more likely to drink-drive
	Wolfe	1974	
	Zylman	1975	Novices are more likely to drink-drive
	Wasilewski	1984	Novices tend to put seatbelts less often than older drivers
	Phillips	1983	
	Perkins et al.	1984	
Auto fleet	Thomas et al.	2009	Safer vehicle design translates into road safety
	DaCoTA	2012	Vehicle safety systems lead to less injuries and fatalities
	ACEA	2018	
Costs	Ameratunga et al.	2006	Social and economic costs of road fatalities are rising
	Wijnen and Stipdonk	2016	Economic costs or road fatalities are 1.5% - 6% of GNP/annum
	World Bank	2017	

The main findings of the Literature review section are summarized in Table 1. Based on the scientific literature it can be concluded that road quality is a key factor of road safety. The extensive amount of research on novice drivers indicates that this group deserves

specific attention and analysis when road safety policy is prepared. More detailed examination of the causes of the group`s overrepresentation in road fatalities, lack of hazard perception or proneness to speeding would provide a ground on which effective measures can be implemented. The usage of modern vehicles in the national auto fleet deserves adequate policy addressing because advanced technologies are proved to save road users` lives. Last but not least the costs of road traffic injuries and fatalities are not only immensely high in figures but also morally unacceptable – reasons for undertaking effective approaches towards declining road fatalities and injuries` scope.

The urgent need for lessening the negative consequences of the road accidents throughout the years led to the introduction of two prominent policies. The Swedish policy, which many researchers recognize as pioneering in the field of road safety, named 'Vision Zero' and the Dutch policy named 'Sustainable Road Safety'. Both of them are discussed in the next paragraph.


Road Safety Policies

The Swedish policy, named 'Vision Zero', has played a fundamental role in shaping the modern perception of the term 'road safety' due to its radical departure from many other road safety policies worldwide (Belin et al. 2012). With its innovative approach this policy significantly stands out from many others applied worldwide (Larsson et al. 2010). In 1994 the Swedish Road Administration prepared a short strategy for action in the field of road safety for the years 1994-2000. In 1997 this strategy was accepted and further developed by the government into the national road safety action plan named 'Vision Zero' (Johansson, 2009). The author recognizes three main goals of this policy:

1) *No one to be killed or severely injured in a road accident*;

2) *Precise allocation of traffic accident responsibility*;

3) *Road design and kinetic energy management*;

The ultimate goal of the policy is that "eventually no one to be killed or seriously injured within the road transport system" (Swedish Ministry of transport and communications, 1997). Vision zero is not a goal but rather a guide, a system approach in achieving the optimum state of a road transport system (Tingvall & Haworth, 1999). The paper states that the ethical approach of the policy is that "life and health can never be exchanged for other benefits in the society". From this standpoint it follows that mobility and safety must never be traded against each other. According to Anderson et al. (1997) mobility becomes a function of safety and not vice versa. Safer roads lead to higher mobility while less safe ones correlate with lower mobility achieved by a reduction in the allowed speed. Tingvall

et al. (1999) argue that until 1997, in most countries the legislation was such that the road users were obliged to behave in a way so that road accidents are avoided, hence when an accident takes place there is at least one road user who is guilty. On the contrary, Vision Zero introduced the approach that the designers of the road system are ultimately responsible for the design, operations and use of the transport system, hence the road safety. Road users are responsible for following the rules set by the system designers (Johansson, 2009). Even if they fail to do so and an accident occurs, the system should not allow anyone to be killed or seriously injured. The policy builds upon the human body tolerance of absorbing kinetic energy. "The level of violence that the human body can tolerate without being killed or seriously injured shall be the basic parameter of the system" (Haq, 2006). The biomechanical tolerance of a human body is constant which necessitates for a road- and vehicle-oriented approaches. Figure 5 shows different impact speeds (speeds at which a pedestrian is hit) with the respective probabilities of a fatality as a consequence. It can be observed that for a change of 5km/h (from 40km/h to 45km/h) the probability of a pedestrian fatality raises with 35p.p. (from 25% to 60%). The idea of Vision Zero is to design a road system where the tolerance of human body is not exceeded in case an accident takes place.

Figure 5. The probability of a pedestrian fatality as a function of impact speed
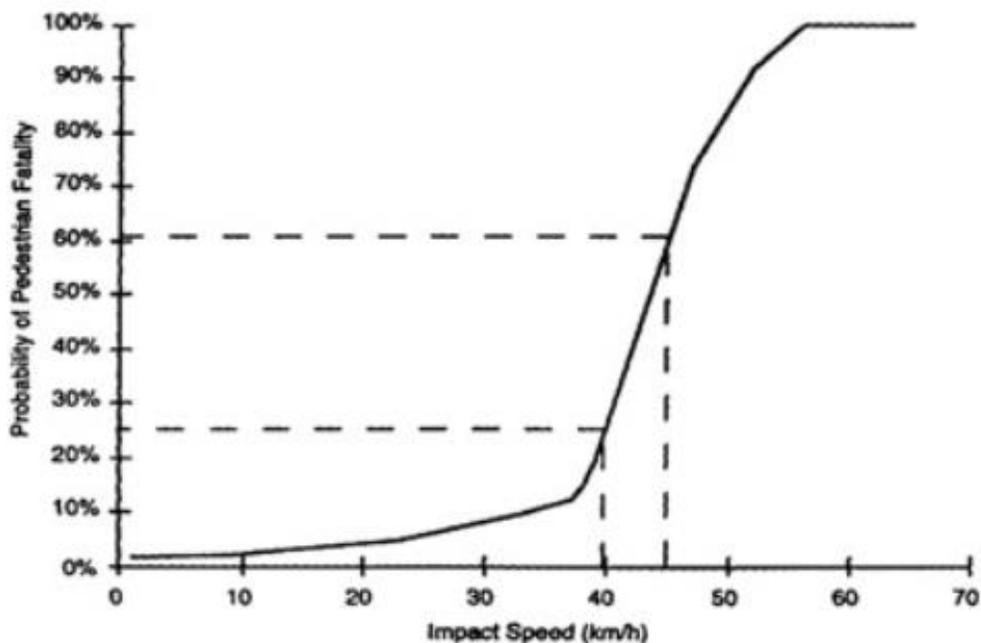
Source: Anderson et al. (1997)

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The innovative approach that the Swedish professionals offered is to manage the kinetic energy. They introduced the concepts of 'Integration and separation of kinetic energy' (STA, 2012). Integration of compatible energy sources and separation of incompatible ones would minimize the chances of a crash happening and even if it takes place, the negative health consequences for the participants will be reduced as much as possible. If a hard physical separation is not an option, roundabouts, temporary separations, bridges, 2+1 roads, tunnels, 30km zones and other design solutions can be applied.

Not only Sweden developed an approach towards decreasing road fatalities. At the end of the 20th century in the Netherlands was introduced the concept of 'Sustainable Road Safety Policy' (Wegman, 1998). The main goal of this policy was to prevent road accidents from happening, and, where this is not feasible, to decrease their severity. The Dutch road safety administration undertook a proactive approach in which human characteristics are used as the starting point: a 'user-centric' system approach. These characteristics refer to both – the human physical vulnerability (as noted in Vision Zero), and to human cognitive capabilities and limitations. This policy takes into account that people are not perfect and sometimes they unintentionally make errors. Moreover, people are not always willing to obey rules and intentionally violate them. By designing a road system which understands and predicts human characteristics and behavior, and by preparing the road user for adverse traffic tasks (via training and education), an inherently safe road traffic system can be achieved. The concept of self-explaining roads is inherent to the Sustainable Road Safety framework (van der Horst & Kaptein, 1996). It presents a framework in which the road 'communicates' with the user how it must be safely used (Herrstedt, 2014). Moreover it must be designed to create adequate understanding and expectations in the driver of the traffic situations, while making it easy for him/her to behave right and difficult to behave wrong.

The literature indicates that these two policies have achieved significant results in their origin countries as well as in many others worldwide, when applied with country-specific adjustments. Vision Zero has been adopted in Canada, United Kingdom, United States and many more, leading to beneficial results in all of them (Vision Zero Network Case Study Series (2017).

So far it was examined the negative social and economic consequences of road fatalities. Moreover the available scientific literature focused on the group of the novice drivers was presented, followed by analysis of two of the most prominent road safety policies applied globally. Up until now the research elaborated on the past of road safety at a global scale while in the following section the focus will be put on its current situation in the European Union. What results have been achieved so far, how the member countries perform as well as their targets and ambitions will be presented.

Road safety in the EU – strategy, trends and results

In 2010 The Council of the European Union set a target of halving the road deaths by 2020 relative to 2010 levels (Adminaite, et al. 2018).The target as well as the actual figures of road fatalities in the EU are presented in graph 1.

Graph 1. European Union absolute road fatalities (2001 – 2017) actual and target values

Source: EU Commission, 2018

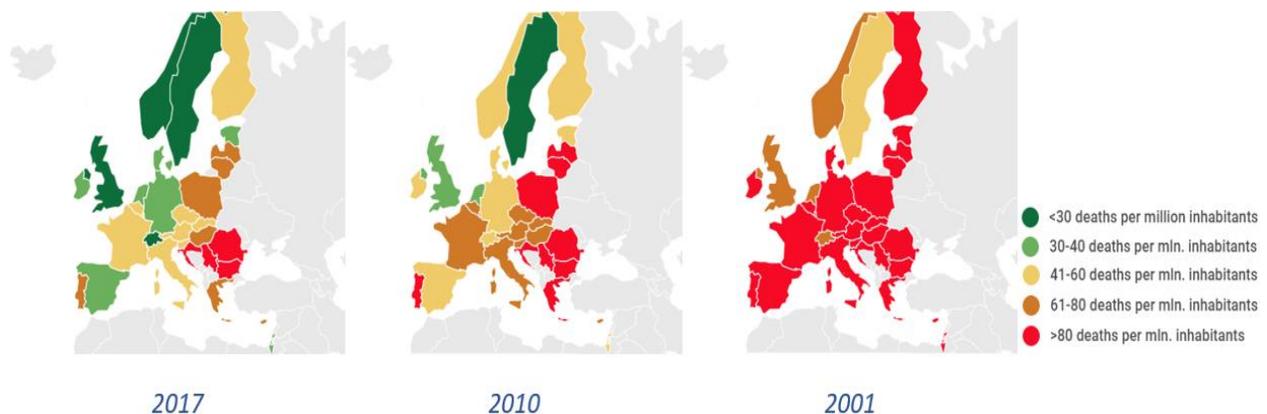Graph 2. Road deaths in the EU members per million inhabitants in 2010 and 2017.
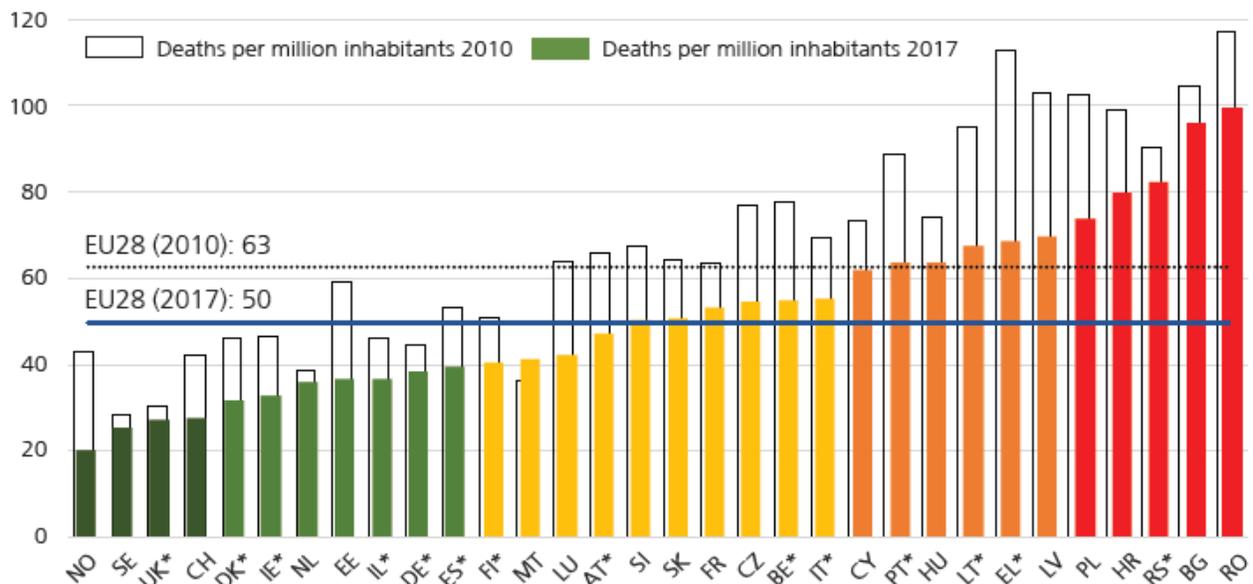
Source: European Transport Safety Council, 2018

Although it is apparent that significant reductions since the year 2001 have been realized, the report on EU Road Safety (2018) indicates that still annually about 25 000 people die and another 135 000 are seriously injured on European roads – a significant gap between actual and target values. The annual socio-economic costs of road fatalities are estimated to be about €120 billion. The ETSC Report (2018) shows what results the EU countries achieved for the period 2010 – 2017 (Graph 2).

It is apparent that overall a decrease in road deaths has been achieved in almost every country for the observed period except in Malta. Moreover it can be noted that the countries with already lowest road fatalities among the EU members (SE, UK, NL, DE) experience stagnation, meaning that they have reached a certain level of reduction, after which they only marginally decrease the fatalities. On the contrary there are countries, which have achieved significant results in improving road safety when compared to their respective 2010 levels. Among the best performers are Norway (NO), Estonia (EE), Luxembourg (LU), Lithuania (LT), Greece (EL), Latvia (LV). The average death rate per million inhabitants used to be 63 in the year 2010, compared to 50 in 2017. Although this is an evident positive result, the target of halving this index is far from achievable within the time window of less than 2 years until 2020. The Valletta Declaration on Road safety (2017) comes with a new and even more ambitious and devoted long-term program for the period 2020- 2030. The goals of the new action plan are to achieve a 50% reduction in both road fatalities and serious injuries by 2030 relative to 2020. Furthermore the Declaration aims to utilize the Vision Zero approach as its guiding framework and to create a strong synchronization of the efforts among the EU member states with common approaches and sharing of best practices. A detailed performance measurement and results-based indicators need to be prepared. The current as well as the future action plan 2020-2030 appear to be very adequate and useful in solving the serious problem of road safety. But it also raises one very important question of whether it is possible to achieve this targets and if not, why. Figure 6 may give the answers to these questions.

Figure 6. Maps of EU road deaths per million inhabitants, 2001, 2010 and 2017

2017   *2010*   *2001*

- <30 deaths per million inhabitants
- 30-40 deaths per mln. inhabitants
- 41-60 deaths per mln. inhabitants
- 61-80 deaths per mln. inhabitants
- >80 deaths per mln. inhabitants

Source: European Transport Safety Council, 2017.

The maps provide a dynamic picture of what results each country in the Union has achieved for 16 years. The best performers move from red colors towards yellow and green while the worst ones, with more than 60 fatalities per million inhabitants, continue to be brown- and red-colored. The map visualizes that in 2017 the worst performers were Croatia (HR), Serbia (RS), Bulgaria (BG) and Romania (RO). According to figure 5 these four countries have worst results in terms of road safety but Croatia and Serbia have about 80 deaths per million while Bulgaria and Romania have 96 and 99 respectively - more than three times the figures of the best EU performers.

Although both countries do not show adequate results in the field of road safety Romania managed to decrease its road fatalities between 2017 and 2008 with 4.9% while Bulgaria did so with only 3.7%. Based on the above-discussed findings this paper will further analyze the road safety situation in Bulgaria. A research of its policies, strategies and achievements in the field may shed more light on why its results are so unsatisfactory. The paper will continue by briefly introducing the country, its geographical position and economic status. Later the road safety strategy, together with detailed analysis of the road accidents of Bulgaria for the period 2009 – 2017 will be presented.

III. Road safety situation in Bulgaria

Bulgaria is a country in Southeast Europe. It has 28 provinces, 110 994km² of territory and population of 7 050 034 people (NSI, 2018). Bulgaria has common borders with Romania to the north, Serbia and Macedonia to the west, Greece and Turkey to the south and Black Sea to the east. The country has a strategic geographic location which turns it into a main transport crossroad (EC, 2018). It affords access to Western Europe, the Near East and the Middle East as well as the Mediterranean which is the reason why five of the Trans European Transport corridors (TEN-T) pass through the country (Appendix 1.1). With GDP of $56 834 million and GDP per capita of $7351 for the year 2016, the country ranks 21 out of 28 member states (Eurostat, 2018; Euromonitor, 2017).

This chapter will analyze the road infrastructure, the auto fleet and the drivers in Bulgaria. The road safety strategy of the country will be discussed, followed by a short conclusion on what targets were set and the results achieved so far.

The infrastructure in Bulgaria

The roads in Bulgaria are classified under two main categories – 'Provincial' and 'Republican' and they differentiate based on the functions they have and the party responsible for their maintenance and management. The provincial category includes municipal and private roads (the latter are left out in this paper due to their negligible length) and are intended to serve accessibility needs on a local scale. This road system allows for the short-distance movement of vehicles. Such are the streets within a village, town or city and the roads, connecting them with the republican roads. The total length of these roads is 19 490km (NSI, 2018). The following map (figure 7) shows what the surface condition of these roads evaluated by the national agency of road infrastructure was in 2015.
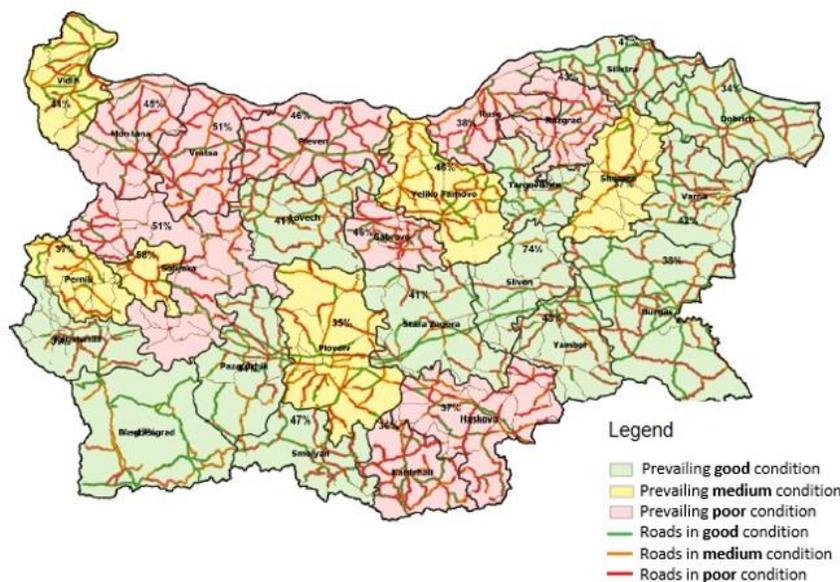

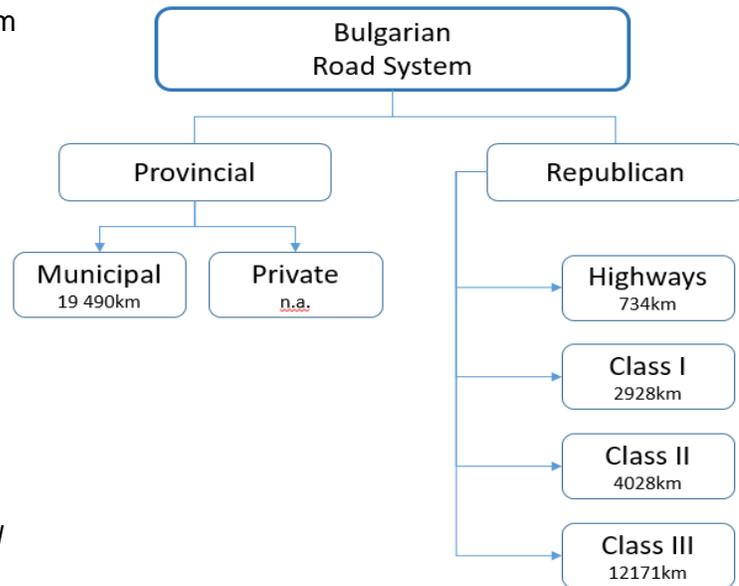Figure 7. The road surface condition of the provincial roads in Bulgaria, 2015.

Source: Ministry of Transport, Information Technologies and Communications, Bulgaria, 2017.

It is apparent that more than half of the provinces are with medium and poor quality road infrastructure. Moreover the roads in poor condition (red lines) are significantly present in provinces, marked with green color, which indicates that the low infrastructure quality is a problem from a national scale.

The republican roads, on the other hand, are divided into four sub-categories (figure 8): Highways, Class I, Class II & Class III. The highways are intended for fast movement of vehicles with at least two lanes, devoted to each direction of movement and a physical separation between the directions. Currently the total length of highways in Bulgaria is 734km (NSI, 2018). The Class I has a total length of 2928km. These roads are meant for transit movement on long distances, mainly between the boarders of the country. Moreover they serve large parts of the country and some of them are a segment of the TEN-T network which crosses Bulgaria. Roads from Class II are intended to serve

movement on medium-length distances and they play a key role in allowing for optimum routes for transit. Their total length is 4028km. Roads class III play a connection role between the provincial roads and the ones of higher class. Furthermore they connect the provinces in Bulgaria with each other and complement the republican road system on a local level achieving better mobility. The republican roads` length amounts to 19861km and the total length of all roads in Bulgaria is 39 351km.

Figure 8. Structure of the road system in Bulgaria

Source: Data gathered from the National Statistical Institute, 2018

Figure 9. Road surface condition of the republican roads in Bulgaria, 2015

Source: Ministry of Transport, Information Technologies and Communications, Bulgaria, 2017.

Figure 9 shows similarities between the provincial and republican roads` surface quality. According to the map only 40% of the republican roads in Bulgaria are considered high-quality roads. The Northwest region has mainly poor quality while in the Southwest prevails good quality.

Road density is one measurement of how developed the road system in a given country is. It represents a division of the country`s total length of roads by its total territory and the result is most often expressed as km of roads/100km² of territory (Trading Economics, 2018). A map presented in the Appendix (1.2) shows that Bulgaria ranked almost last among the EU member states on road density (17.89km per 100km² territory) for the year 2012.

Bulgaria is a country with mountainous landscape and it has relatively high average elevation, compared to the other EU members, ranking 6th with average elevation of 472m above the sea level (Appendix 1.3). The difficulty to build roads could explain the low road density but the quality of the infrastructure may be more important than its length. Except the static evaluation of Bulgaria`s Transport Ministry of the road system quality there are other sources which will provide dynamic picture of how the quality factor develops throughout the years. Such tool is the Logistics Performance Index, developed by the World Bank. This interactive index aims to help countries identify the weaknesses and opportunities they have in their trade logistics. LPI evaluates each country on six criteria, one of which is road infrastructure quality.

Graph 3. Infrastructure LPI score of the countries, listed in the legend.
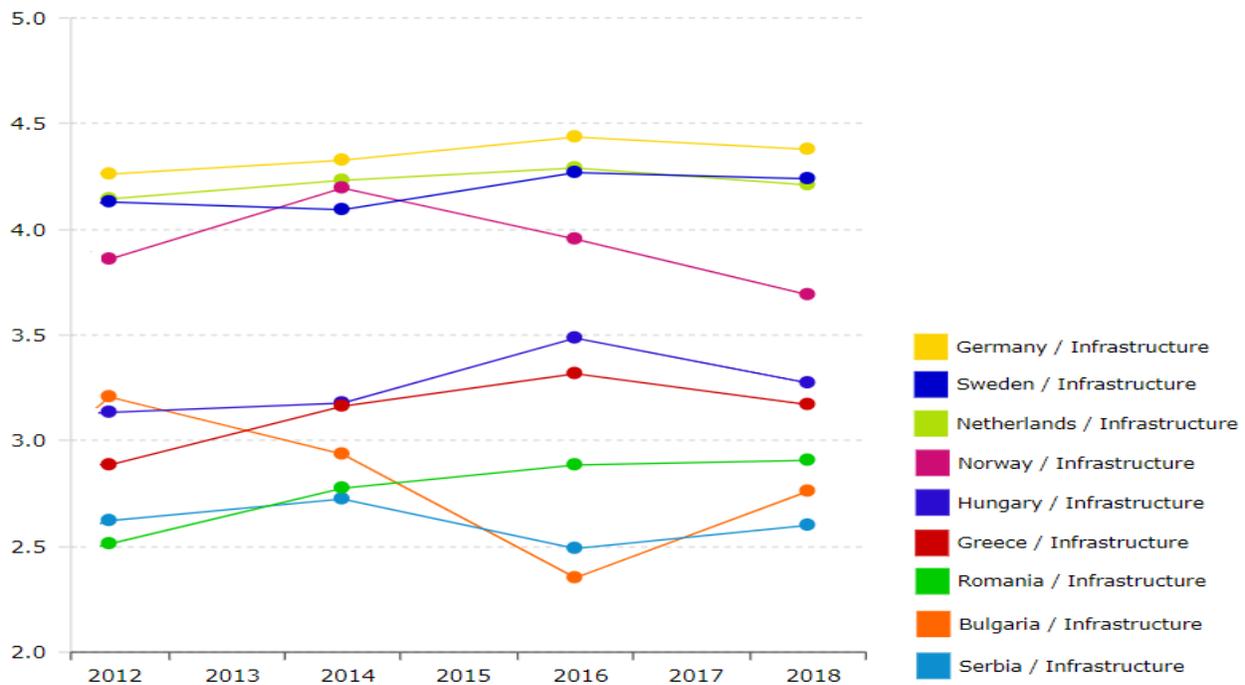
Source: Data from World Bank, LPI, 2018.

Graph 3 presents the Logistics Performance Indices of the countries with the lowest and the highest road fatalities figures in Europe for 2017. The graph shows that Germany is the leader (both among the observed group and globally), followed closely by the Netherlands and Sweden. Norway is fourth in the observed group. It is interesting to note, that these four countries are among the best road safety performers in the EU. On the other hand, the countries with high road fatalities score lower on the infrastructure LPI. Serbia scores worst, followed by Bulgaria, Romania and Hungary. The graph shows that Bulgaria deteriorated its infrastructure score from above 3.2 in 2012 to 2.7 in 2018.On a global scale Bulgaria ranks 64th out of 160 countries. The poor road system quality may be one of the reasons for its current road safety situation.

The auto fleet in Bulgaria

From figure 10 it can be concluded that the largest proportion of the currently active vehicles in the country are vehicles above 20 years old (39%) while the 15 – 20 years old represent 29%. Only 5% are the vehicles aged 5 years or younger. The chart shows that 68% of all motor vehicles in Bulgaria are 15years or older. The average age of the auto fleet is about 18 years. Based on the above-explained safety characteristics of the modern vehicles, and the fact that vast majority of the safety systems are being installed in vehicles after the year 2000 it can be concluded that large portion of the vehicles in Bulgaria does not possess most of the currently available safety systems. From this perspective it becomes evident that a large part of the current auto fleet does not contribute to the road safety but rather deteriorates it.
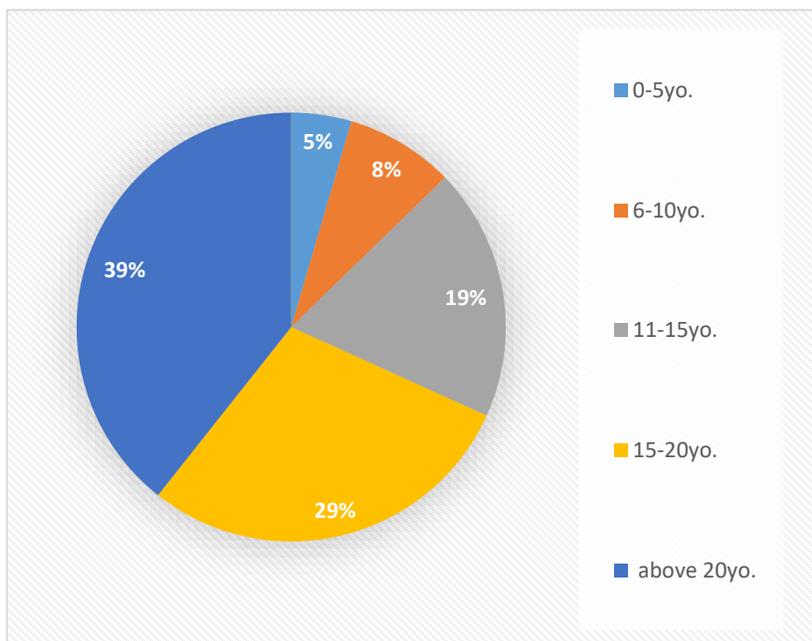

Figure 10. All motor vehicles registered and still in use in Bulgaria by 1st of July, 2017, categorized by age.

Source: Data retrieved from the National Statistics Institute of Bulgaria (NSI, 2018).

It is out of the scope of this paper to examine the reasons which lead to the unsatisfying quality of the road infrastructure or the auto fleet age in Bulgaria but it would be valuable to show what is the correlation between GDP per capita, fleet age and road fatalities within the countries of the European Union. It is a reasonable assumption that countries with higher GDP/capita have both better financial opportunities to invest on an individual level in new cars and on a national level in safer road infrastructure. The following figures show whether this is the case. In the Appendix (1.4) a table with the 28 EU member states with their respective Average fleet age for the years 2006-2015, road fatalities for the year 2017 and GDP per capita for 2017 is presented. From this data it is apparent that Bulgaria has the highest average fleet age among all EU members – 17.6 years. It is important to mention that Luxembourg, Cyprus and Malta have population of less than 1 million inhabitants which means that they can be considered as outliers and their inclusion in the model would result in skewed outcomes. This is why these three countries are left out of the model. A simple regression analysis in Excel shows that, as expected, there is negative correlation between GDP per capita and road fatalities (*road fatalities = 96.6 – (1.114)*GDP/cap*). On the contrary the correlation between average fleet age and road fatalities is positive, suggesting that countries with higher average fleet age experience higher levels of road deaths (*road fatalities = 6.15 + (3.871)*aver.fleet age*).

Graph 4. Correlation between road fatalities, GDP/capita and average fleet age among the countries in the EU, excluding CY, LU and MT.
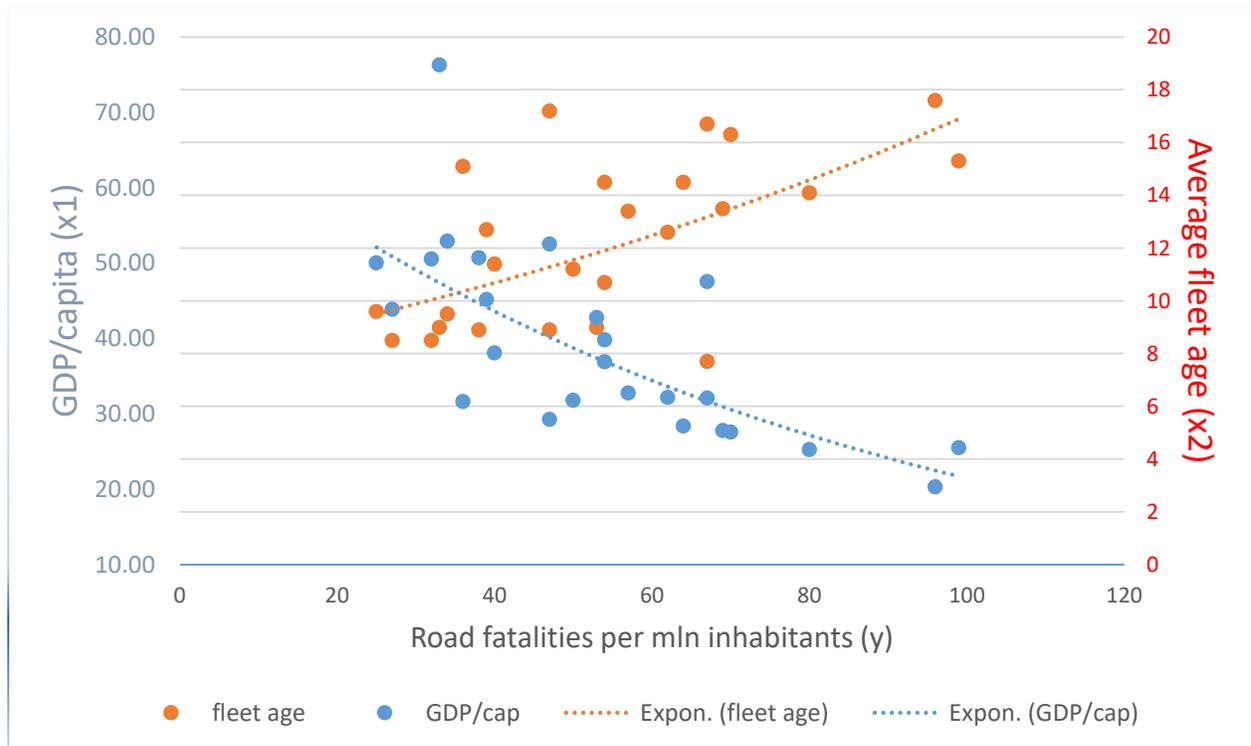

Source: Data sources: GDP per capita: World Bank (2018); Average fleet age: ACEA (2017); Road fatalities: ETSC (2018).

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The graph (No.4) visualizes the two correlations, using exponential trend lines because the effect of the explanatory variables may depend on their respective levels. For example an increase in the GDP per capita from 20 to 30 may have way stronger effect on fatalities than an increase from 60 to 70. The results coincide with the expectations that wealthier countries have lower average fleet age and less fatalities. The research on this topic is out of the scope of the paper but it is suggested for further investigation.

The drivers in Bulgaria

According to the Bulgarian law a person is eligible to obtain a driving license for category B (car) after he becomes 18 years old. The candidate must attend 6 study hours (40 minutes each) theoretical lessons where he is taught the rules on the road in all their aspects. After the participant finishes with this part he must undertake an official exam given by the National Road Policy Department. Once the candidate passes this exam positively he can start practicing on the road with an instructor. The compulsory time that a learning driver must practice is at least 31 study hours (40 minutes each). Once the learner is done with the second part then he goes to an official practical exam, where he is driving while an authorized representative of the National Road Police Department is navigating him and evaluating his performance. If the candidate performs according to the standards and he manages to drive properly for about half an hour, he successfully passes his driving course. After he receives the driving license he is allowed to drive any vehicle of category B on his own, regardless of the vehicle`s characteristics. Although there is no available statistics of the licensed drivers in Bulgaria by age, the following graph (No.5) gives more information about the population in the country. It can be seen that the 'novice drivers' segment, as discussed in the Literature review amounts to 7% of the population (18 to 24 years old).
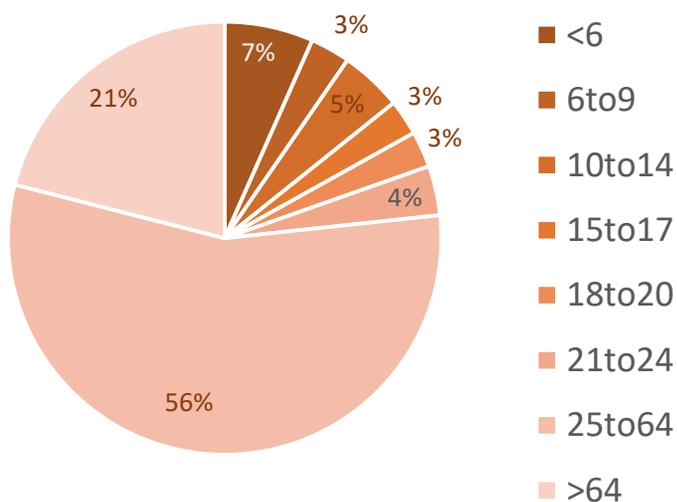
Graph 5. Population in Bulgaria, presented by age category, 2017.

Legend:
- <6
- 6to9
- 10to14
- 15to17
- 18to20
- 21to24
- 25to64
- >64

Source: Data retrieved from National Statistical Institute, 2018.

After the discussion of the three main aspects of road safety and their current situation in Bulgaria the next section will elaborate on the Road Safety Strategy of the country - its targets and current achievements.

Road safety strategy of Bulgaria

The currently active Road Safety Strategy was presented in the year 2010 and it covers the period 2011-2020. In the document it is clearly stated that the government wants to change its model of road safety management. The strategy seems to adopt fundamental principles from Vision Zero and aims to apply them in Bulgaria, recognizing that the human body is easily damageable. Moreover it is stated that we, humans, tend to make mistakes and the system must anticipate this. It is noted that road safety is shared responsibility. Before this strategy was introduced the law was such that when an accident happens at least one of the road users involved did not take necessary actions to prevent it, hence he was guilty. This strategy recognizes that the infrastructure engineers and managers have main responsibility in the road safety. The goal of the strategy is to decrease the road fatalities with 50% and the seriously-injured in a road accident with 20% by the year 2020, compared to 2010 levels. In order this to happen the Government recognizes multiple aspects which need to be addressed (Ministry of Transport, 2010). The Strategy 2011-2020 introduced the measures which the Government planned to implement:

1. *Implement road safety topics within the kindergarten, the primary and the high schools;*

2. *Restructure the driving license courses, extending the learning period;*

3. *Post- driving education, for the ones recently passed the exam;*

4. *Campaigns on informing and changing attitude of the road users about: speeding in- and outside residential areas, drink-driving, pedestrian safety and their right of way, road safety and novice drivers;*

5. *More effective control with special attention to speeding, dink-driving and pedestrian safety;*

6. *Road infrastructure – new manner of engineering and building roads, ideas for self-explaining roads*

7. *Safer auto fleet via Governmental fostering the purchase of new, safer vehicles with high EuroNCAP rating; gradual restriction on old vehicles registration and usage; better annual technical inspections;*

The Strategy recognizes several target groups which require special attention when it comes to road safety. Among them are the novice (young) drivers aged 18-24. Numerous measures such as: stronger emphasis on road safety during the theoretical course, specially-built areas for practicing driving in adverse road conditions, zero tolerance towards alcohol, restrictions for night-driving, restrictions on the vehicle power etc. are suggested in the strategy. The following two figures present what the planned target is and what has been achieved so far.

Figure 11. Absolute and relative (per million) road fatalities for 2002 – 2017 and projected trend for 2010 – 2020.
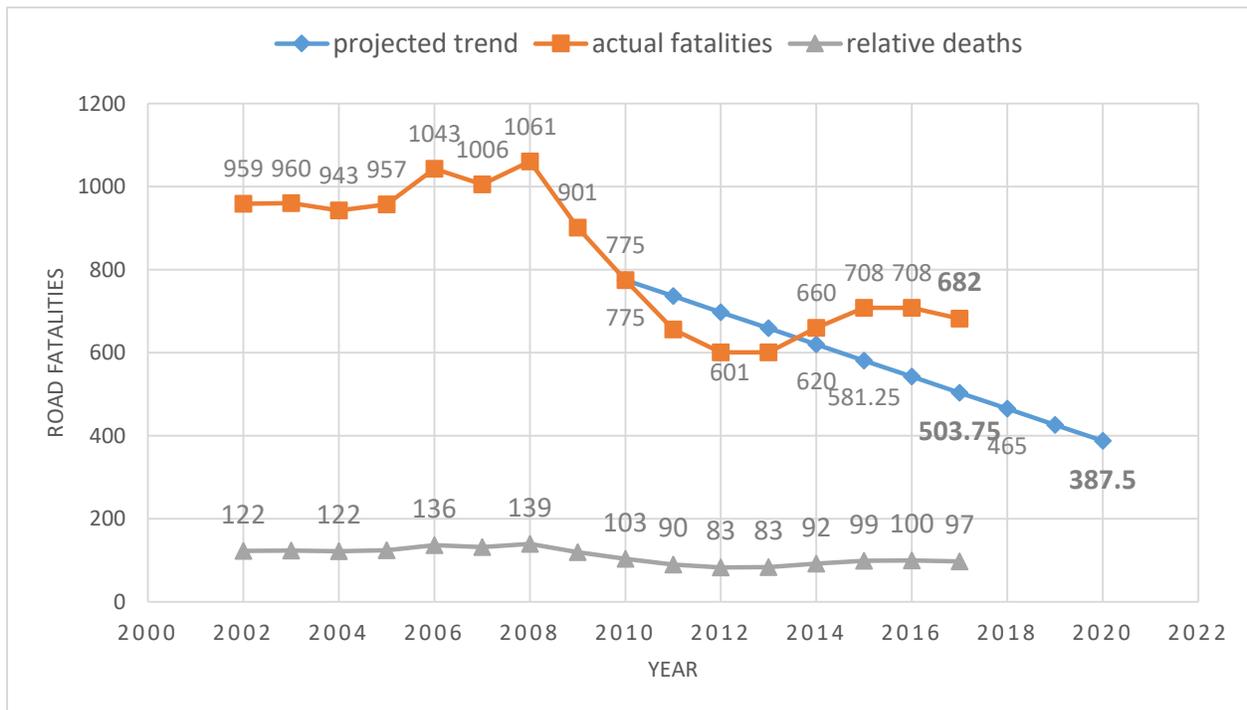
It is evident from figure 11 that the absolute number of road fatalities rose for the period 2002 – 2008 after which it dropped to 601 for the year 2012. Unfortunately it kept rising, to the figure of 682 for 2017. On the other hand the relative road fatalities show much modest decline for the period observed, indicating that actually the problem of road deaths has not been efficiently tackled yet, as the absolute figures may suggest. The blue line on figure 11 represents the absolute road fatalities as targeted by the strategy – a steady decline from 2010 until 2020, to reach the number of 388 by 2020. It can be observed that a difference between the two lines is present (for 2017 about 35%) and the trend suggests that most probably the goal will not be achieved within the remaining period until 2020.

Figure 12 indicates that there was a decline in the absolute number of road traffic injuries from 2008 until 2010, after which a rise was experienced, leading to 8680 road injuries for 2017. The grey line shows that on a relative basis the road injuries for the period 2010 – 2017 rose. The projected trend targets a 20% reduction by 2020 reaching 6460 but the current trend indicates that most probably this will not be achieved. For the year 2017 there is 25% difference between the actual and the desired level of absolute road injuries.

Figure 12. Absolute and relative (per million) number of road injuries for 2008 – 2017 and projected trend for 2010 – 2020
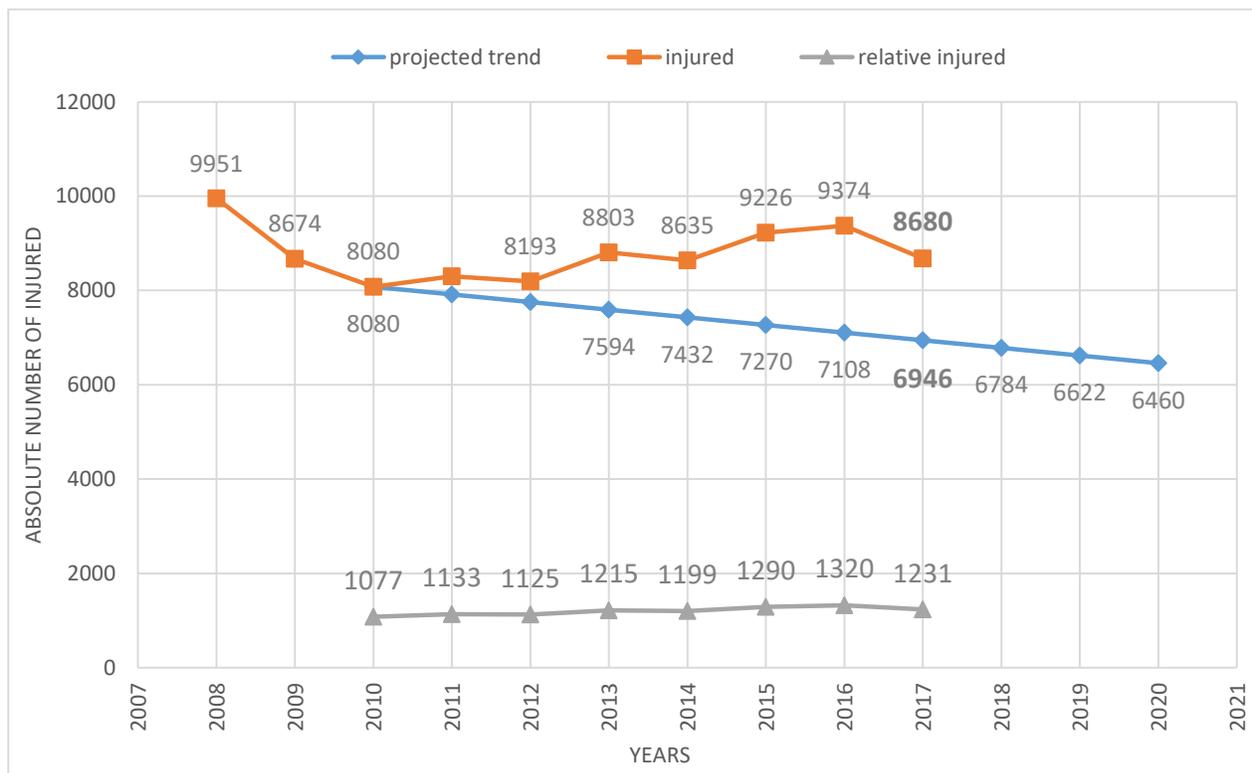

So far none of the planned measures, except No.4 & 5 to some extent, were implemented by the Government. Moreover almost none of the novice drivers` special measures were applied up to date. The lack of action on the planned measures, together with many other factors led to the results of both figures discussed above – the Government does not achieve its goals and most probably will not manage to achieve them by the end of the strategy period. The lack of results leads to enormous costs, both economic and emotional. Mobility becomes too 'expensive' which strongly contradicts with the Vision Zero concept that mobility is a function of safety, and not vice versa. In order to tackle this severe problem a better understanding and analysis of the road accidents is needed. A thorough description of all available data on the past 9 years published by the National Road Police Department will be presented in the next section, based on which trends and main causes will be highlighted and further examined.

IV. Analysis of road fatalities and injuries in Bulgaria

1. Fatalities by day of the week and time of the day

   Graph 6 presents the number of fatalities per day for each year from 2010 to 2017. It is evident the fact that in almost all years observed Wednesday has the lowest fatalities. Monday shows unstable character but towards the end of the day the fatality values tend to stabilize. The values during the work week tend to be relatively low while there is a peak on Friday afternoon and in some years on Saturday noon as well. There is only one exception in the year 2010 where Sunday fatalities are much more than in any other year. On average there have been more fatalities during the weekend than during the work week. There are several possible explanations for this trend. During the work week (Mon-Thu) there is relatively lower number of fatalities because most of the drivers go from home to work and back leaving the long-distance trips for the weekend.

   Graph 6. Road fatalities by day of the week, 2017
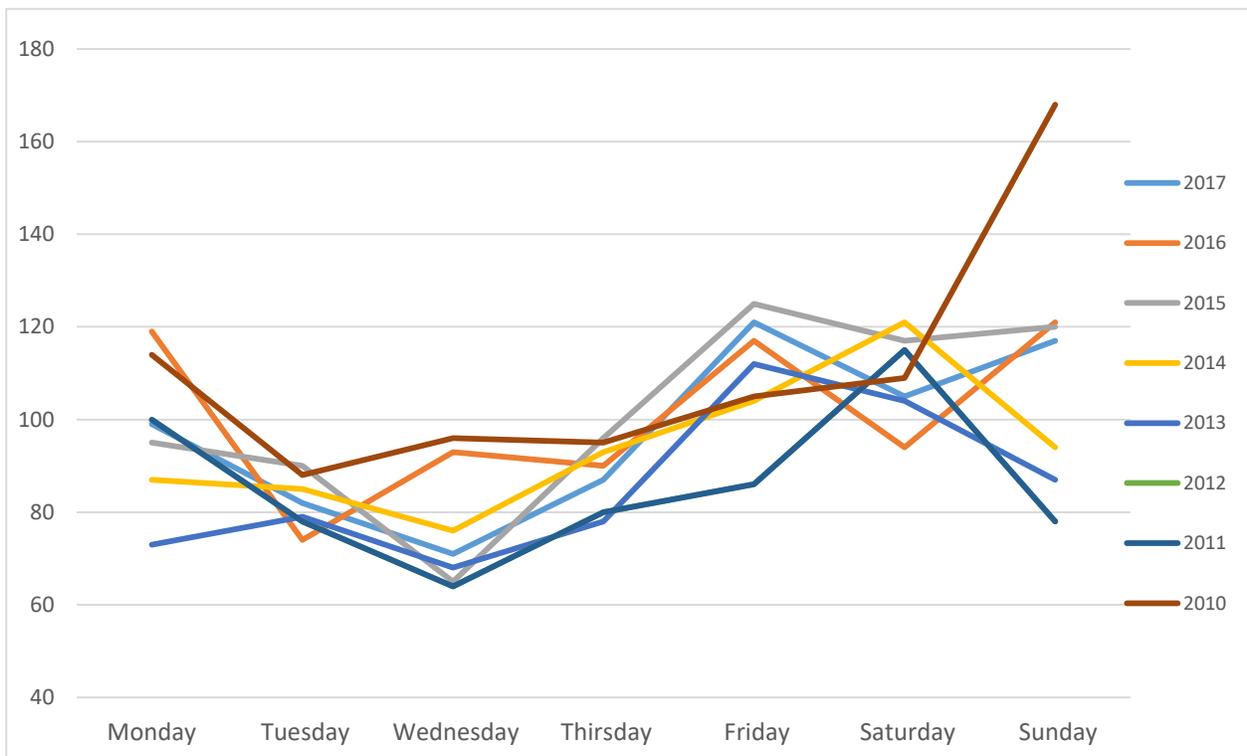
Source: Data obtained from National Road Police Department of Bulgaria, 2018

It is apparent that on Friday afternoon the number of fatalities rises and stays high until Sunday noon after which it declines in some years but rises in others. This Friday-Sunday peak is most probably due to the weekend trips that many people undertake leading to more vehicles on the roads hence higher chance of a fatality. Another plausible reason for the weekend peak could be the prerequisite of consuming alcohol during these days, leading to drink-driving. According to the EU Commission (2018) the distribution of road accidents in Europe has similar Mon-Thu character. The report shows that there is a peak in the accidents early on Saturday and Sunday mornings.

Graph 7. Road fatalities for Friday, Saturday and Sunday by hour, 2017.
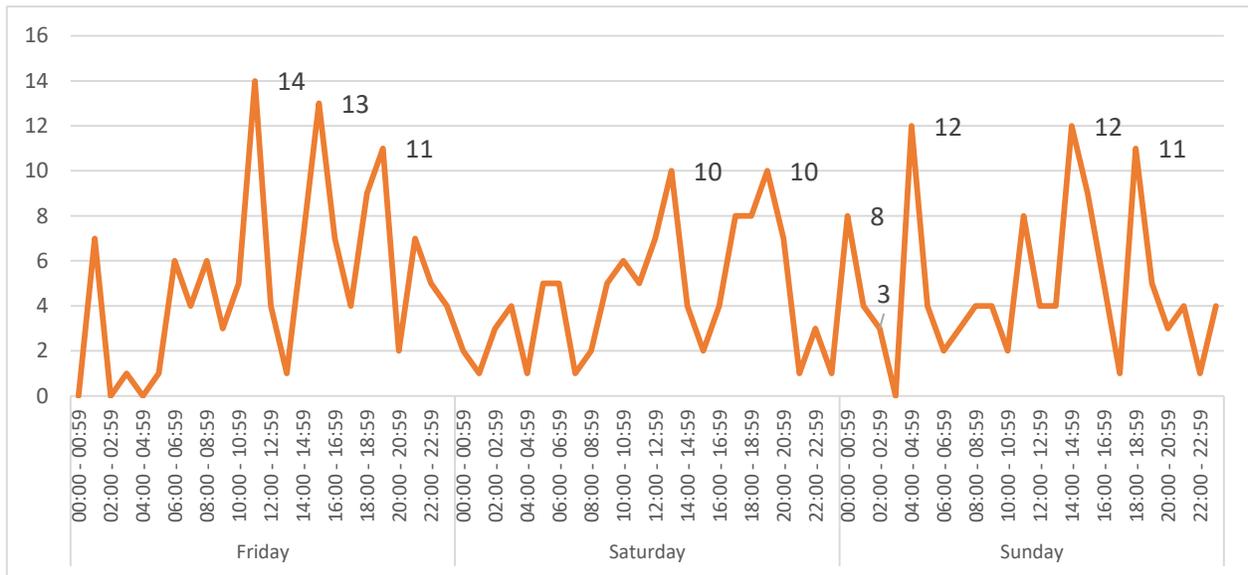
Source: Data obtained from National Road Police Department of Bulgaria, 2018

Graph 7 visualizes the fact that in 2017 the peak of road fatalities was on Fridays, followed by Sundays and Saturdays. There are two peaks of fatalities in Friday and Sunday which are around 14:00 – 14:59 o`clock and 18:00 – 18:59 o`clock. This could be explained by the two waves of weekend commuters which leave on Friday and come back on Sunday. It is important to note that the nighttime fatalities are only few during the work week while Friday to Sunday they rise and barely reach zero. Saturday towards Sunday has the most night deaths throughout the whole week. For 2017 from 00:00 until 05:00 o`clock there are 5 deaths on Mondays, 2 on Wednesdays, 11 on Saturdays and 27 on Sundays. This significant difference is most probably due to alcohol use, tiredness or heavier traffic during that time. According to the EU Commission (2017) in Europe most fatalities happen during the afternoon and relatively few during the night but there is a peak in fatalities early on Saturday and Sunday mornings. Bulgaria fits in the general European pattern in this respect. The two graphs observed indicate that the focus of the Government should be on the rush hours during the week as well as more attention on the weekend trips.

2. Fatalities by gender and type of participant (driver, pedestrian, passenger).

   Graph 8 shows the gender and whether the road fatality participant was driver (Dr), pedestrian (Pe) or passenger (Pa). The most evident result is that for all years observed the proportion of men involved in a fatal crash as a driver is more than 10 times larger than that of women. Actually there are years when male driver fatalities are almost 20 times more than the female fatalities. This result is in line with the overall findings in the Literature review. According to the WHO (2014) male drivers participate 3 times more often in a road fatality then women, especially evident among the young drivers. The situation in Bulgaria in similar but much more pronounced than in the EU. Possible reasons for this difference could be, attention, confidence and focus. The fact that there are more male than female drivers in Bulgaria is plausible but no exact data on this topic is present. The data for pedestrian fatalities also indicates that every year male involved in such accidents are more than female. The third category – passenger shows no significant difference between the two groups.

   The most important message of this section is that male drivers participate about than 10 to 18 times more often than female in a fatality as drivers.

   Graph 8. Road fatalities by gender and type of accident participant
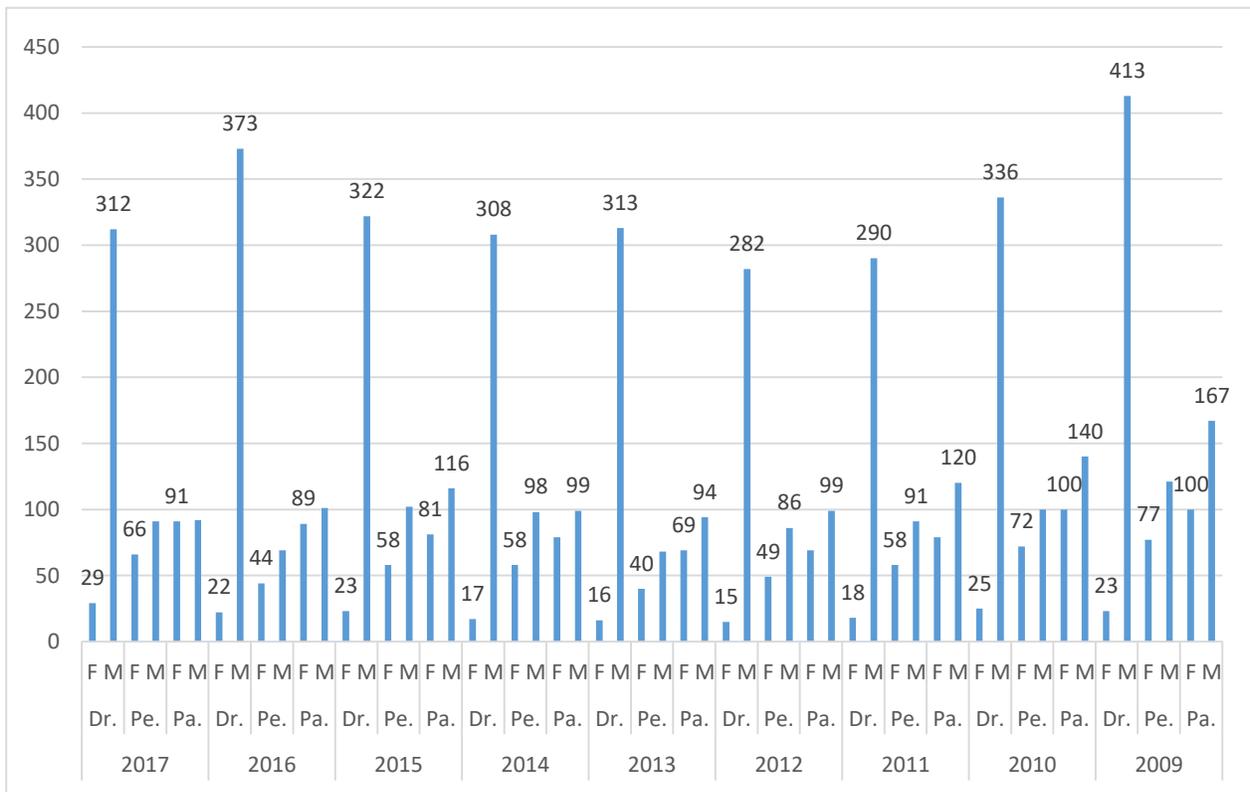
Source: Data obtained from National Road Police Department of Bulgaria, 2018

3. Fatalities by class of the road

   The graph below (No.9), which presents the road fatalities by class of the road for the years 2010 – 2017, shows that most road deaths happened on roads from Class I. The findings are understandable since although this type of road accounts to only 7% of the road system in Bulgaria they are main roads which go from one border of the country to another. Class I roads are the most heavily used in the country. The speed limit is 90 km/h and they are one-lane roads which means that overtaking is done by entering the opposite-flow lane, hence raising the risk of an accident. The next roads on which most fatalities take place are Class 2 and Class 3. Both types of roads represent 41% of the road system in Bulgaria. The prevailing poor quality of these roads and the one-lane design are probably one of the reasons why so many accidents happen on them. Municipal and Freeways share 4th and 5th place which is in line with the findings stated in the literature review. On Municipal roads most accidents happen with speed of about 50km/h which means that the severity of the accidents is slightly lower than on Class 1, 2 and 3 which allow for 90km/h. On freeways, although a maximum speed of 140km/h is allowed it is observed that this category has the lowest fatality rates throughout all years presented. The reasons could be that the length of freeways in Bulgaria is only 2% or the fact that vehicles in the opposite direction flow are physically separated with metal fence. Furthermore there are at least two lanes in a direction, which drastically removes the risk of frontal impact while overtaking, present on the other types of roads. The main conclusion that should be carried away from this graph is what actually makes class 1, 2 and 3 so dangerous and how efficiently to tackle these causes – is it lack of markings, poor quality or illegal overtaking.
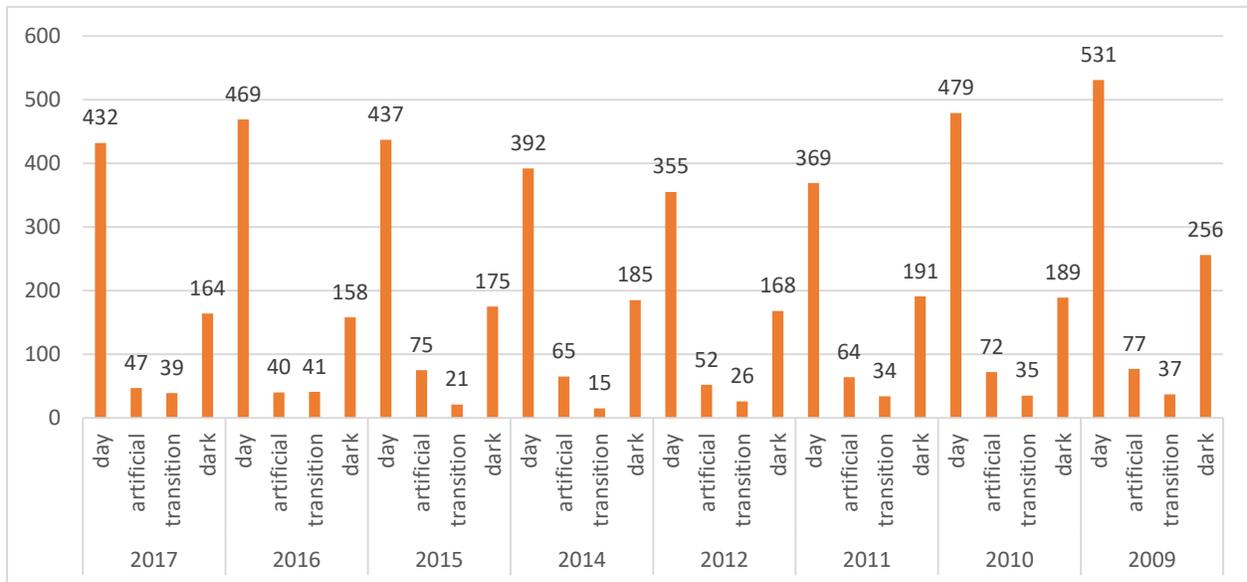
Graph 9. Road fatalities by type of road
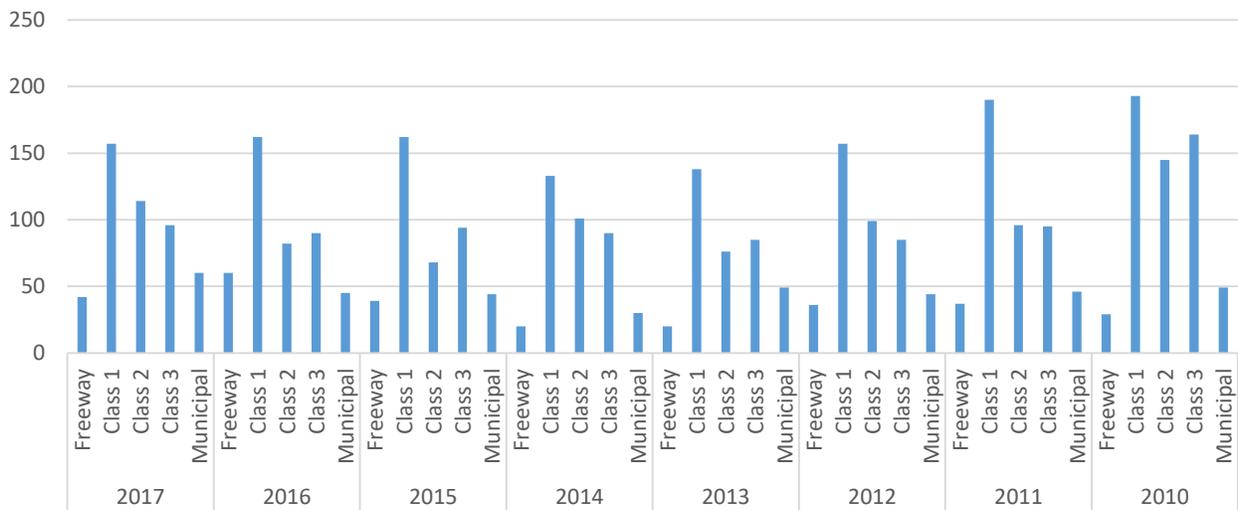
Source: *Data obtained from National Road Police Department of Bulgaria, 2018*

4. Fatalities by type of light

Graph 10. Road fatalities by type of light

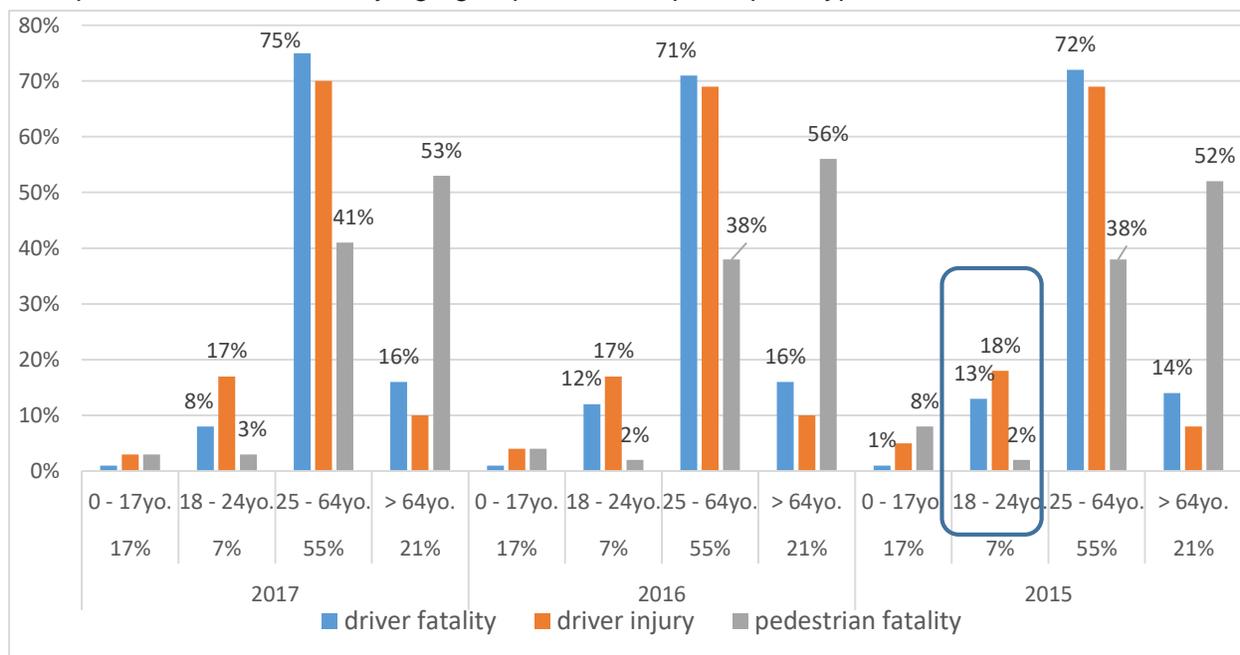Source: *Data obtained from National Road Police Department of Bulgaria, 2018*

Graph 10 shows that most of the fatalities happened during day light - about 60%. This is in line with the expectations because most of the traffic including both rush hour periods is during this part of the day. Fatalities on darkness rank second. Although the traffic is much less during this time of the day, the absence of street lights and road marking on many roads, especially in combination with darkness and adverse weather conditions most probably lead to high percentage of fatalities during the night. Furthermore larger proportion of drink-driving happens during the night. The artificial light source and the transition period are 3rd and 4th. The most important fact of this graph which may be useful for the policy makers is that fatalities during the night are between 22% and 29% of all fatalities. Further analysis on this topic could shed more light on what causes such high numbers of fatalities during the night when the traffic is usually much more relaxed.

5. Fatalities and injuries by age group

According to the scientific literature novice drivers, aged 18-24 years, are disproportionately more present in road fatalities compared to their proportion in the society. The exact graphs for the EU showed that novice drivers are about 10% of the population but represent more than 25% in driver fatalities. It is important to note that not

the whole population is eligible to drive, hence 100% of the drivers do not represent 100% of the population but even when this is taken into account still novice drivers` risk is significantly higher. Graph 11 shows the road fatalities` distribution by age of the participant. The age groups are presented on the x-axis with their respective population proportion as of 2017. The graph presents the years 2017, 2016 and 2015 with the corresponding proportion of each age group in driver fatalities, driver injuries and pedestrian fatalities. It is evident that there is a similar pattern throughout the years observed and it stays relatively similar for all 9 years since 2009 (see Appendix 1.5).

Graph 11. Road fatalities by age group and traffic participant type

Source: *Data obtained from National Road Police Department of Bulgaria, 2018*

It is evident that the percentage of people aged 18-24 in Bulgaria is 7%. The people with driving license in that group are considered 'novice drivers'. In 2017 the novices account for 8% of the driver fatalities and 17% of drivers` injuries. In 2016 the novices accounted to 12% of driver fatalities and 17% of driver injuries – for 2015 the figures are 13% & 18% respectively. These findings are in line with the EU statement of the high risks associated with novices. In the years 2016 and 2015 it is apparent that young drivers are disproportionately more in driver fatalities and injuries. Although the overrepresentation of the group 25-64 is fact, the novice drivers` overrepresentation in relative terms is much higher.
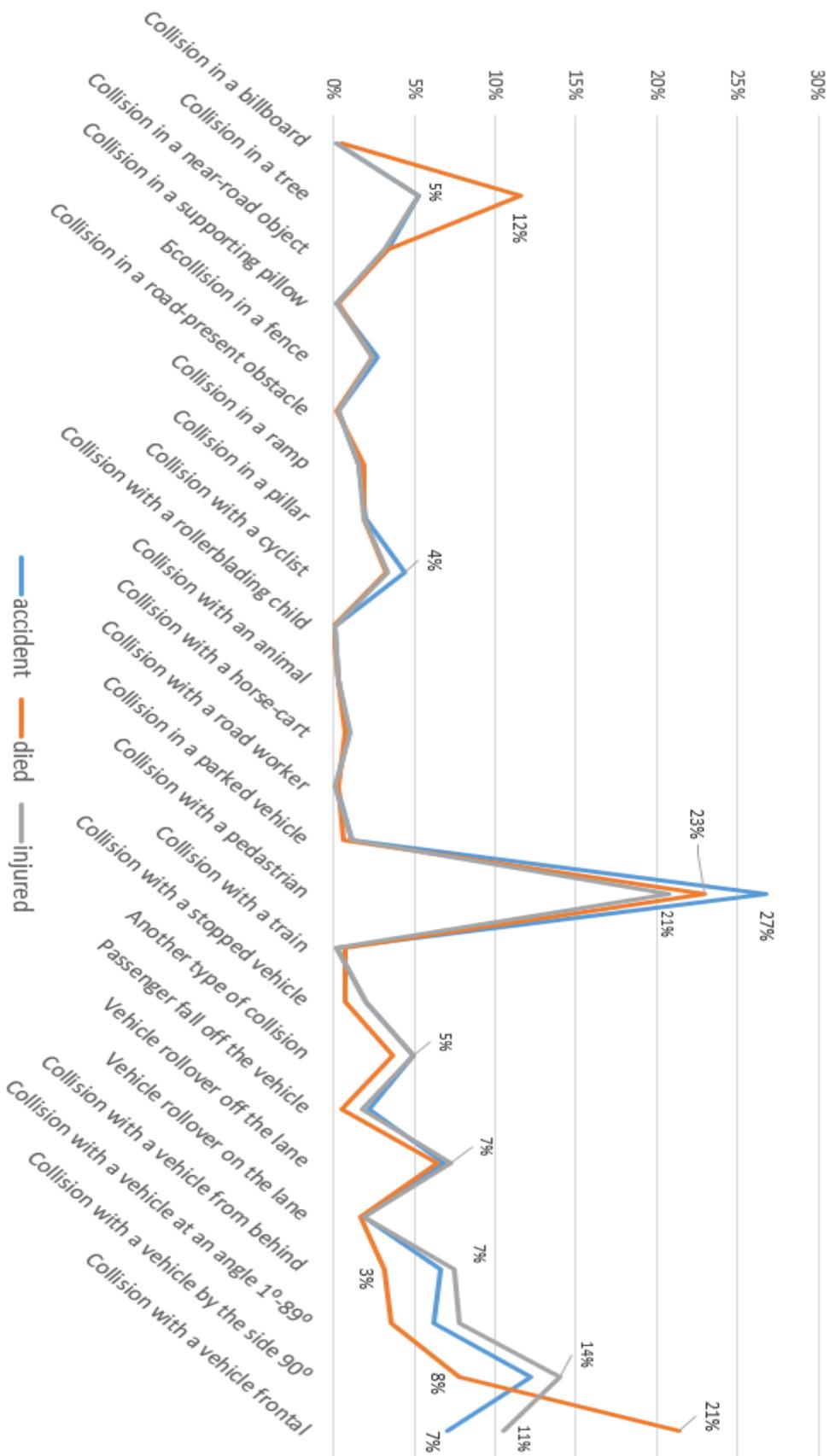
As of pedestrians the group of 18-24 year olds experienced the least fatalities among all other age categories. On the contrary the 64+ year-olds, which represent 21% of the population, account for more than 50% of the pedestrian fatalities in all years observed. The conclusion of these two graphs is that the overrepresentation of the group novice

drivers in the driver fatalities is present which necessitates for additional policy attention. The second important fact is the overrepresentation of the age group 64+ in pedestrian fatalities. This group most probably has some moving and perception limitations, they have slower reactions and worse perception of the overall traffic situation.

6. Type of road accident

Graph 12 presents all categories of road accidents that the Bulgarian Road Police Department uses with the respective road accidents, fatalities and injuries they led to. There are three lines, each representing the proportion of every crash category with respect to all accidents, all fatalities and all injuries. The presented graph observes year 2017 while the other years 2009-2016 can be found in the Appendix (1.5). It is interesting that for every year the results are almost the same, meaning that the severity of each accident type did not change much for 10 years. According to the data 'collision in a tree' accounts to 5% of the accidents and injuries but it is a cause of 12% of all road deaths. This signals that the severity of such accident is very high and in case it happens the probability to survive is relatively low. Possible factors which make a vehicle leave the lane and collide with a tree could be losing control due to high speed, lack of road marking, drink-driving, distracted driving, vehicle malfunction and others. 'Collision with a cyclist' crashes are 4% of all accidents and 3% of all road fatalities. In Bulgaria there are no dedicated cycling lanes, except in the city centers of several big cities. This necessitates the cyclists to ride on the lanes, next to vehicles which highly rises the risk of accident involvement. The next severe accident type is 'collision with a pedestrian'. In the literature review it was discussed that this group of road users is unprotected and in case an accident happens the tolerance of the human body makes them easily susceptible to injuries and death. EU Commission (2018) states that for 2017 in the EU 22% of all killed on the roads were pedestrians. In Bulgaria the 'impact with a pedestrian' crash type accounts for 27% of all road accidents, 23% of all road deaths and 21% of all injured – very similar with the overall EU findings. Based on the data this type of accident is the most severe and it represents the largest proportion of deaths and injuries on the road. It is not clear what part of these crashes happened on a crosswalk but the fact that almost one-fourth of all deaths are due to this cause deserves special attention. 'Another type of collision', which does not give enough information to discuss, leads to 5% of all accidents and 4% of the road deaths. The last four types of accidents are all important contributor to deaths and injuries on the road. Collision with a vehicle from behind, as discussed above, is not the most life-threatening accident but leads to severe injuries.

Graph 12. Road accidents by type of c and severity, 2017

Collision in a billboard
Collision in a tree
Collision in a near-road object
Collision in a supporting pillow
Бcollision in a fence
Collision in a road-present obstacle
Collision in a ramp
Collision in a pillar
Collision with a cyclist
Collision with a rollerblading child
Collision with an animal
Collision with a horse-cart
Collision with a road worker
Collision in a parked vehicle
Collision with a pedestrian
Collision with a train
Collision with a stopped vehicle
Another type of collision
Passenger fall off the vehicle
Vehicle rollover off the lane
Vehicle rollover on the lane
Collision with a vehicle from behind
Collision with a vehicle at an angle 1°-89°
Collision with a vehicle by the side 90°
Collision with a vehicle frontal

accident
died
injured

0% 5% 10% 15% 20% 25% 30%

5% 12% 4% 23% 21% 27% 5% 7% 7% 14% 8% 11% 7% 3% 21%

35

This statement is also supported by the fact that 3% of the road deaths and 7% of the road injuries are due to this cause. Collision with a vehicle from the side and at 90 degrees are also severe crashes, especially the latter leading to 8% of deaths and 14% of the injuries on the road. The most severe type of vehicle-to-vehicle crash is the frontal impact. In this type of accident usually both vehicles move with speed higher than the allowed 90km/h. In Bulgaria, as discussed, the majority of the roads are one-lane which is a prerequisite for overtaking, happening in the lane of the opposite direction traffic. The data shows that this accident type accounts for 7% of all accidents, 11% of the road injuries but it causes 21% of the road fatalities - an indicator of the severity of this type of collision.

If only these categories: 'collision with a tree', 'collision with cyclist', 'collision with a pedestrian', and 'the frontal collisions' were halved this would result in a 26% drop of all road fatalities. Given the fact that in 2017 there were 682 fatalities a 26% decrease would lead to 177 human lives saved.

This graph gave indication of which types of accidents that happen in Bulgaria are the most severe. Better understanding of the road crashes and their causes would be valuable for the policy makers in order to prepare effective and tailored approaches in addressing road safety.

7. Accidents due to driver`s fault

The data on the accidents which happened due to drivers` fault in 2017 is presented in Graph 13. The graphs for 2009 – 2016 can be found in the Appendix (1.6). After the category 'other type of violation', which cannot be further analyzed it is apparent that 'Entering in the opposite direction lane' accounts for 5% of the road accidents due to drivers` fault but it leads to 16% of all road deaths. This violation is in line with the results of graph 8 where frontal impact was one of the most severe causes of death. Entering the opposite traffic lane and eventually participating in an accident may be due to number of factors but most often the reasons are lack of visibility when performing an overtaking, inappropriate assessment of the road environment by the overtaking vehicle, lack of road markings and adverse weather conditions. The next main accidents` cause is irregular driving backwards which leads to 3% of the accidents and 2% of the road deaths. Irregular left turn also leads to 3% of the accidents but apparently it is not very severe as it leads to only 1% of the fatalities. All drivers` faults before tailgating share common proportion in accidents and death causes close to 0.5%. Tailgating on the other hand leads to 5% of the accidents and the injuries and to 1% of fatalities, indicating that this type of collisions are usually not life-threatening but can lead to serious injuries. The violation 'inappropriate speed under road conditions' which means that the driver did not choose a speed such that to be able to prevent a possible accident leads to 19% of the accidents and injuries and it is the largest contributor to road deaths due to drivers` fault - 22%.

Graph 13. Road accidents due to drivers` fault by severity, 2017
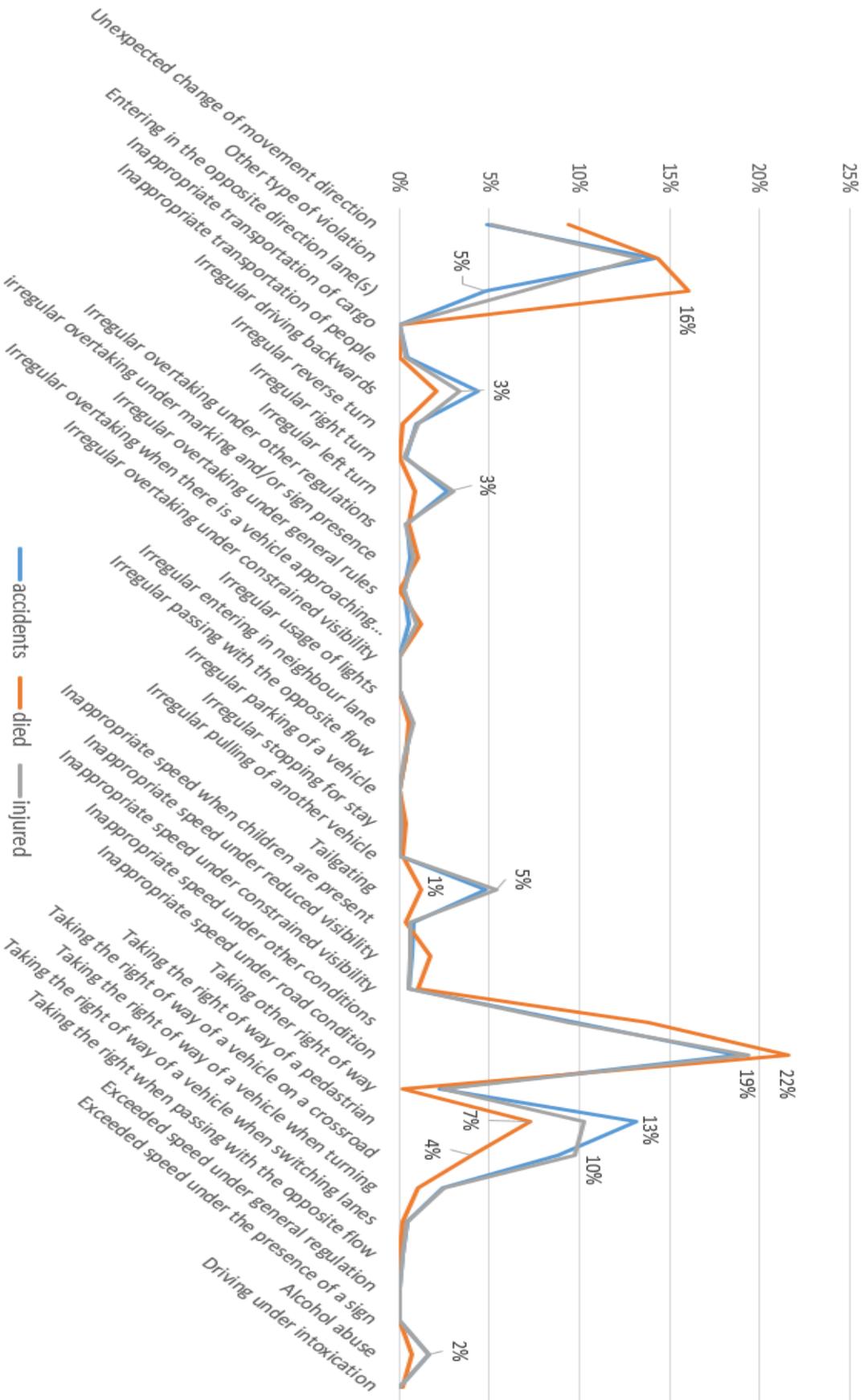
Legend: accidents, died, injured

37

This single cause is closely related to speeding and although it is not known whether the crashes happened in urbanized or rural areas it is a signal that high speed is correlated with more severe accidents. 'Not giving the right of way of a pedestrian on a crosswalk' accounts to 10% of the violations of drivers, 13% of the injuries and 7% of all road deaths. From this data we see that a large proportion of the 'collision with a pedestrian' from the previous graph happened on places where the pedestrians had the right of way. Their vulnerability together with lack of markings and signs, not illuminated crosswalks, speeding in urbanized areas and many other factors lead to this high presence in the fatalities and injuries. The next cause of accident is 'taking the right of way of another vehicle on crossroads'. It leads to 10% of the accidents and the injuries and 4% of the road deaths. Depending on the type of crossroads and the vehicle impact, we can translate this to the previous graph where vehicle-to-vehicle collisions with angle from 1-90degrees appear to be a severe cause of injuries and deaths. In this case, as well as the previous graph it is apparent that these crashes lead to more injuries than deaths which is most probably due to the lower speed with which they happen, assumed they occur mostly in urbanized areas. Alcohol usage leads to 2% of the injuries and 1.5% of the road fatalities. The results of 2017 are very similar to the results of the years 2009-2016.

From this graph it can be concluded that inappropriate speed, followed by entering in the opposite traffic lane and not giving right of way on a crosswalk are the most severe violations that drivers tend to make. The three largest contributors to road deaths account to 45% of all road deaths. It is of a significant importance for the policy makers to know what violations the drivers tend to make in order to prepare effective action plans. A comparison of this graph with the others, presented in the Appendix show that almost nothing has changed regarding drivers` faults severity since 2008. The violations and their significance is almost the same which indicates that the road safety strategy of the Government and their planned actions without clear argumentation fail to show desired results.

Based on the results about novice drivers in the data analysis, which coincide with the literature review conclusions, it would be valuable to further analyze this group of drivers. The fact that they are overrepresented in injuries and fatalities as drivers signals that a specific policy approach is needed for them, but in order to better focus on this group it is needed to understand it. The type of accident and driver violations graphs give a solid base for further research on the most severe causes of injuries and deaths (table 2 summarizes the main findings). As we saw the injuries and deaths statistics of Bulgaria show that the targets are far from achievable. This paper aims to further research the group of novice drivers and to find more information regarding the most severe violations` causes. This way more specific and hopefully effective policies will be prepared and implemented.

In order to further investigate the topic of novice drivers a data specifically on this group is needed. A thorough analysis of the group behavior, attitude, knowledge and perception on the topic of driving and road safety would be of a great value for the policy makers. Although young drivers got most of the road safety research attention worldwide in

Bulgaria the case is rather different. There is no scientific literature on the topic of novice drivers which necessitates for data gathering in the form of survey. The following chapter will discuss how the survey was prepared and conducted. The questionnaire that was distributed is presented in the Appendix (1.7).

Table 2. Summary of road accidents data.

Category	Main findings
By day and time	Most accidents and fatalities happen on Friday-Sunday. Significantly more nighttime accident (23:00 - 05:00) during the weekend compared to Mon - Thu
By gender and fatality	Driver fatalities are 10 to 18 times higher for male compared to female. Relatively more men die as pedestrians than female (about 1.5 times more).
By road class	Most fatalities happen on Class1, followed by Class 2 and 3
By type of light	Most accidents happen during the day and about 2 times less during the night. Given the traffic difference during these two periods night fatalities are relatively high number.
By age	The group 64+ is significanlty overrepresented in pedestrain fatalities. The group of novice drivers 18-24 is overrepresented in driver fatalities and even more in driver injuries.
By type of accident	Collision in a tree, with a cyclist, with a pedestrain, vehicle rollover off the lane as well as the four types of vehicle-to-vehicle collision are the most severe.
	The frontal collision between vehicles leads to most fatalities
Due to driver's fault	Most severe types of violations which lead to fatality: Entering the opposite direction lane, irregular left turn, tailgating, inappropriate speed, taking the right of way of a vehicle/ pedestrain; alcohol abuse

V. Case study

Data gathering

In this section will be discussed the manner via which data on novice drivers in Bulgaria was gathered. The structure of the survey, the type of questions and the distribution channels will be discussed in the following paragraphs (see the survey in Appendix 1.8).

The results of the scientific literature on novice drivers suggest two main statements:

1. '*Novice drivers are riskier on the road due to their lack of knowledge and experience*' to which the authors offer better pre-exam education and delayed solo-driving.
2. '*Novices are much more dangerous on the road due to their maturation level and overconfidence*' In this case the researchers suggest stricter sanctions and rules such as zero alcohol tolerance, driver-related insurance and vehicle power restrictions for young drivers.

It becomes evident that there are two general options for novices to become less risky on the road – better preparation and more experience or drive under stricter rules. Stemming from these findings the survey, uses four types of questions which are expected to provide enough information based on which assessment and conclusions can be made.

The first group of questions is on the topic - '*personal beliefs and attitude'.* These questions aim to understand how the survey participants assess their driving skills, how acceptable do they believe specific traffic violations are and how often they do them. For example the group of questions like: "*How acceptable, do you personally believe, it is for a driver to drive without wearing a seatbelt"* aims to show the personal attitude of the driver while "*How often in the past 30 days did you find yourself driving without a seatbelt"* would provide information on the actual behavior of the respondent. A comparison between believes and willingness will allow for specific problems to be found. The literature suggests that young drivers tend to overestimate their driving skills which has also been addressed with a question. Speeding was found to be highly correlated with young drivers which is included as a question. The final question of this group asks the respondent to show whether he believes that all necessary road safety aspects were practiced and well-presented to him during the theoretical and practical courses so that he felt completely prepared for solo-driving.

The second group is '*general knowledge'* questions, which are based on safety practices and general truths on the topic of distance keeping with the car in front. The literature concluded that tailgating is a common violation among the novice drivers and the answers of these questions would shed more light on what is the situation in Bulgaria.

The third group of questions is on the "*practical knowledge"* topic. It was shown above that largest amount of road accidents and fatalities was due to not giving the right of way to other road users such as drivers, pedestrians, cyclists etc. These questions ask the respondent to state the right of way, based on images presenting different road situations with at least to road users. The pictures were taken from Dutch books for driving theory preparation that are used nowadays. They are colorful and show all necessary information in order the respondent to be able to assimilate the traffic situation and answer correctly.

The last group are "*Personal info"* questions which would allow for further segmentation of the respondents based on years of experience, gender and age.

The survey contains 15 questions in total. It was translated in Bulgarian language because the only target group is Bulgarian novice drivers. The questionnaire was prepared in the online platform "Qualtrics" which gives the opportunity for online distribution of the survey. The manners in which answers were collected were on-street and online. The on-street responses were gathered in two of the largest cities in Bulgaria, located in the east and the west side of the country – Varna and Sofia. Before participation in the survey the potential respondents were asked whether they have driving license and whether they got the driving license more than 7 years before the day being asked. According to the literature review the group of 18-25 year-olds are considered as young drivers so potential survey takers which did not have a driving license or the ones with more than 7 years of experience were not surveyed. On-street surveying in Varna took place for three days (5th, 6th and 7th of October, 2018 between 13:00 and 18:00) nearby the universities and on the main pedestrian areas in the city. The manner of collecting answers was by providing the respondent with a tablet where electronically he/she could anonymously fill the answers in. The use of tablet eased the responses collection, it allowed for anonymity and it directly recorded the surveys taken in "Qualtrics". In this way a real-time data about the number of conducted surveys as well as easy online data analysis later was ensured. Most of the people asked, after short introduction about the topic of road safety survey and its importance, were willing to participate. The next three days (8th – 10th of October, 2018 between 11:00 and 17:00) responses were being gathered in Sofia. Again several universities were visited as well as main pedestrian areas. Mostly students or recently graduated students participated in the survey. The response rate was again relatively high. Meanwhile since 5th until 25th of October, 2018 the online link of the survey was send to my friends, friends of my friends and it was posted in two social media groups of young drivers. The different ways via which answers were gathered allowed for more diverse and random sample. On 31th of October the survey was canceled, so that no more answers could be collected. By that date 126 responses were collected which will be the sample size used in this paper.

After having discussed the manner via which the responses were gathered the next section will elaborate on the findings of the survey.

Survey analysis

Graph 14 shows the driving experience of the participants in the survey. It can be observed that 25% of the surveyed have 3 to 5 years of experience while 24% of them - 5 to 7 years. Experience of less than six months have 12%, six months to one year are

7%, one year to two years of experience represent 13% of the surveyed and two to three years are 18% of the sample. There are respondents from all novice categories which contributes to the randomization of the answers.

Graph 14. Distribution of driving experience of the respondents.
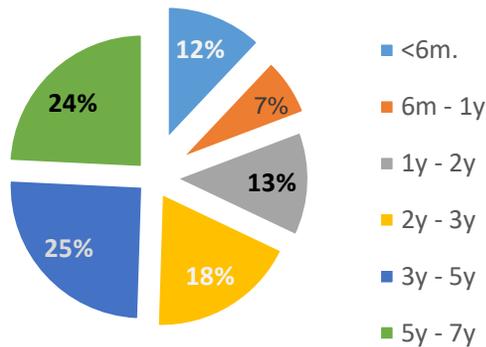
Graph 15. Age distribution of the respondents.
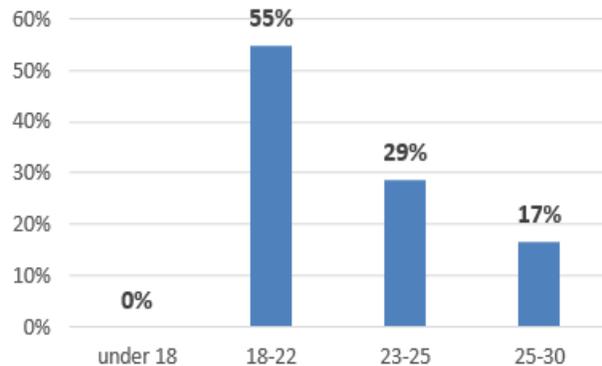
The gender distribution of the surveyed shows 64% of male and 37% of female. There are no respondents below the age of 18. The group of 18 – 22 year olds are 55%, 23 to 25 year olds - 29% and the group of 25 – 30 year olds represent 17% of all respondents (graph 15). It is evident that answers were collected from all age and experience levels which the novice driver category includes.

Question 2 and question 7 aim to show what knowledge on '*right of way*' traffic situations the participants have and how adequate their preparation is. Question 2 visualizes a situation in which there are three road users coming at the same time to a junction. The respondents are asked to answer who has the right of way, starting from the first road user. The traffic situation is rather complicated because there is a bus, a car and a bicycle. The crossroad is not regulated by traffic light but there are well-visible traffic signs regarding priority. It becomes evident that the bicycle and the bus come from a road with priority, while the car does not. The bike is on the right side of the bus which means that the first who has to pass is the bicycle, followed by the bus and lastly passes the car. The responses to this question show 85% correct answers against 15% of wrong ones.

Question 7 presents a situation in which at the same time a bicycle and a car approach a T-shaped junction without traffic light. It is evident from the sign that both road users approach intersection with equal roads. In this case the bicycle, which is on the right side of the car, has to go first. The results show that 57% of the novices surveyed chose the right answer while 43% got it wrong. These two questions are significantly important because as we saw in the previous section vehicle-to-vehicle side collisions lead to high numbers of injuries and fatalities in Bulgaria. Good understanding of the traffic signs and the traffic rules is crucial for ensuring safe journeys. The value of this theoretical knowledge becomes highly visible on non-regulated crossings or junctions without the

presence of traffic light. The findings of the two questions show that, especially in the latter case, still a large percentage of the respondents make crucial mistakes which could be fatal if they happened in real life situation.

Question 3 aims to show how successful and effective was the Government in realizing its goals of conducting numerous campaigns on the topic of road safety in Bulgaria. A successful campaign with a clear message is expected to be well-remembered and understood by the target audience. Sixty percent of the respondents indicate that they have seen a road safety advertisement (campaign) in the mass media in the past 1 year (graph 16). Nineteen percent of the surveyed respond that they have not seen such a campaign while 21% are not sure whether they have seen such or not. This results show that at least 40% of the respondents have not been effectively reached by any long-lasting message on the topic of road safety. A more dedicated and advanced approaches towards this goal of the Government are needed in order to benefit from the advantages of such campaigns.

Question 5 examines the confidence level of the surveyed on two traffic situations – driving on a snowy road and driving in intense traffic on a highway (graph 17). The results for snowy roads show that 6% of the surveyed are 'not confident at all' while on a congested highway they are only 3%. 'Not very confident' on snow are 25% of the responses while the answers for highway are 13% - almost two times lower. 'Somewhat confident' on snow are 16% and in heavy traffic – 11%. 'Confident' and 'very confident' categories show 39% & 14% on snowy roads and 37% & 36% on heavy traffic respectively. It is evident that very confident on highly congested highway are almost two-times more that these on snowy roads. It can be stated that the confidence levels are relatively higher for highway traffic compared to the snowy conditions where majority of the respondents is somewhat confident and not very confident in its skills.

Graph 16. Distribution of the answers regarding a road safety campaign.
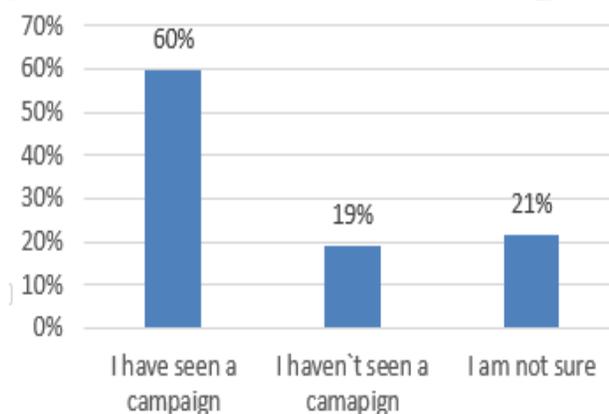
Graph 17. Distribution of the answers regarding confidence to drive on snow and in heavy traffic..
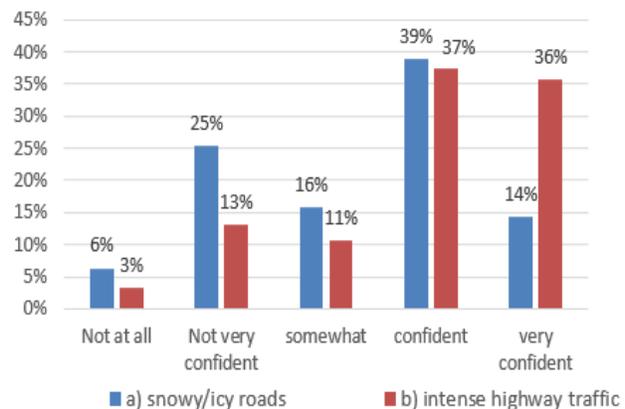
Graph 18 visualizes that 90% of all respondents consider themselves about the same level as most drivers or better than them. Out of all novices surveyed 21% indicate that they are 'much better drivers' than the rest. For 'somewhat better' consider themselves 33% of the surveyed. 'About the same' was answered in 36% of the cases. Only 7% believe that they are 'not as good as the other drivers' while 4% consider themselves for 'much worse drivers'. Is it interesting to note that compared to the previous question where large portion of the drivers were not very confident in their driving skills on adverse traffic conditions these answers show that their overall perception for their performance on the road is relatively high. Question 8 aims to understand the attitude of the surveyed drivers towards speeding. The respondents are asked to indicate how many kilometers above the speed limit they feel it is okay to drive in residential area and on a highway. The results, presented in graph 19, show that 31% consider 0km/h above the limit in a residential area to be acceptable for them while 10% chose this answer for a highway. For the option 1-5km/h above the limit in residential area voted 40% and on a highway - 6%. The third category of speeding with 6-10km/h in residential area was chosen by 25% and by 29% for the highway question. 11-15km/h above the limit is acceptable in residential area for 5% of the surveyed while 27% of them chose this answer for a highway. The last category of more than 15km/h was considered from no one to be acceptable in residential areas while this category got 27% of the answers concerning highway.

Graph 18. Distribution of respondents` self-assessed driving skills.
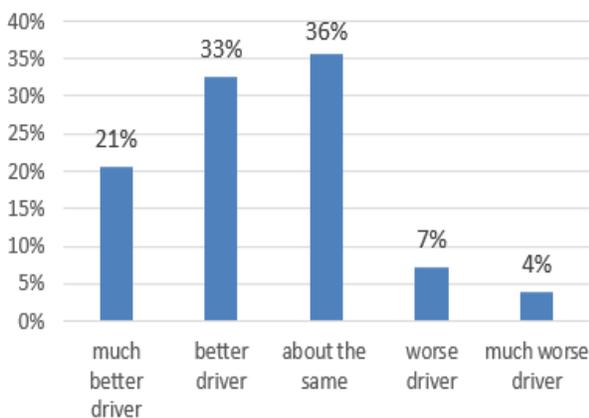
Graph 19. Acceptable speeding in residential area and on a highway.
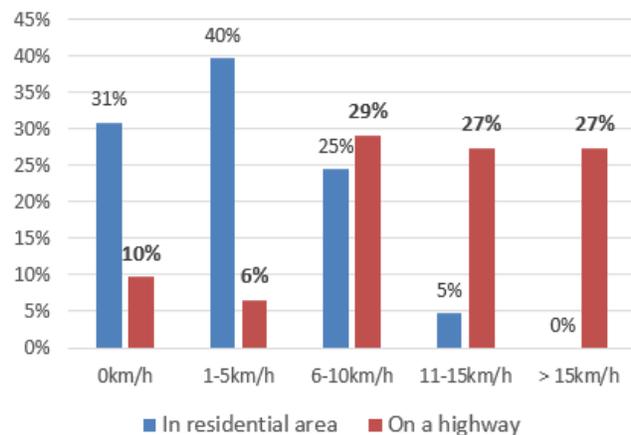
The findings present several tendencies. Firstly there is a clear positive attitude for speeding in both cases among the respondents. It is evident that the speeding in residential areas is largely acceptable in the range 1-5 and 6-10km/h above the limit (65% in total), while speeding on a highway is clearly preferred in the speed range 6-10, 11-15 and above 15km/h (total 83%) of the responses. The findings are in line with Boyce and Geller (2002) who state that novice drivers tend to drive above the speed limit. As discussed earlier one of the most severe types of accidents happen in urbanized areas

such as collision with a pedestrian and collision with a cyclist. The accidents due to driver`s fault also indicate that inappropriate speed is the most severe road fatality cause in Bulgaria. Speed is a crucial factor in road accidents and these findings show that novices actually do tend to drive above the limit. In the Literature review it was shown that an increase of the speed from 50km/h to 60km/h raises the chances of a potential fatality in collision with a pedestrian, to almost 100%. In the results it is apparent that 30% of the respondents consider residential area speeding in the range of 6-15km/h for acceptable which indicates for serious problem. Although on the highway the road environment is designed for relatively high speed still driving with 6-15km/h and even more is a violation of the law and severely deteriorates the road safety. Both cases observed find that actually the surveyed novices, as expected, tend to drive above the speed limit.

 Question 9 addresses the topic of the quality of the driving courses in Bulgaria (graph 20). The respondents are given two affirmative statements to which they have the option to respond in five ways from 'strongly disagree' to 'strongly agree'. The first statement discusses the theoretical course before acquiring a license: '*Throughout this course the respondent got a thorough and adequate knowledge in order to undertake safe journeys'*. The results show that 21% of the surveyed strongly disagree with this statement, 22% - disagree and 16% have neutral opinion about it. Among all surveyed 35% agree and 6% strongly agree. In total 59% of the novices surveyed have neutral to negative opinion about this statement. The results signal that in general the respondents do not have positive opinion about the driving theory course as they are expected to have. The theoretical course is one of the two phases after which a license is obtained. If the novices show negative attitude and do not find what they were taught for valuable and adequate, then specific improvements should be made in this direction.

Graph 20. Respondents` opinion about the theoretical and the practical driving courses.
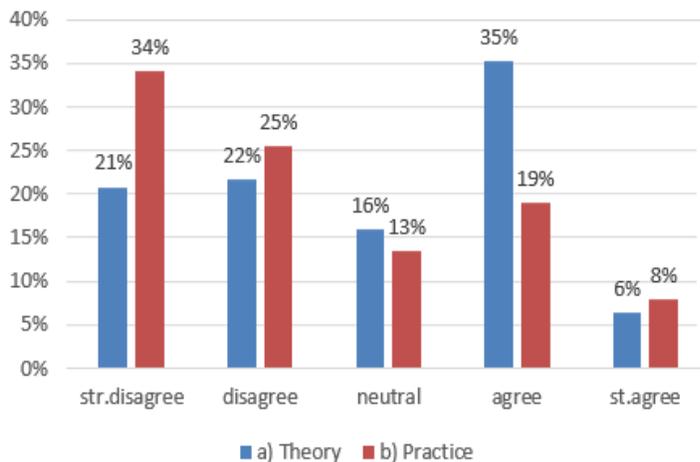
Graph 21. Opinions about attending a refreshing driving course.
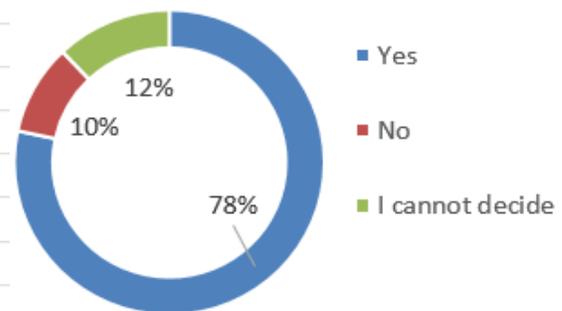
The second statement was that '*during the practical course before acquiring a license the respondent managed to practice different dangerous situations so that he was fully prepared for solo-driving*'. In this case strongly disagree was the answer of 34% of the surveyed, 25% disagree and 13% chose the answer neutral (graph 21). Towards the positive answers it is observed that 19% of the respondents agree and 8% completely agree with the statement. The answers in the range neutral to strongly disagree are in total 72% compared to the first statement which has 59%. The results show that a large proportion of the respondents do not perceive the practical course they went through for as useful and extensive as it must be. The significant amount of people that disagree, indicate that the driving schools, methods of learning or the system in general does not provide them the knowledge and the experience they must get before becoming an eligible driver. The driving schools are one of the key tools of the Government via which it can influence road safety. Such negative result necessitate for an appropriate actions and amount of attention especially on this topic.

Graph 21 visualizes the answers of a whether the respondents would attend an optional free-of-charge refreshing driving course (2 hours of theory and 5 hours of driving) if this would result in a lower insurance premium for them. The responses show that 78% would attend such course, 10% would not and 12% cannot decide about it. The insurance premiums and the manner via which a vehicle is insured in Bulgaria is the other key tool which the Government can use to influence road safety. It is apparent that 78% of the respondents would attend such refreshing course which could be beneficial not only for them but for the other road users, for the insurance companies and for the Government resulting in improved road safety. The answers show what would be the novice drivers` attitude towards a possible cooperation between the insurance companies and the Government aimed to improve road safety.

Graph 22. Meters needed until the car fully stops. Answers distribution.
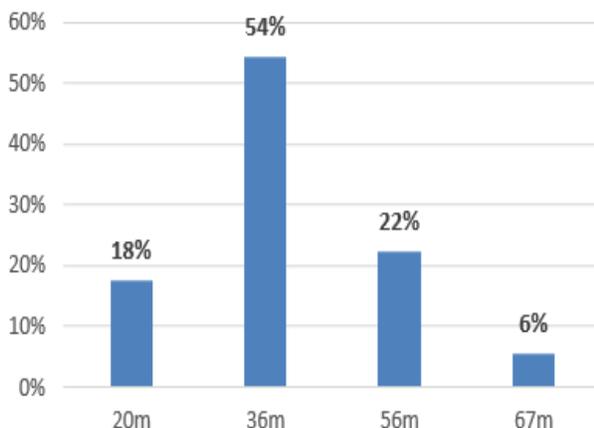
Graph 23. Answers to the '2-second rule'.
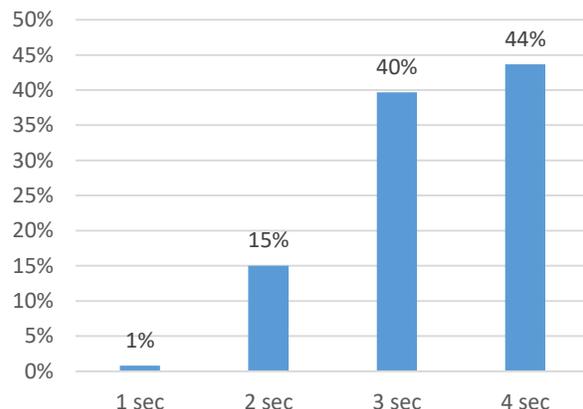
The problem of tailgating and the accidents due to rear-end collisions are addressed in the following two questions. Question 11 asks the respondents to indicate how many meters are needed for a vehicle driving at 100km/h on a dry road to come to a full stop after the driver presses the brakes (graph 22). The literature indicates that in such situations at least 56 meters are needed for the vehicle to come to a full stop. The possible answers that the respondents can choose from are 20, 36, 56 and 67 meters. The least distance (20m) is chosen by 18% while 54% indicate that 36 meters are required before the vehicle stops. The answer 56 meters is chosen by 22% and the last answer – 67 meters was chosen by 6% of the respondents. It becomes evident that 72% of the novices chose a distance lower than the needed against 28% which decided that 56 meters or more are required for such emergency braking This type of knowledge is not part of the theoretical course that every drivers passes through. The results show than not adequate knowledge is present on this very important topic and in case such action is needed, a large portion of the novices could become part of an accident. It can be concluded that the lack of knowledge would lead the drivers to follow the vehicle in front too closely, deteriorating road safety.

Question 12 also addresses the topic of tailgating and more specifically it asks the surveyed what the safe distance (in seconds) is recommended that they must keep between their vehicle and the vehicle in the front. The so-called '*2-secnd rule*' is the background of this question, which states that at least 2-second-distance between two vehicles must be kept in case a safe emergency braking is needed. The respondents are given four options – 1, 2, 3 and 4 seconds. From graph 23 it is evident that 1% answered that 1 second is needed, 16% answered 2 seconds, 40% decided that 3 seconds are needed while 44% of the responses chose 4 seconds as an answer. The results of this question may be interpreted in several manners but the two most logical are that either the novices tend to keep a very large distance or they do not understand the question and what exactly '2- or 3-seconds distance' means. This rule is not explained during the theoretical courses so the second assumption is more plausible. If this is the case then again the driving course topic must be addressed, but if the respondents do understand the question then 84% of them keep distance larger than 3 seconds between theirs and the vehicle in front which is safe enough.

Question 4 and question 7 are included in the survey in order to provide information on a topic from two different perspectives – how acceptable novices find a specific law violation and how often they actually do it. Such comparison would allow for better understanding of the respondents` awareness of how severe different traffic violations are as well as the drivers` willingness to obey the rules. Question 4 (graph 24) asks the participants to rank five violations such as '*talking on a smartphone while driving*', '*driving without a seatbelt*' etc. on a scale from 'completely unacceptable' to 'completely acceptable'.

Graph 24. Respondents` attitude towards five traffic law violations.
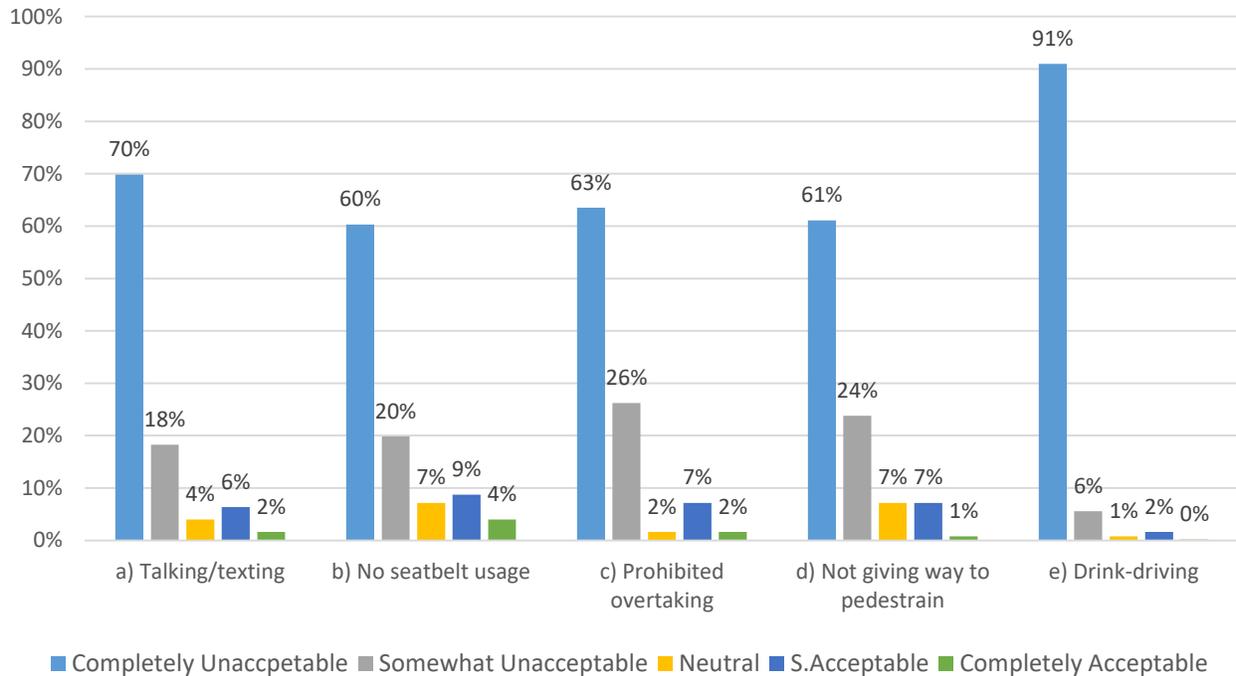
Talking/texting while driving is considered 'completely unacceptable' by 70%, 18% think it is 'somewhat unacceptable', 4% answered 'neutral'. For 6% it is 'somewhat acceptable' and 2% say it is 'completely acceptable'. For the majority of the surveyed (88%) gave a negative response which indicates that they are aware of the seriousness of this violation. On the other hand 8% of the answers are rather positive, meaning that still some drivers believe that this violation is not so dangerous.

Driving without a seatbelt is considered 'completely unacceptable' from 60% of the surveyed while 20% say that it is 'somewhat unacceptable'. 'Neutral' answer is given by 7% compared to 'somewhat acceptable', which represents 9% of the answers and 'completely acceptable' - 4%. Again the largest proportion of respondents indicate a negative attitude (80%) but it is evident that still 15% of the surveyed have positive attitude towards driving without a seatbelt.

Prohibited overtaking was considered by 63% of the surveyed for 'completely unacceptable', 26% stated it is 'somewhat unacceptable' and 2% gave 'neutral' answer. The positive attitude of all surveyed novices towards this violation is in total 9% (7% answered 'somewhat acceptable' and 2% - 'completely acceptable'). In total 89% of the respondents expressed negative attitude with this severe type of violation. There are yet 9% of the respondents for which prohibited overtaking is neutral to positive.

*Not giving the right of way to a pedestria*n is considered 'completely unacceptable' by 61% of the surveyed while 24% find it 'somewhat unacceptable'. 'Neutral' and 'somewhat acceptable' categories received 7% each. Only 1% of the participants consider this violation for 'completely acceptable'. For this question it is evident that the majority of novices surveyed recognize the importance of this action while 8% consider it acceptable.

Driving after having consumed alcohol receives the most 'completely unacceptable' answers compared to all other violations – 91%. It is perceived as 'somewhat unacceptable' by 6% of the respondents, 1% find it rather 'neutral' and 2% 'somewhat acceptable'. No one has a 'completely acceptable' attitude towards it. These findings signal that the largest portion of the respondents are aware of the severe consequences this violation may have. The results show that among the five traffic violations this is the one with the strongest negative association.

So far it was discussed the attitude of the novice drivers surveyed towards the five violations presented above. In the next section it will be elaborated upon how often the respondents actually did these violations in the 30-days-period before the survey took place – question 7 (graph 25). If the novices behave in accordance with their beliefs, stated in question 4, then it is expected that the answers of both questions will be similar. If this is not the case and there are differences present then the gap between perception and action would pinpoint the topics that require policy attention.

Graph 25. Respondents` behavior regarding five traffic law violations.
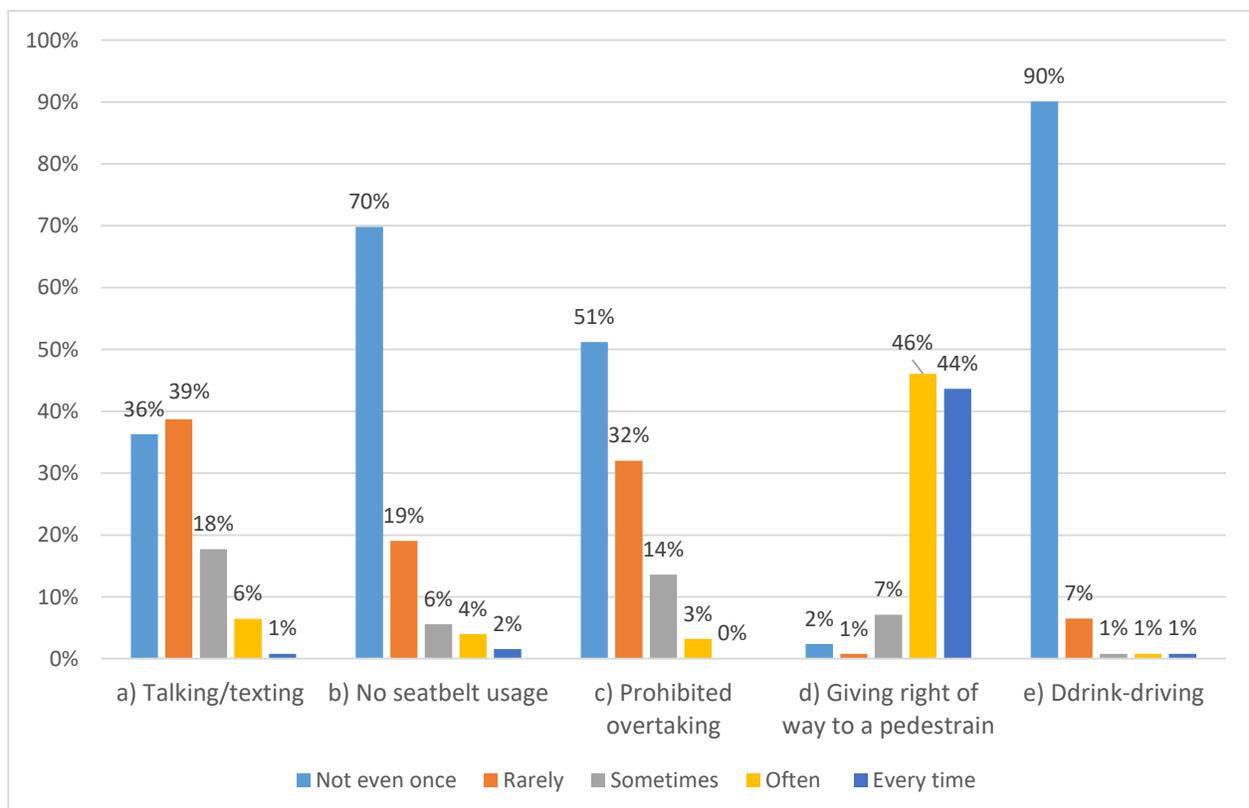
Talking/texting while driving was never done by 36% while 39% did it rarely. 'Sometimes' was chosen by 18% of the respondents while 'often' and 'every time' by 6% and 1% respectively. It is evident that 25% of the novices surveyed texted/talked sometimes or more often during the month before they got surveyed. An interesting finding is the strong difference between the answers here and the answers in question 4. This type of violation is considered completely unacceptable by 70% of the surveyed but only 36% never did it, almost 2 times less. On the other hand 18% show that it is 'somewhat unacceptable' but 39% indicate that they did it rarely. Again a mismatch is present – much more people tend to do it compared to the attitude showed in the previous question. In general it can be concluded that there is a tendency of texting/talking on the phone while driving and although the majority of the respondents show awareness they still perform the hazardous action.

Driving without a seatbelt was never done in the past 30 days by 70% of the respondents while 19% did it rarely. The answer 'sometimes' is chosen by 6%, 'often' by 4% and every time by 2% of the novices surveyed. These findings are in line with the attitude stated in question 4 but they indicate that still there is a group of the participants which tend to drive without using seatbelt.

Prohibited overtaking was never done by 51% of the surveyed. In comparison 63% stated that this action is completely unacceptable. Thirty-two percent did it rarely, 14% - sometimes, 3% - often and no one did it every time. The differences between attitude and willingness are relatively small but it must be noted that a large group of the surveyed performs this extremely dangerous action.

Giving the right of way to a pedestrian was done every time by 44% and often by 46% of the respondents. On the other hand 61% believe that not doing it is a completely unacceptable violation – again there is a mismatch. 'Sometimes' is the answer of 7% of the respondents, 'rarely' – of 1% and 'never' – of 2%. Most answers are similar to the attitude stated in the previous question. Still it is apparent that some novices surveyed do not give the right of way to pedestrians.

Driving after alcohol consumption gets the largest proportion of the negative answers – 90% of the surveyed indicate that they never did it. 'Rarely' is the answer of 7% while 'sometimes', 'often' and 'every time' got 1% each. The findings are in line with the attitude towards this violation.

As a sub-conclusion of the general findings it can be stated that there are several aspects which deserve policy attention. From the responses it is evident that the majority of surveyed do not know the distance needed for a vehicle to fully stop. The question of speeding, especially in residential areas, shows that a large proportion of the respondents find driving above the speed limit for acceptable. The general confidence when driving on snow and in intensive highway traffic is relatively low. A large proportion of the novices surveyed did not answer correctly to the right of way question. The satisfactory levels of

the theoretical and the practical courses before acquiring a license are relatively low. The responses about optional refreshing driving course are rather positive. There is a large group among the participants who tend to violate the traffic law by talking on the phone or overtaking in forbidden zones. It can be concluded that there are several main problems which the general analysis of the survey presented. They will serve as the base for further policy recommendations but in order effective measures to be prepared a deeper and more detailed discussion of some key questions should be undertaken.

The following paragraphs will elaborate on the statistical methods used to analyze four survey questions and the results of these analysis. The base questions are: the experience level of the respondent; whether the respondent has seen a road safety campaign; the self-assessed driving skills of the respondents and the gender of the participant. Each of these four questions will be statistically analyzed so that robust conclusions can be drawn. The exact methods used are presented in the next chapter.

Methodology.

All questions used in the survey are from categorical type – they describe a quality or characteristic. The categorical type of data is qualitative and it can be either ordinal (e.g. worse driver, average driver, better driver) or nominal (e.g. male/female; yes/no/not sure). The analysis of the above-presented questions will try to find whether there is enough statistical evidence that two specific variables are related (associated) with each other. When such relationship between categorical variables is examined the most appropriate statistical method to use is the 'Chi-square Independence Test'. In this case it will be checked if the answers of one question (variable) are associated with the answers of another question (variable).

There are two key assumptions of the Chi-square test. The first assumption requires that the observations are independent from each other while the second one states that no more than 20% of all expected frequencies are lower than 5. The first assumption holds for all analysis but in most cases the second assumption is violated. The fact that the sample size contains only 126 observations leads to the violation of the assumption which means that the interpretation of the results will be biased and not precise.

The null hypothesis of the test states that there is no association between the two variables tested.

H_0: There is no association between the two variables

The alternative hypothesis states is that there is an association between the two variables analyzed.

H_a: There is an association between the two variables

For the purpose of this analysis an alpha value of 0.05 (α=0.05) will be used. This value is the most commonly used in such statistical analysis and it will serve as a threshold, based on which the null hypothesis will be either rejected or not.

In cases where the null hypothesis can be rejected it will be checked what is the strength of the association, measured by the 'Cramer`s V'. This indicator can take values from 0 to 1 as values closer to 1 represent stronger relation between the two variables while values closer to 0 represent weak relation.

The statistical analysis of the variables will be performed in the software package 'SPSS'.

The final data of the questionnaire was exported from the Qualtrics platform in SPSS format. After the file was opened in the software a Chi-square statistical analysis of cross-tables was performed, the results of which are presented in the next chapter.

VI. Results

1) The first question based on which Chi-square tests are performed is the *experience of the respondent* (question 1).

Figure 13. Chi-square test results. *Experience (Q.1) & Confidence to drive on snow (Q.5a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	55,569[a]	20	,000
Likelihood Ratio	51,748	20	,000
Linear-by-Linear Association	28,600	1	,000
N of Valid Cases	126		

a. 22 cells (73,3%) have expected count less than 5. The minimum expected count is ,57.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,664	,000
	Cramer's V	,332	,000
N of Valid Cases		126	

The result shows that there is a statistical evidence of an association between experience and confidence to drive on snow – the P-value (Approximate Significance) is 0.000, which is lower than the alpha value of 0.05. The null hypothesis can be rejected. The Cramer`s V is 0.332, which means that the association between the two variables is moderate.

Figure 14. Chi-square test results. *Experience (Q.1) & Confidence to drive in intensive traffic (Q.5b).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	34,733[a]	20	,022
Likelihood Ratio	35,688	20	,017
Linear-by-Linear Association	23,240	1	,000
N of Valid Cases	123		

a. 20 cells (66,7%) have expected count less than 5. The minimum expected count is ,26.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,531	,022
	Cramer's V	,266	,022
N of Valid Cases		123	

Figure 14 shows that there is enough evidence to reject the null hypothesis. The P-value of 0.022 is lower than 0.05, which means that there is an association between the experience of the respondents and their confidence to drive in intensive traffic. The Cramer`s V has a relatively low value (0.266) which shows that the relation between the two variables is not very strong.

Figure 15. Chi-square test results. *Experience (Q.1) & Speeding in residential area (Q.8a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14,191[a]	15	,511
Likelihood Ratio	15,868	15	,391
Linear-by-Linear Association	3,636	1	,057
N of Valid Cases	126		

a. 13 cells (54,2%) have expected count less than 5. The minimum expected count is ,43.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,336	,511
	Cramer's V	,194	,511
N of Valid Cases		126	

The test of relation between experience and speeding in residential areas shows that the null hypothesis cannot be rejected (P-value of 0.511 is higher than 0.05). There is not enough evidence to conclude that there is association between the two variables.

Figure 16. Chi-square test results. *Experience (Q.1) & Right-of-way (Q.13).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,683[a]	5	,596
Likelihood Ratio	3,711	5	,592
Linear-by-Linear Association	,741	1	,389
N of Valid Cases	124		

a. 2 cells (16,7%) have expected count less than 5. The minimum expected count is 3,42.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,172	,596
	Cramer's V	,172	,596
N of Valid Cases		124	

The test of association between experience and the right of way has a P-value of 0.596, which means that the null hypothesis of no relation cannot be rejected. There is not enough evidence to conclude that there is association between the two observed variables.

2) The second question based on which a Chi-square tests is performed is *whether the respondent has seen a road safety campaign* (question 3).

Figure 17. Chi-square test results. *Campaign (Q.3) & Talking/texting while driving (Q.7a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11,346[a]	8	,183
Likelihood Ratio	11,095	8	,196
Linear-by-Linear Association	6,101	1	,014
N of Valid Cases	126		

a. 8 cells (53,3%) have expected count less than 5. The minimum expected count is ,19.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,300	,183
	Cramer's V	,212	,183
N of Valid Cases		126	

Figure 17 shows that the P-value (0.183) of the Chi-square test is higher than 0.05. The null hypothesis cannot be rejected - the responses of the campaign question are not associated with the responses on the talking/texting while driving question.

Figure 18. Chi-square test results. *Campaign (Q.3) & Speeding in residential areas (Q.8a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14,191[a]	15	,511
Likelihood Ratio	15,868	15	,391
Linear-by-Linear Association	3,636	1	,057
N of Valid Cases	126		

a. 13 cells (54,2%) have expected count less than 5. The minimum expected count is ,43.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,336	,511
	Cramer's V	,194	,511
N of Valid Cases		126	

The test of relation between the campaign and speeding in residential areas` questions shows that the null hypothesis cannot be rejected. The P-value of 0.511 indicates that the answers of the variables analyzed are not associated with each other.

3) The third question based on which Chi-square tests are performed is the *self-assessed driving skills of the respondents (question 6).*

Figure 19. Chi-square test results. *Self-assessed driving skills (Q.6) & Experience (Q.1).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	60,074[a]	20	,000
Likelihood Ratio	57,598	20	,000
Linear-by-Linear Association	32,244	1	,000
N of Valid Cases	126		

a. 19 cells (63,3%) have expected count less than 5. The minimum expected count is ,36.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,690	,000
	Cramer's V	,345	,000
N of Valid Cases		126	

The Chi-square test of association between self-assessed driving skills and experience shows that there is enough evidence to reject the null hypothesis (P-value is 0.000). There is a relation between the two variables observed and the Cramer`s V (0.345) indicates that it is of moderate strength.

Figure 20. Chi-square test results. *Self-assessed driving skills (Q.6) & Confidence driving on snow (Q.5a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	101,126[a]	16	,000
Likelihood Ratio	85,004	16	,000
Linear-by-Linear Association	44,809	1	,000
N of Valid Cases	126		

a. 15 cells (60,0%) have expected count less than 5. The minimum expected count is ,32.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,896	,000
	Cramer's V	,448	,000
N of Valid Cases		126	

Figure 20 shows that the P-value is lower than the critical alpha, hence the null hypothesis of no association between the two variables can be rejected. Self-assessed skills are related with the confidence of driving on snow. The relationship has a moderate strength (Cramer`s V equals 0.448).

Figure 21. Chi-square test results. *Self-assessed driving skills (Q.6) & Talking/texting while driving (Q.7a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	93,644[a]	16	,000
Likelihood Ratio	40,958	16	,001
Linear-by-Linear Association	22,180	1	,000
N of Valid Cases	126		

a. 19 cells (76,0%) have expected count less than 5. The minimum expected count is ,04.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,862	,000
	Cramer's V	,431	,000
N of Valid Cases		126	

The P-value of this test is below the critical alpha, which indicates that the null hypothesis of no relation between the two variables can be rejected. There is enough evidence to conclude that there is an association between self-assessed driving skills and talking/texting while driving. The strength of the relation is moderate (Cramer`s V equals 0.431).

Figure 22. Chi-square test results. *Self-assessed driving skills (Q.6) & Right-of-way (Q.13).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10,816[a]	4	,029
Likelihood Ratio	11,839	4	,019
Linear-by-Linear Association	6,681	1	,010
N of Valid Cases	124		

a. 3 cells (30,0%) have expected count less than 5. The minimum expected count is 2,14.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,295	,029
	Cramer's V	,295	,029
N of Valid Cases		124	

The analysis of association between self-assessed skills and answers on the right-of-way question show that the null hypothesis can be rejected. With P-value of 0.029 the Chi-square test allows us to conclude that there is a relation between the two variables. The strength of this relationship is relatively low (Cramer`s V = 0.295).

4) The fourth and last question based on which Chi-square tests are performed is the question about the gender of the respondents (question 14).

Figure 23. Chi-square test results. *Gender (Q.14) & Confidence driving on snow (Q.5a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	24,063[a]	4	,000
Likelihood Ratio	25,791	4	,000
Linear-by-Linear Association	21,401	1	,000
N of Valid Cases	126		

a. 1 cells (10,0%) have expected count less than 5. The minimum expected count is 2,92.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,437	,000
	Cramer's V	,437	,000
N of Valid Cases		126	

This test shows that the hypothesis of no association between gender and confidence driving on snow can be rejected. The P-value is lower than 0.05, hence there is a statistical evidence that the gender and the confidence to drive on snow are related with each other. The strength of this relation is moderate (Cramer`s V is 0.437).

Figure 24. Chi-square test results. *Gender (Q.14) & Confidence driving in heavy traffic (Q.5b).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	25,004[a]	4	,000
Likelihood Ratio	25,249	4	,000
Linear-by-Linear Association	18,920	1	,000
N of Valid Cases	123		

a. 3 cells (30,0%) have expected count less than 5. The minimum expected count is 1,46.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,451	,000
	Cramer's V	,451	,000
N of Valid Cases		123	

The Chi-square test indicates that the null hypothesis of no relation between gender and confidence driving in heavy traffic can be rejected. With P-value is lower than 0.05, hence there is enough evidence that the two variables are associated with each other with moderate strength of the relation (Cramer`s V equals 0.451).

Figure 25. Chi-square test results. *Gender (Q.14) & Self-assessed driving skills (Q.6).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14,825[a]	4	,005
Likelihood Ratio	15,045	4	,005
Linear-by-Linear Association	9,493	1	,002
N of Valid Cases	126		

a. 3 cells (30,0%) have expected count less than 5. The minimum expected count is 1,83.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,343	,005
	Cramer's V	,343	,005
N of Valid Cases		126	

The above-presented figure indicates that there is an association between gender and self-assessed driving skills. The P-value of 0.005 is lower than the critical alpha level, hence the null hypothesis can be rejected. There is a moderate association between the two variables (Cramer`s V is 0.343).

Figure 26. Chi-square test results. *Gender (Q.14) & Speeding in residential areas (Q.8a).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5,191[a]	3	,158
Likelihood Ratio	7,201	3	,066
Linear-by-Linear Association	3,263	1	,071
N of Valid Cases	126		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is 2,19.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,203	,158
	Cramer's V	,203	,158
N of Valid Cases		126	

 The null hypothesis that there is no association between gender and the answers of speeding in residential areas cannot be rejected. The P-value of the Chi-square test is 0.158, which is higher than the critical alpha. There is not enough evidence to conclude that the two variables are associated with each other.

Figure 27. Chi-square test results. *Gender (Q.14) & Right-of-way (Q.13).*

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5,674[a]	1	,017		
Continuity Correction[b]	4,814	1	,028		
Likelihood Ratio	5,668	1	,017		
Fisher's Exact Test				,024	,014
Linear-by-Linear Association	5,628	1	,018		
N of Valid Cases	124				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 19,66.

b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,214	,017
	Cramer's V	,214	,017
N of Valid Cases		124	

The Chi-square test on gender and the right-of-way question shows that the null hypothesis of no association can be rejected. With a P-value of 0.017 the result indicates that there is relation between the two variables of interest. The strength of this relation is rather weak (Cramer`s V is 0.214).

Table 3. Results of the Chi-square tests.

	Experience (Q.1)			
	Null hypothesis	**P-value**	**Assumptions**	**Cramer`s V**
Confidence on snow (Q.5a)	Reject	0.000	NOT met	0.332
Confidence in traffic (Q.5b)	Reject	0.022	NOT met	0.266
Speeding in residential area (Q.8a)	Cannot reject	0.511	NOT met	-
Right-of-way (Q.13)	Cannot reject	0.596	NOT met	-

	Campaign (Q.3)			
	Null hypothesis	**P-value**	**Assumptions**	**Cramer`s V**
Talking/texting while driving (Q.7a)	Cannot reject	0.183	NOT met	-
Speeding in residential area (Q.8a)	Cannot reject	0.154	NOT met	-

	Self-assessed drivign skills (Q.6)			
	Null hypothesis	**P-value**	**Assumptions**	**Cramer`s V**
Experience (Q.1)	Reject	0.000	NOT met	0.345
Confidence on snow (Q.5a)	Reject	0.000	NOT met	0.448
Talking/texting while driving (Q.7a)	Reject	0.000	NOT met	0.431
Right-of-way (Q.13)	Cannot reject	0.029	NOT met	0.295

	Gender (Q.14)			
	Null hypothesis	**P-value**	**Assumptions**	**Cramer`s V**
Confidence on snow (Q.5a)	Reject	0.000	Met	0.437
Confidence in traffic (Q.5b)	Reject	0.000	NOT met	0.451
Self-assessed skills (Q.6)	Reject	0.005	NOT met	0.343
Speeding in residential area (Q.8a)	Cannot reject	0.158	NOT met	-
Right-of-way (Q.13)	Cannot reject	0.017	Met	0.214

Based on the discussed graphs and categorized analysis of the survey results the main findings will be summarized, so that the most effective and adequate policies to be advised.

VII. Conclusion

This paper has discussed the topic of road safety in Bulgaria. Examining the available scientific literature on road safety it became evident that road accidents and fatalities are global phenomenon which led to the introduction of different policies and approaches aiming to solve it. One of the most prominent policies is the Swedish 'Vision Zero' which became fundamental for many national and regional road safety strategies. It was found that in the European Union each country has the right to choose its own way to decrease the road accidents and in doing so to improve not only the situation in the country but also to contribute to solving the problem on a EU level. Currently the European Union is far from its target on road fatalities and road accidents and one of the main contributors to this mismatch is Bulgaria, which is the second worst-performing country in terms of road safety in the EU, after Romania. The paper discussed the infrastructure, the auto fleet and the road users in Bulgaria and it was found that the country ranks last in terms of average fleet age and it has relatively poor road infrastructure – both significant contributors to traffic accidents. The strategy of Bulgaria on the road safety topic was presented and discussed, showing that the actual numbers of fatalities and injuries are much higher than the targeted values. After a thorough analysis of the available road accidents data for the country it became apparent that novice drivers are overrepresented in driver fatalities and injuries. Furthermore it was found that the most severe types of accidents that happened in the past 10 years are collision with a cyclist, collision with a pedestrian, vehicle rollover off the lane as well as the three vehicle-to-vehicle collisions – frontal, side and rear-end. The analysis pointed that the most severe types of accidents which happened due to drivers` fault were entering in the opposite direction lane, inappropriate speed, taking the right of way of pedestrian, taking the right of way of another vehicle, tailgating and drink-driving. Based on the literature review examined and the analysis of the road accidents a survey was prepared and distributed among Bulgarian novice drivers aged 18 to 25 years old. The general results showed that the majority of the respondents do not feel confident to drive in adverse conditions, they are not satisfied with the theoretical and the practical pre-exam courses and they consider lower safe distance between two vehicles than what actually is. Furthermore still a large proportion of the surveyed violate the law by talking/texting while driving. They do prohibited overtaking and do not give right of way to pedestrians. The majority did not know who has the right of way on two presented traffic situations. Although the survey analysis gave indication of the general opinion of the surveyed novices some questions were further examined so that more precise and reasoned policy recommendations can be given. The last section of the paper presents the results of a statistical analysis (Chi-square test) of the questions regarding experience, self-assessment, campaign remembrance and gender of the respondent. Although almost all analysis did not meet one of the two main assumptions of this test, the results suggested that experience and confidence on snow and in traffic are associated with each other.

Self-assessed driving skills are related with confidence on snow, with experience, with texting while driving and with the answers on the right-of-way question.

The gender-based statistical analysis suggested that there is an association between gender and confidence driving on snow and in traffic, with self-assessed driving skills and with the right-of-way question. What is important to note is that among all Chi-square tests, only the two tests for association between gender & confidence on snow and gender & right-of-way do meet the two assumptions. This means that an association between these variables is proven to be present.

Most of the findings are in line with the presented literature on the road safety topic. The purpose of this paper was to contribute to the gap of scientific research on the road safety topic in Bulgaria via collecting and analyzing both available and survey-gathered data. No such research has been done so far in Bulgaria on the topic of road safety and novice drivers and this paper aimed to shed more light and to give direction for further research on that topic. The responses of the questionnaire were 126 and although being not enough for precise statistical tests and conclusions these responses led to interesting and valuable results. The topic of novice drivers in Bulgaria deserves special attention and such surveys must be prepared and addressed on a larger scale so that more robust conclusions can be drawn. The findings of this research can serve as a starting point for the respective institutions so that they further develop and build upon the findings described. The following and last chapter of this research will provide policy recommendations to the Government and it will give direction for further research.

VIII. Discussion and Policy recommendations

The results of the survey as well as the statistical analysis of the four questions gave an indication of the most problematic road safety topics among the surveyed novices. It became apparent that the respondents who have seen a campaign do not differ much in their answers regarding speeding, talking on the phone while driving and the right of way. It was also evident that vast majority of the surveyed novices find speeding in residential areas with 10-15km/h for acceptable. The literature review presented how dangerous can speeding be in case of collision with a pedestrian, a cyclist or another vehicle. The Chi-square test suggested that there is an association between the experience of the respondent and his/her confidence to drive in snow and in heavy traffic. The results are most probably due to the fact that more experienced drivers have had the opportunity to drive in such adverse conditions more often, hence they feel more confident.

The other important finding is that there is relation between self-assessed driving skills and experience. It would be reasonable to assume that more experienced drivers find themselves better. The statistical analysis suggested that there is an association between self-assessed skills and confidence to drive in snow and talking/texting while driving. Again the confidence in the respondents` abilities may be the reason why there is a relation between these answers.

From the Chi-square tests, based on gender, it became apparent that there is an association between gender and confidence on snow, confidence in traffic and self-assessment of driving skills. Furthermore there is relation between the gender of the respondent and the answers on the right-of-way question. The question why there is such difference between the two genders is of significant importance and it must be further researched as the results may lead to more appropriate policy measures.

In general it can be stated that there are four main aspects on which policy recommendation may be given, based on all findings in this research paper. The advices cover all issues examined and they must be applied together, rather than separately if positive effect is desired. These topics are: Driving courses, Campaigns, Control and Work with the insurance companies.

I.) The driving courses
As it became evident, majority of the novices surveyed do not consider the courses for thorough, substantial and effective. The respondents underwent through theory and practice, based on which they have received a driving license but their answers on the question regarding the driving courses indicates that a large portion of them were not satisfied with what they were taught. A simple question regarding right of way between a bicycle and a vehicle was answered wrong by 43% which presents that almost half of the surveyed are theoretically unprepared. The question about confidence when driving in adverse conditions also showed that a large part of them do not feel confident, especially in snow. The association between respondents` experience and confidence to drive in such conditions is a sign that experience is an important factor. This is why the first advice that can be given to the Government is to focus on the driving courses. The general structure, the duration and the exact manner of teaching must be addressed. Currently no such topic as defensive driving (driving in such a manner to avoid possible accident) is discussed during the theoretical courses neither are the potential drivers taught how to drive in adverse weather conditions. Safe distance, impact speed severity and the consequences of tiredness on driving performance receive almost no attention during the theoretical courses. The fact itself that most of the responses did not find the driving lessons on the level they are expected to be speaks about the skills and the ability of the novice drivers to undertake safe journeys. The literature discussed that longer periods of teaching, followed by extended solo-driving period would have favorable effect on the road

safety. Specific attention must be paid by the Government on the driving courses, given this is the base the drivers get. This is the main tool via which road safety can be affected by the Government. The Government must find and apply good practices from the best performers in the EU in terms of driving courses structure and examination methods.

II.) Road safety campaign.

The second topic that is recommended for revision from the policy makers is the road safety campaigns. It became apparent that there is no significant statistical difference between the respondents who have and the ones who have not seen a campaign regarding talking/texting while driving and speeding in residential areas. The topic of road safety campaigns, and in general the topic of campaigns, requires special preparation, research and clear manner of evaluating the results of a campaign. As Hoekstra & Wegman (2011) explain there are different spheres of road safety and each can be influenced by a campaign only to a certain extent and with the appropriate tools. The role of the campaigns must be to inform the target audience, to provoke awareness on specific topic be that of speeding, pedestrian safety, drink driving etc. Campaigns should have a clear goal and it must be communicated in the right manner to the targeted population so that it reaches as many people as possible. If the Government wants to address the novice drivers with specific road safety messages it can advertise in websites, social media, events or places that such drivers tend to visit. In Bulgaria there is no near-road safety advertisements to remind the drivers to slow down, to keep distance or to put their seat belt. A well-prepared campaigns with clear messages and evaluation methods should be prepared and conducted. A constant reminding of the drivers with short understandable messages near the road would also contribute to accidents decrease due to speeding, illegal overtaking, tailgating or texting/talking while driving. In order a campaign to be successful it must never be conducted on its own but rather as a complement to other actions, namely the better control which is the third topic of advice.

III.) Improved control and law enforcement

The third policy recommendation that this paper suggests is the focus on the better traffic control. The main tool that the Government can use to influence road safety is the control of the municipal and the republican roads. Currently cameras are underutilized and the system of the National Police Department is such that sometimes it costs the administration more resources to collect a fine than the actual fine amount (National Road Police Department, 2018). Improvements in this direction must be made so that a well-functioning systems will allow the respective institutions to constantly monitor for speeding, seatbelt usage, phone usage or other violations on the roads. Control, especially in residential areas, is also very important, as it was shown that many of the respondents tend to drive above the limit in areas with pedestrians and other easily-harmed road users. The control, supported by adequate fines and restrictions would contribute to one safer road system.

IV.) Public-private cooperation

The last among the four policy recommendations that will be given is the cooperation of the Government (the public party) with the Insurance providers (the private parties). As we saw from the survey results 78% of all novices asked would attend a free-of-charge refreshing driving course if this would result in lower insurance premium for them. Currently the insurance system in Bulgaria requires the insurance to be attached to the vehicle`s owner regardless of who drives it. This way, although novice drivers are considered much riskier and their premiums are higher than these of the more experienced drivers, a novice does not have to pay any insurance unless he has a car on his name. This way such young driver who uses his parents` car does not personally feel any motivation or concerns in terms of insurance premiums. If the Government manages to restructure the system via which vehicles are insured, so that at least a proportion of the burden is put on the driver then there could be possible effects. Moreover the answers of the insurance question showed that majority of the respondents would positively accept the idea if the policymakers cooperate with insurance companies and together they prepare refreshing courses for novice drivers. If it is proven that such courses contribute positively to road safety, as it was discussed in the literature review, then the insurance companies would be able to afford paying for these courses given this will result in less accidents, hence less reimbursements to be paid. In this cooperation the role of the government is to research the topic and to address the possible stakeholders so that a well-functioning system is ensured.

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Appendix:

Appendix 1.1. The corridors of the Trans-European Transport Network (TEN-T) that pass through Bulgaria with their respective numeration
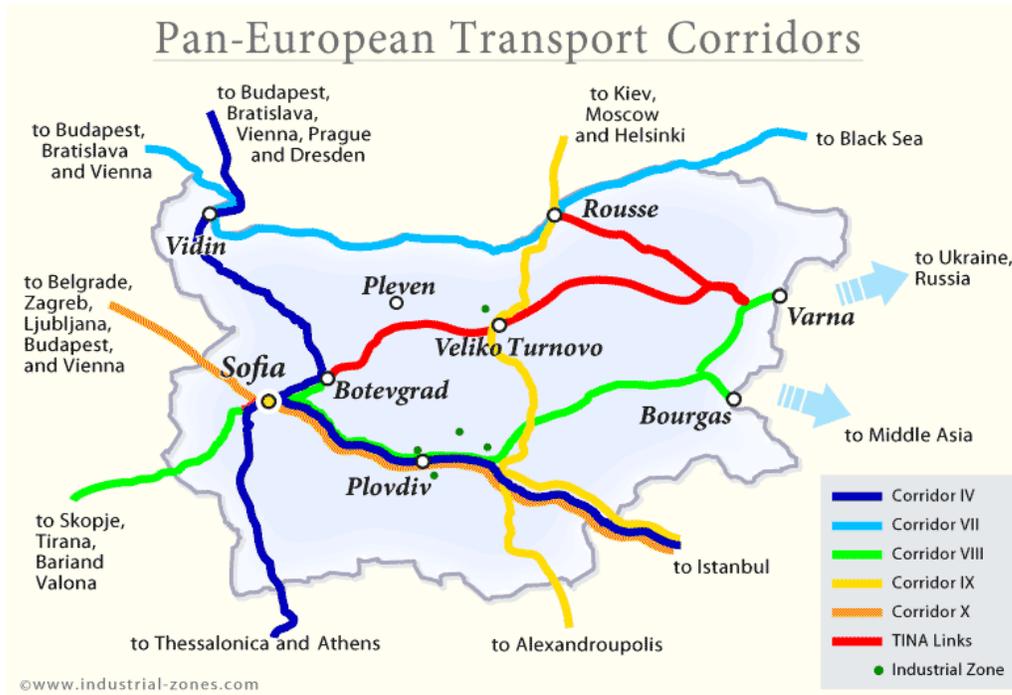
Source: www.industrial-zones.com

Appendix 1.2. Road densities in Europe.
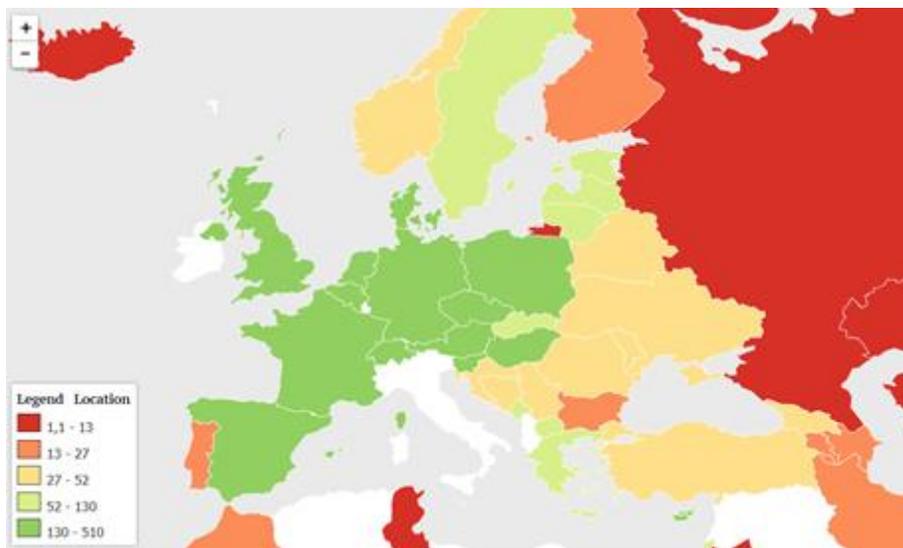
Source: www.knoema.com/atlas/topics/Transportation/Road-transport/Road-density?type=maps.

Appendix 1.3. Average elevation of the countries in the EU

Rank	Country	Average elevation (in meters)	Rank	Country	Average elevation (in meters)
1	Austria	910	15	Germany	263
2	Spain	660	16	Malta	253
3	Italy	538	17	Belgium	181
4	Greece	498	18	Poland	173
5	Slovenia	492	19	Finland	164
6	Bulgaria	472	20	UK	162
7	Slovakia	458	21	Hungary	143
8	Czech Republic	433	22	Ireland	118
9	Romania	414	23	Lithuania	110
10	France	375	24	Cyprus	91
11	Portugal	372	25	Latvia	87
12	Croatia	331	26	Estonia	61
13	Luxembourg	325	27	Denmark	34
14	Sweden	320	28	Netherlands	30

Source: Data gathered from www.en.wikipedia.org/wiki/List_of_countries_by_average_elevation.

Appendix 1.4. Average fleet age (2006-2015), road fatalities for 2017 and GDP per capita for the countries in the EU. The three outliers are presented below the table.

Country	Av.fleet age (2006-2015)	road fatalities/mln inhabitants for 2017	GDP/cap	GDP/cap/1000
Austria	8.9	47	52557.5	52.56
Belgium	7.7	67	1493.421672	47.56
Bulgaria	17.6	96	20329.3	20.33
Croatia	14.1	80	25264.4	25.26
Czech Republic	14.5	54	36915.9	36.92
Denmark	8.5	32	50540.8	50.54
Estonia	15.1	36	31637.7	31.64
Finland	12.7	39	45191.6	45.19
France	9	53	42778.9	42.78
Germany	8.9	38	50715.6	50.72
Greece	13.5	69	27809.4	27.81
Hungary	14.5	64	28375.4	28.38
Ireland	9	33	76304.7	76.30
Italy	10.7	54	39817.2	39.82
Latvia	16.3	70	27598.3	27.60
Lithuania	16.7	67	32092.5	32.09
Netherlands	9.5	34	52941.1	52.94
Poland	17.2	47	29291.4	29.29
Portugal	12.6	62	32198.8	32.20
Romania	15.3	99	25533	25.53
Slovakia	13.4	57	32801.6	32.80
Slovenia	11.2	50	31807.6	31.81
Spain	11.4	40	38090.9	38.09
Sweden	9.6	25	50069.7	50.07
UK	8.5	27	43876.6	43.88
outliers				
Country	Av.fleet age (2006-2015)	road fatalities/mln inhabitants for 2017	GDP/cap	GDP/cap/1000
Cyprus	n.a.	45	34970	34.97
Luxembourg	6.2	total 25	103744.8	103.74
Malta	n.a.	total 19	31847	31.847

Source: Data gathered from: GDP per capita: World Bank (2018); Average fleet age: ACEA (2017); Road fatalities: ETSC (2018).
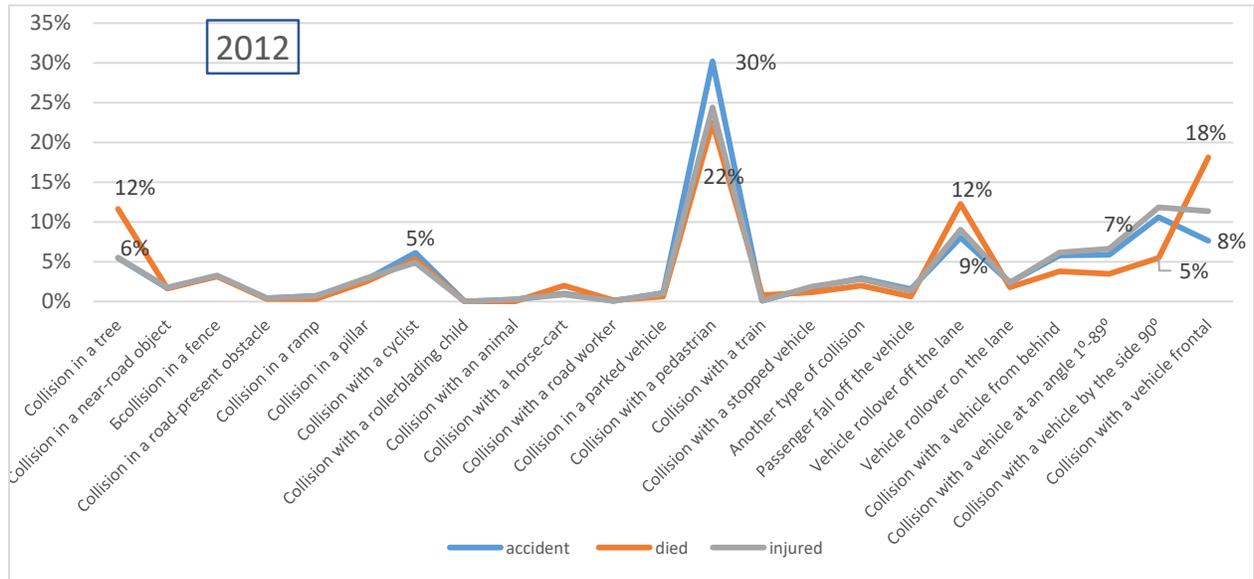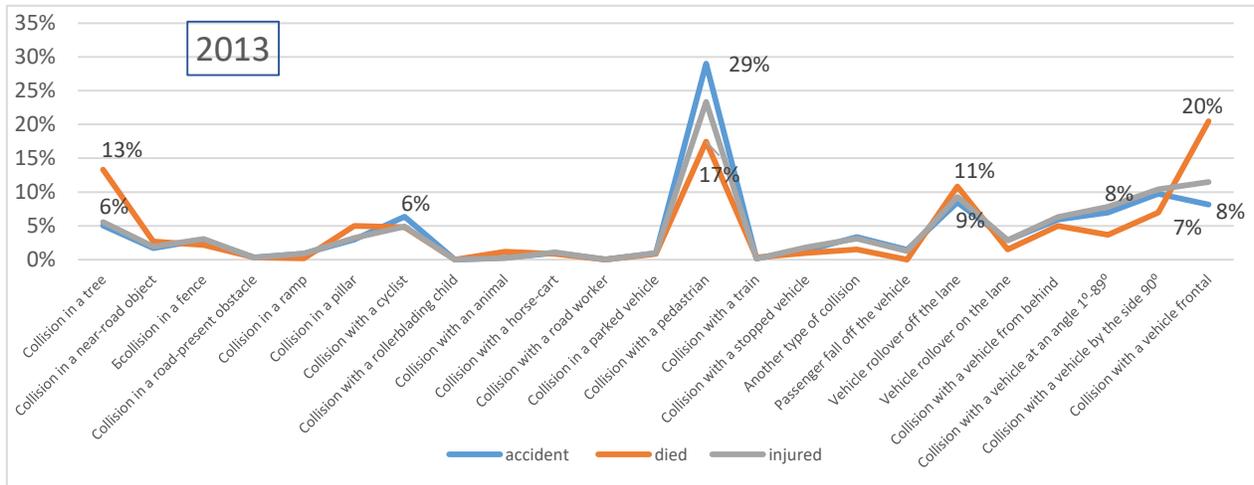
Appendix 1.5. Road fatalities by age group and traffic participant type for the years 2014-2013-2012 & 2011-2010-2009
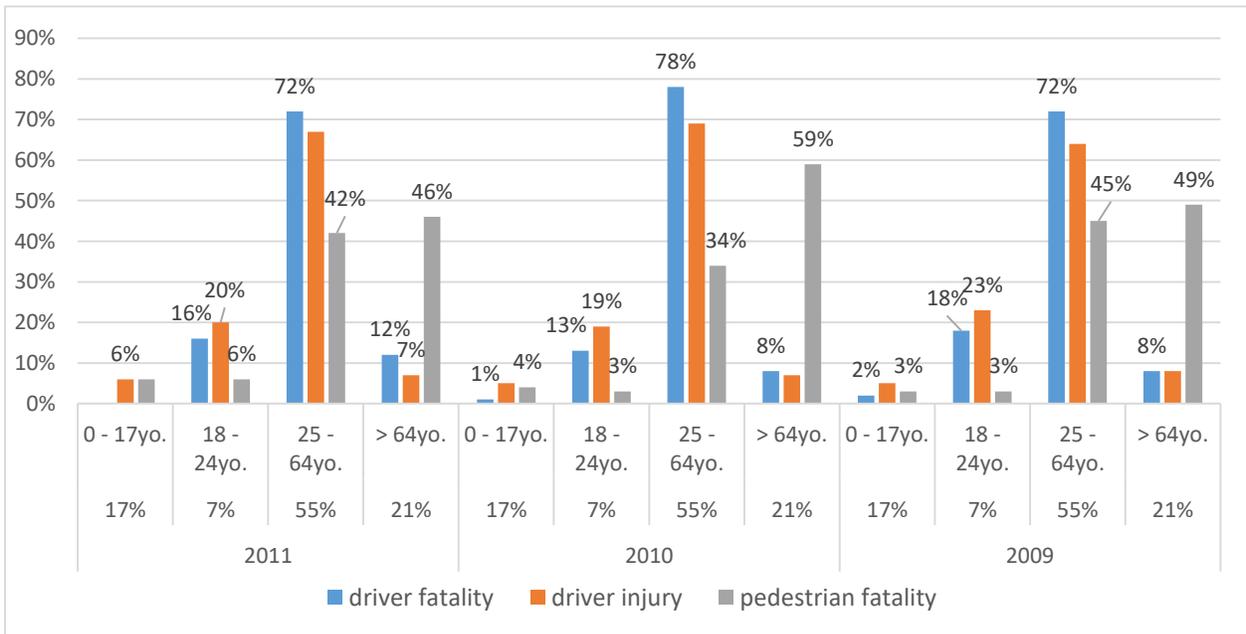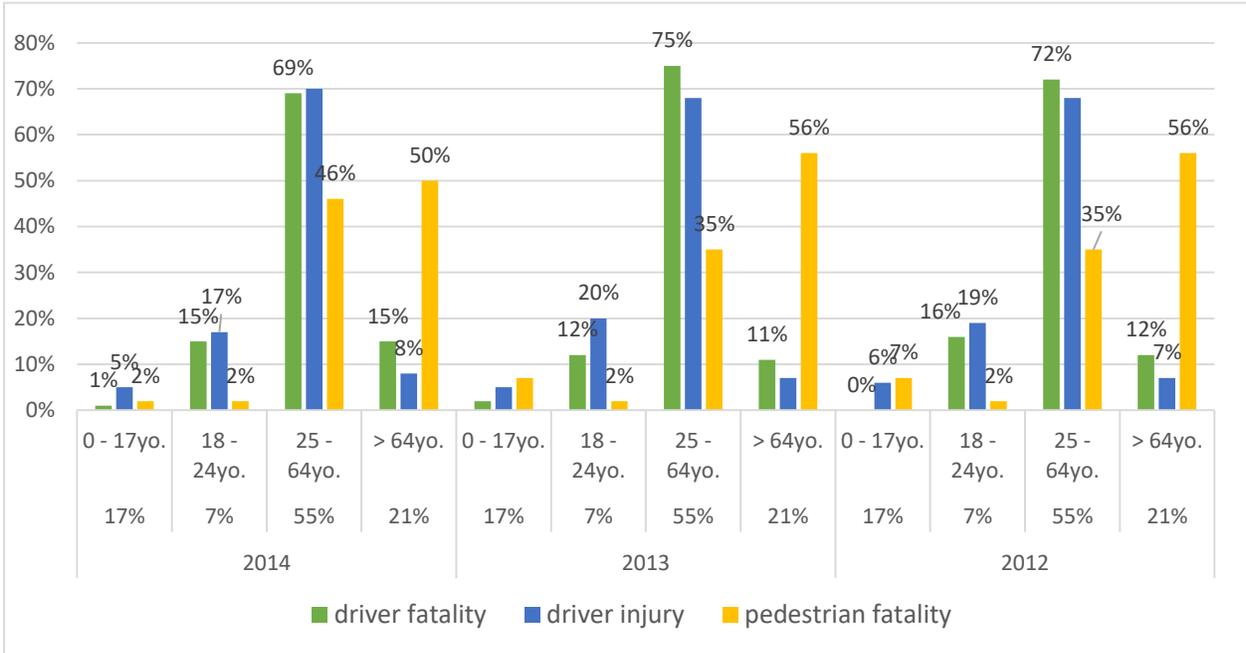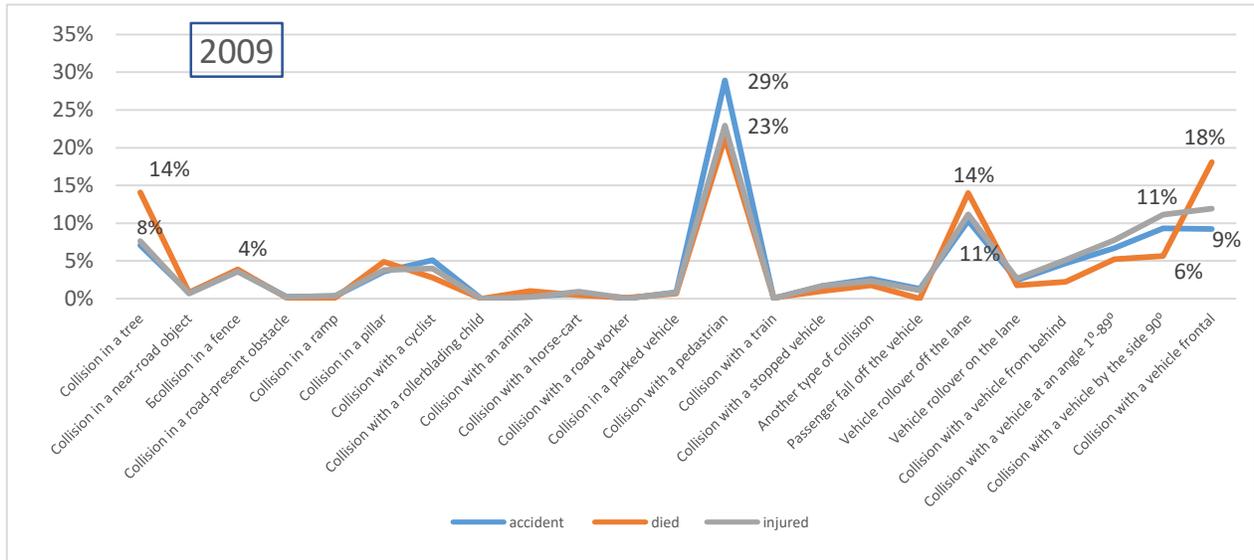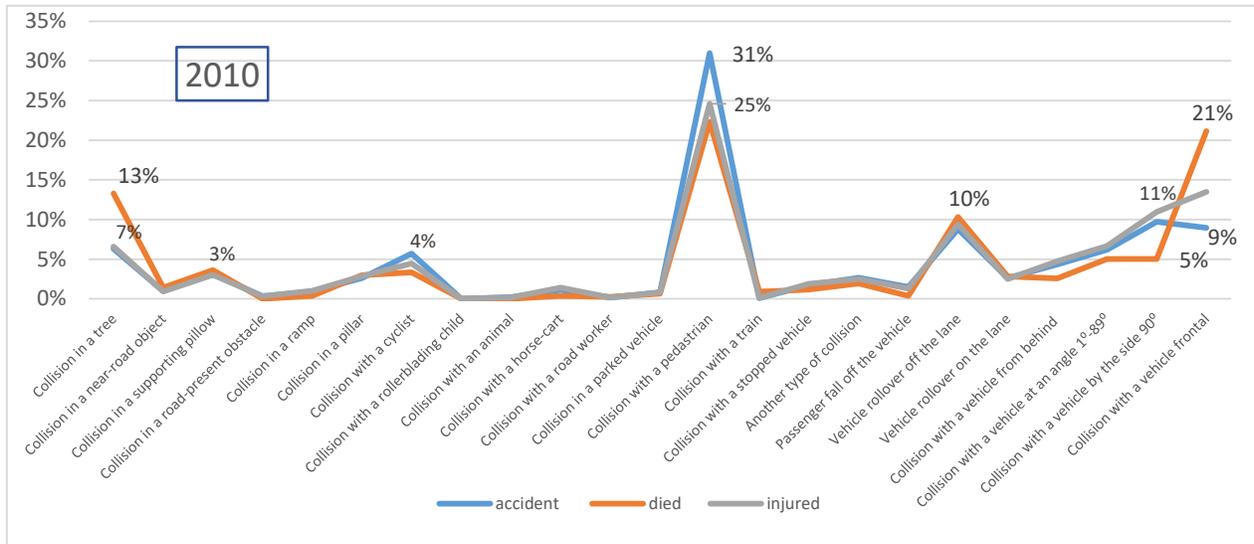

Source: Data obtained from National Road Police Department of Bulgaria, 2018

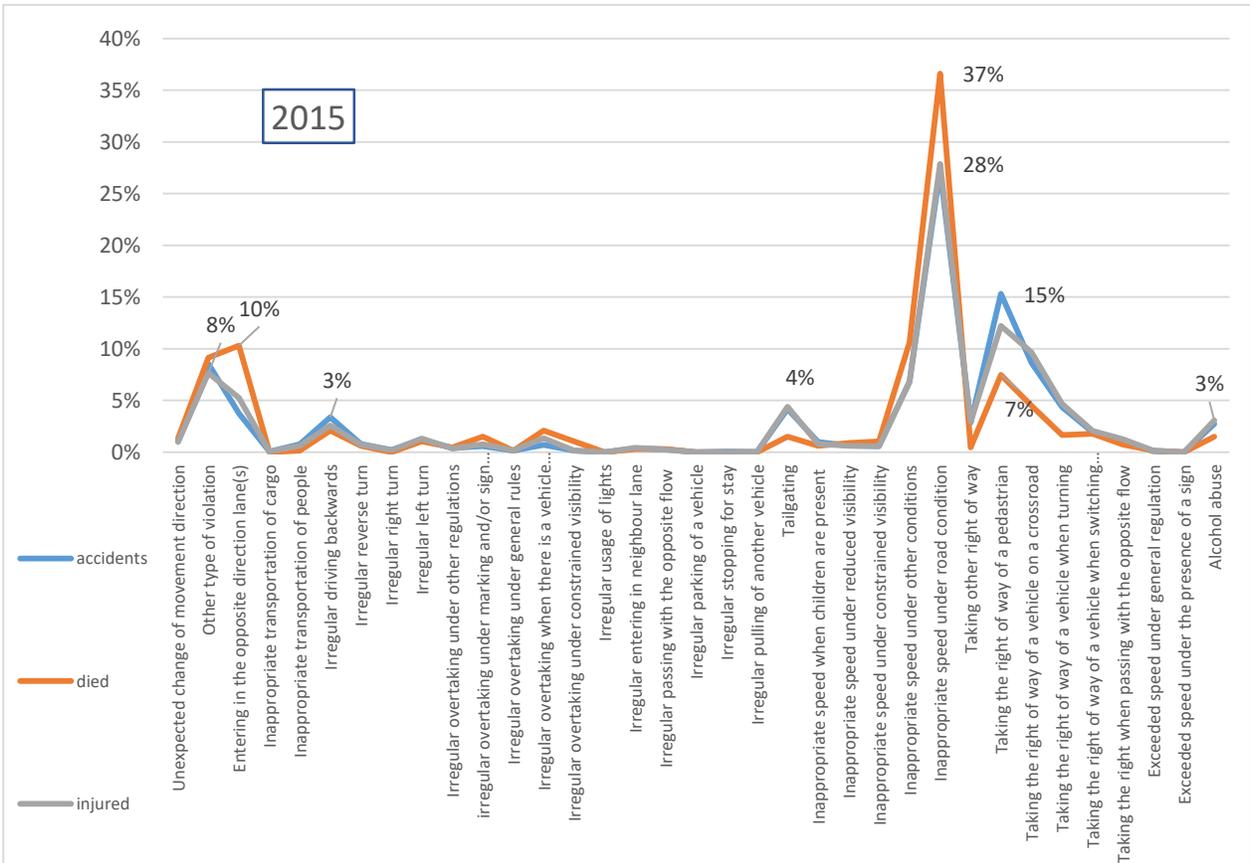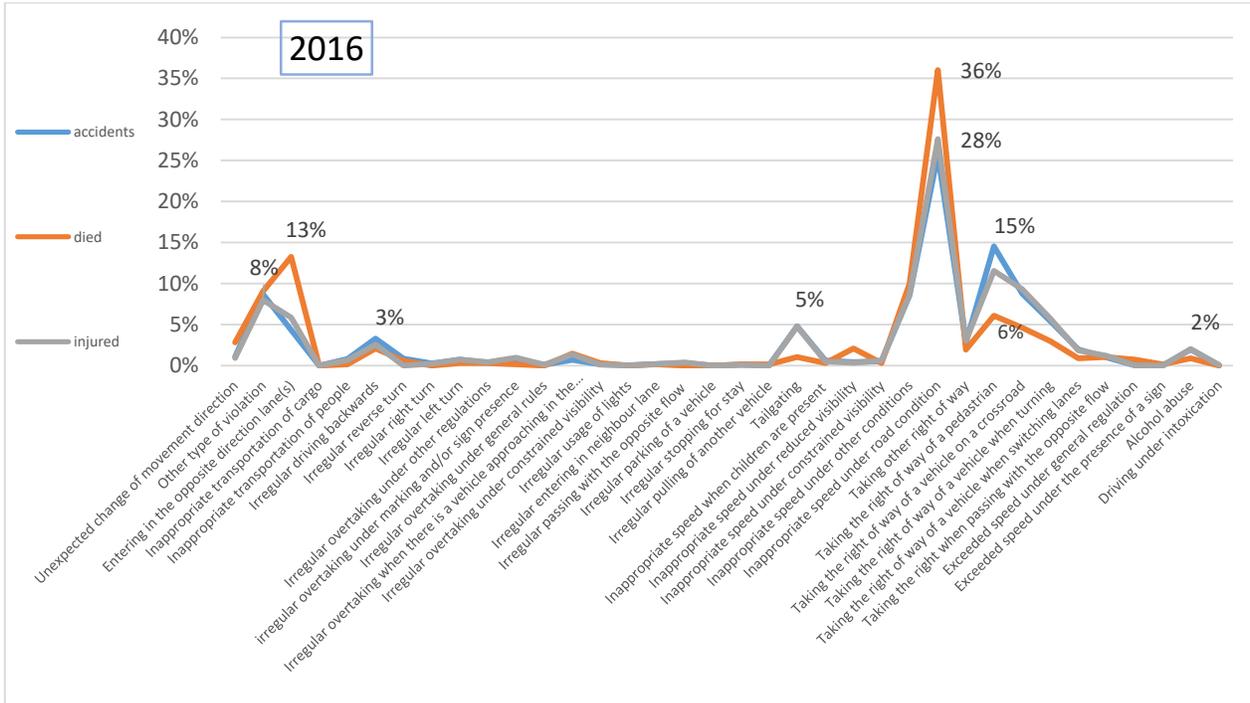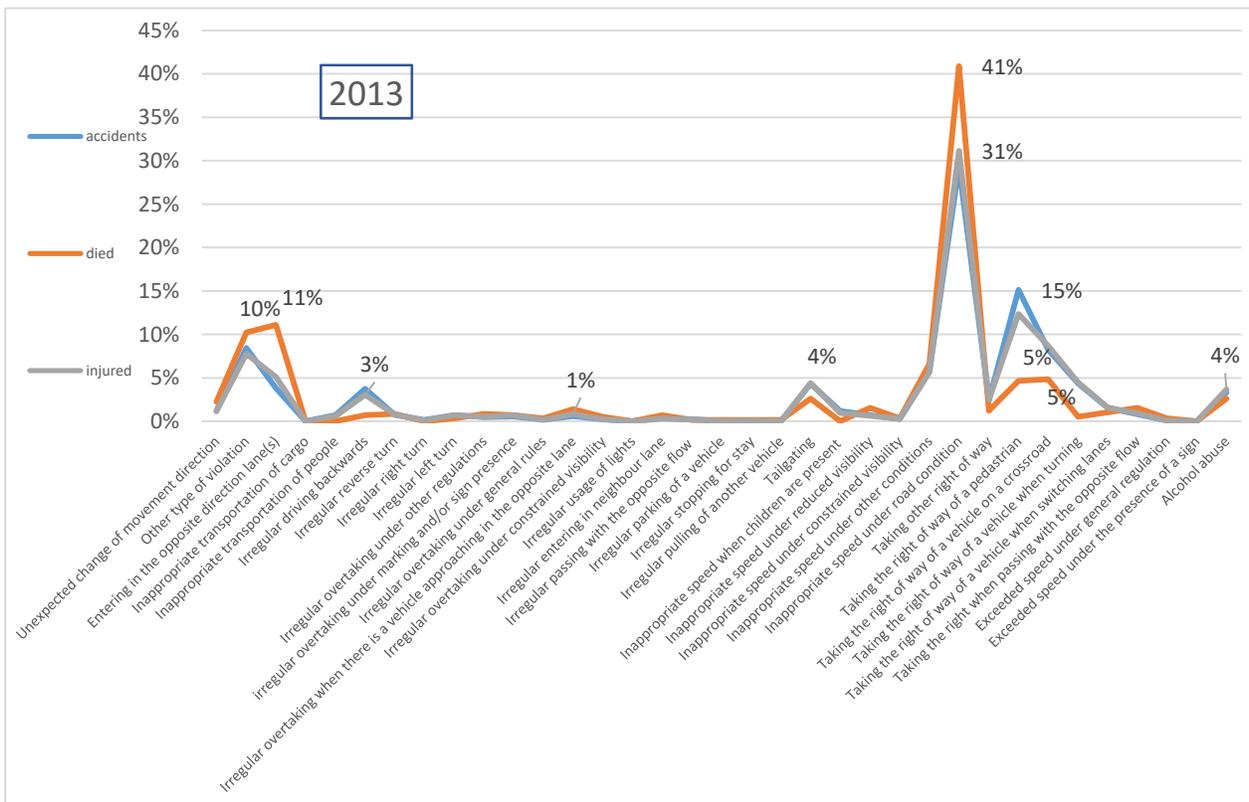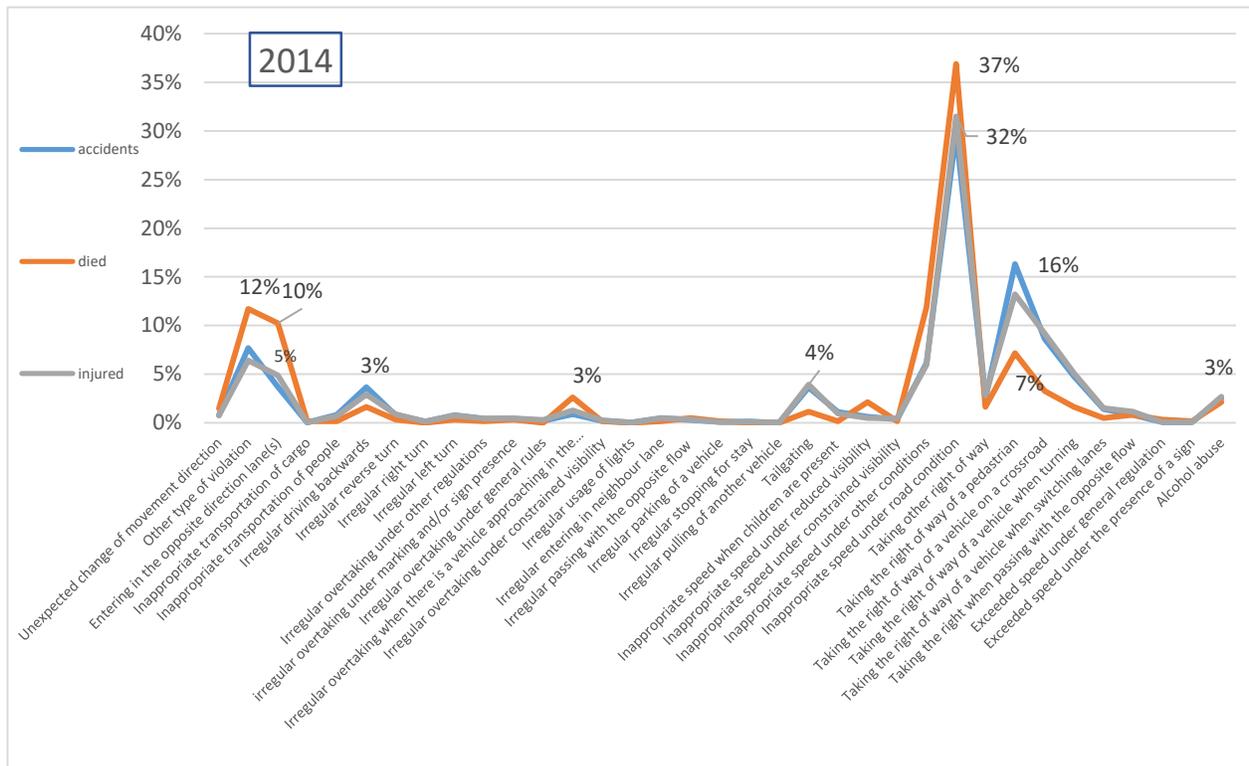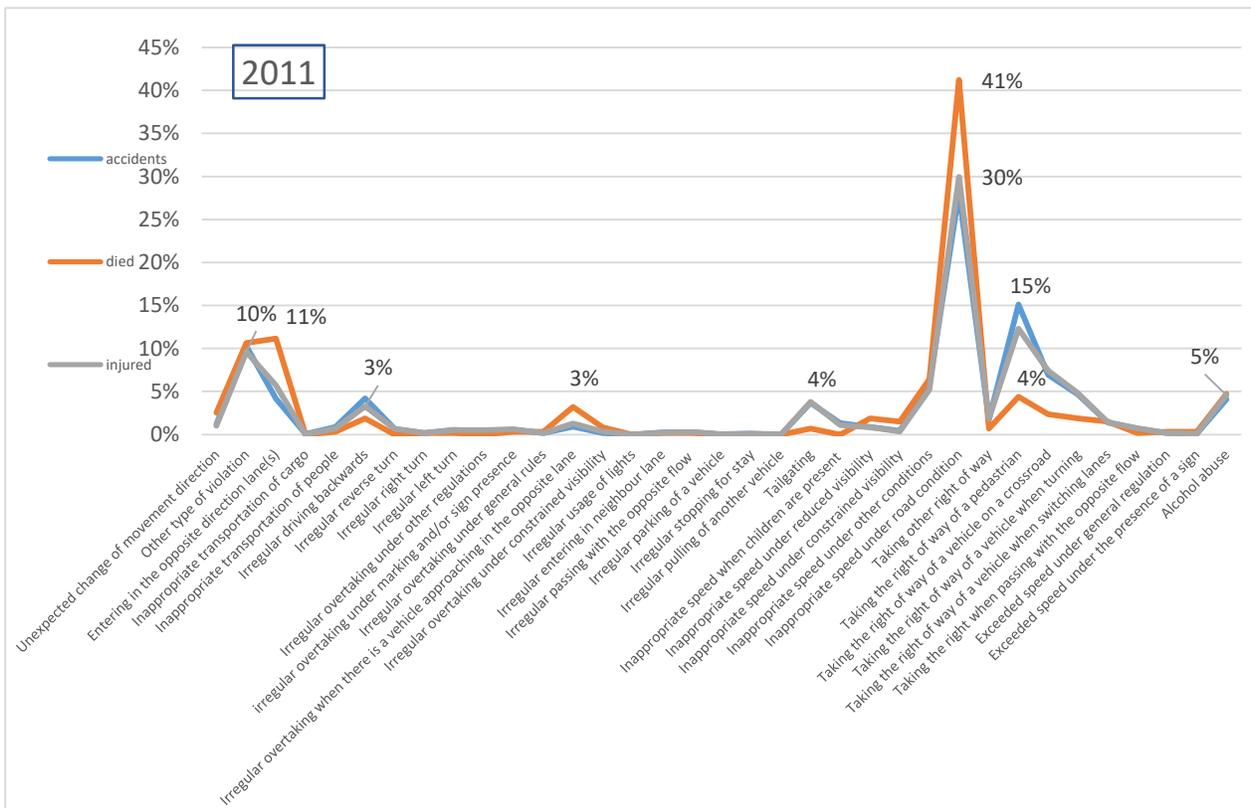## Appendix 1.6. Road accidents by type of collision and severity, 2009-2016
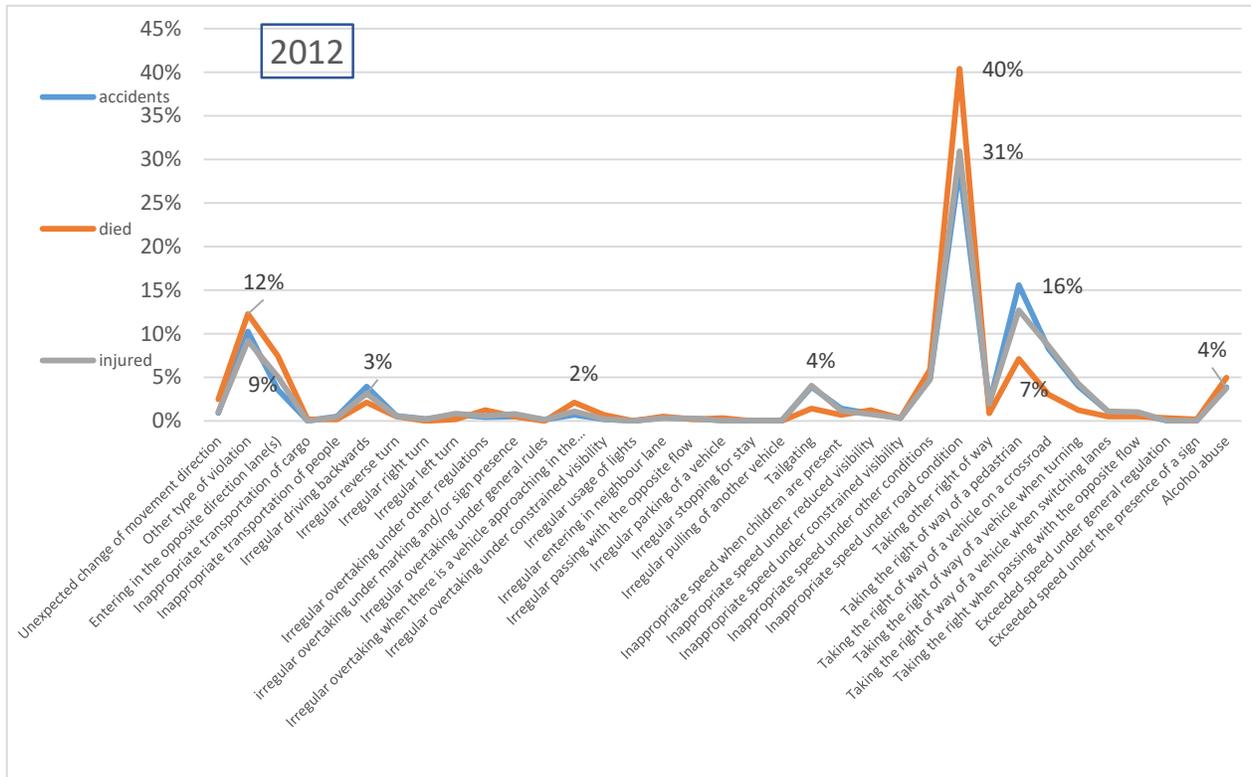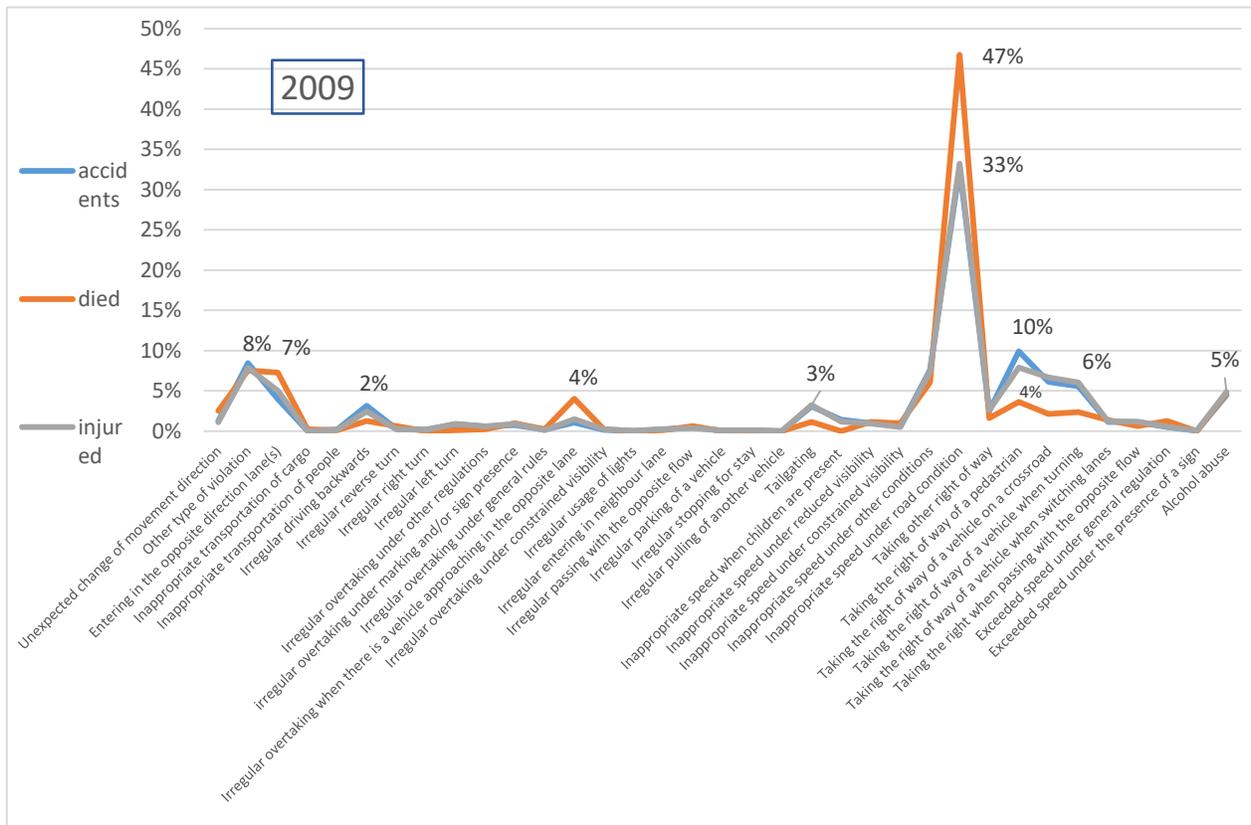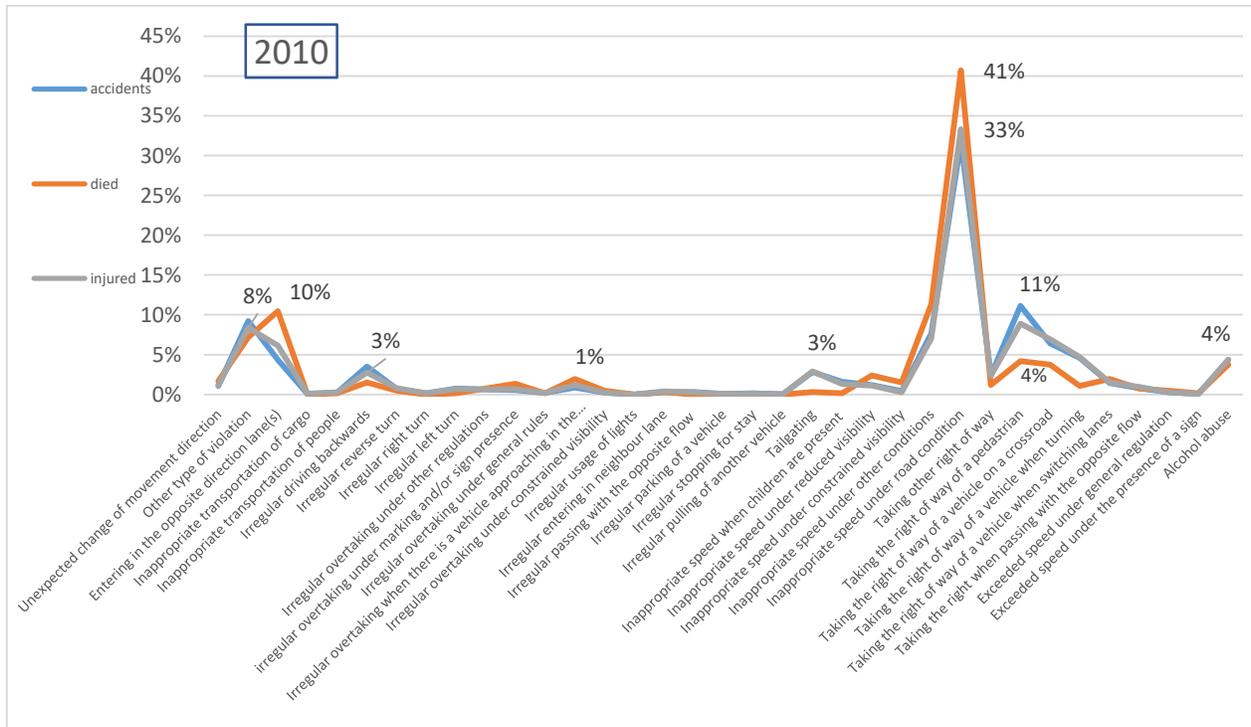

2016

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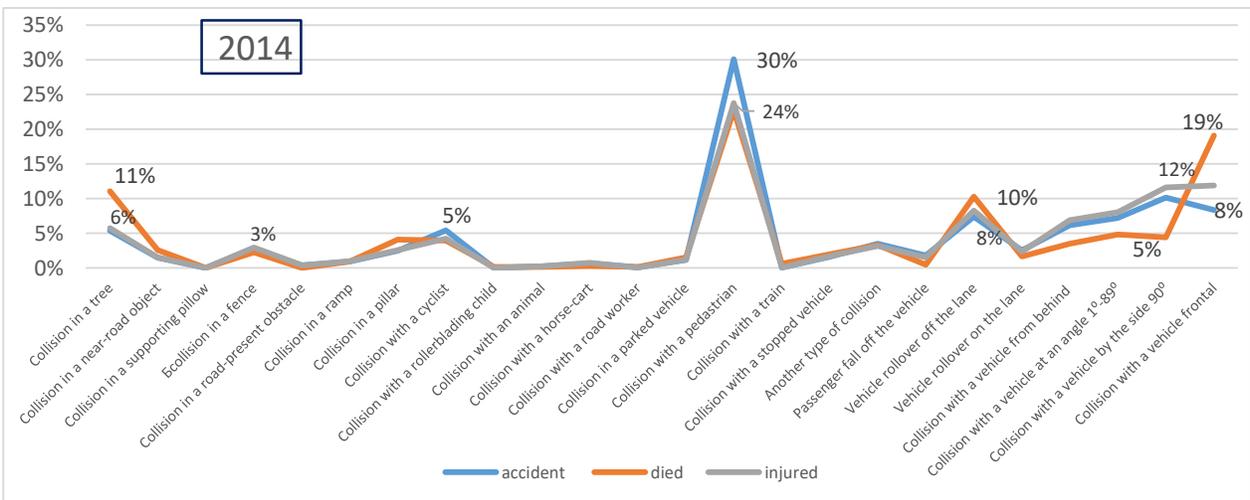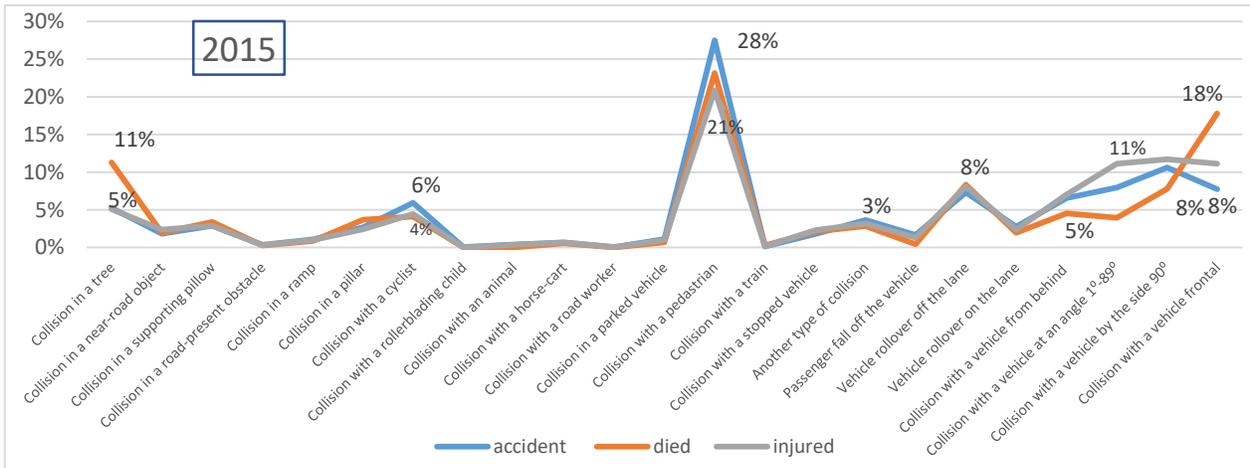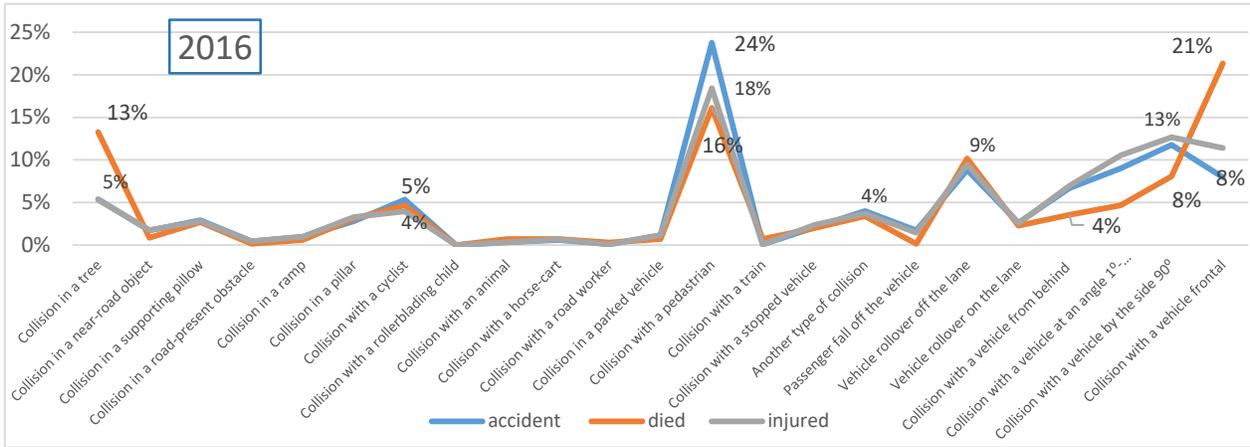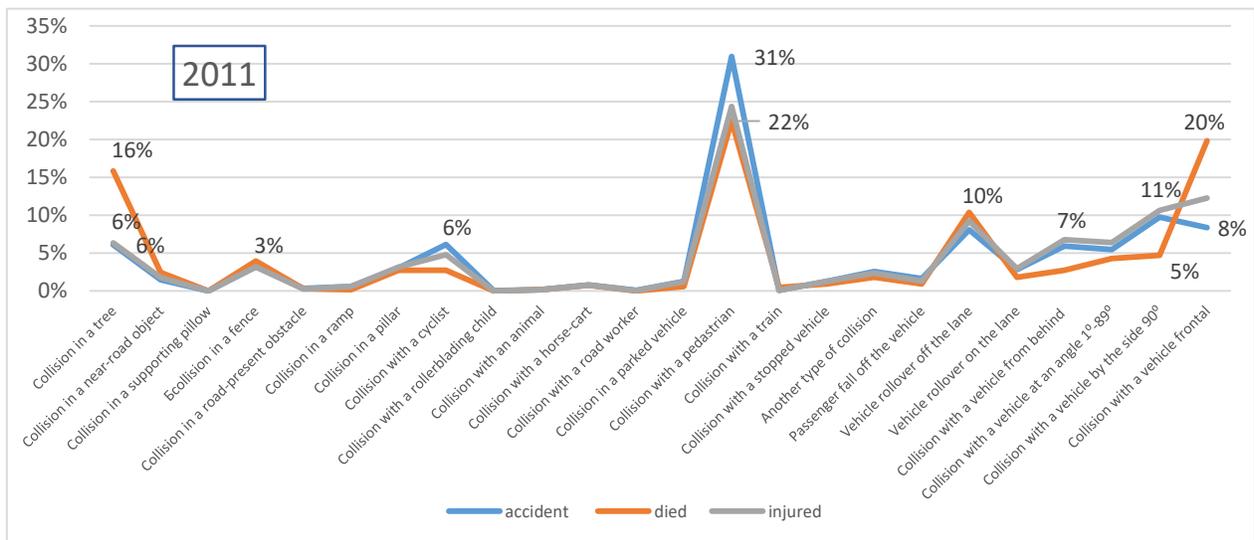
Source: *Data obtained from National Road Police Department of Bulgaria, 2018*

Appendix 1.7. Road accidents due to drivers` fault by severity, 2009-2016

2010

2009

Appendix 1.8. Questionnaire

Questionnaire Legend	
Color	**Type of question**
	Personal beliefs and attitude
	General knowledge/ Spec. advice
	Practical knowledge/ right of way
	Personal info

Question #

1

How acceptable do you, personally, feel it is for a driver to:

	Completely Unacceptable	Somewhat Unacceptable	Neutral	Somewhat Acceptable	Completely Acceptable
a) Talk on a cell phone while driving	o	o	o	o	o
b) Texting/ using social media while driving	o	o	o	o	o
c) Drive without using a seatbelt	o	o	o	o	o
d) Drive after having drunk too much alcohol	o	o	o	o	o
e) Overtaking in zones prohibited with sign and/or road marking	o	o	o	o	o

2

In the past 30 days how often did you:

	Never	Rarely	Sometimes	Often	Always
a) Use your smartphone for texting/talking while driving	o	o	o	o	o
b) Drive a vehicle without a seatbelt	o	o	o	o	o
c) Drive when you were sleepy	o	o	o	o	o
d) Failed to yield to a pedastrian who had the right of way	o	o	o	o	o
e) Follow the vehicle in front of you too closely	o	o	o	o	o

3

Compared to most other dirvers on/around your age whould you say that you are:

o	a) a much better driver
o	b) a somewhat better driver
o	c) about the same driver
o	d) not as good as the other drivers
o	e) way worse than the rest drivers

4

How many kilometers above the speed limit do you feel it is okay to drive?

a) In a residential area	0km	1-5km	6-10km	11-15km	15+km
	o	o	o	o	o

b) On a highway	0km	1-5km	6-10km	11-15km	15+km
	o	o	o	o	o

5

In the past 30 days how often did you find yourself travelling above the posted speed limit?

Never	Rarely	Sometimes	Often	Always
o	o	o	o	o

6

How confident do you feel to:

	Not confident at all	Not confident	Somewhat confident	Confident	Very confident
a) Drive on snowy/icy roads	o	o	o	o	o
b) Drive at night	o	o	o	o	o
c) Drive on a highly congested highway	o	o	o	o	o

7

To what extent do you agree with the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
a) The theoretical course before acquiring a driving license gave you a thorough, adequate and long-lasting knowledge in order you to undertake safe journeys.	o	o	o	o	o
b) During the practical course before acquiring a driving license you managed to practice many different dangerous situations so that you felt fully-prepared for driving alone?	o	o	o	o	o

8	How likely is that someone will be fined (by a policeman or cameras) if speeding or driving without a seatbelt ?	very unlikely	unlik	somewhat lil	likely	very likely
		o	o	o	o	o

9	Would you attend an optional refreshing driving course (2 hours of theory and 5 hours of driving) for freeif it would result in a decreaesd insurance premium for you?	Yes		No
		o		o

10	Have you seen an advertisment regarding road safety in the mass media (TV, radio, newspaper, billboards or somewhere else) in the past 1 year?	Yes		No
		o		o

11	How often, do you believe, the specialists recommend a 15min break should be taken when on a long journey?	Every 1 hour	Every 2 hours	Every 3 hours	Every 4 hours
		o	o	o	o

12	Driving a passenger vehicle on a dry road with 100km/h would take how many meters until it comes to a full stop after pressing the pedal ?	20m	36m	56m	67m
		o	o	o	o

13	How can you use your vehicle`s engine to control its speed?
o	a) Change to a higher gear
o	b) Change to a lower gear
o	c) Change to netral
o	d) Change to a reverse

14	What is the distance (in seconds) recommended by specialists you should maintain between you and the vehicle in front?
o	a) 1 second
o	b) 2 seconds
o	c) 3 seconds
o	d) 4 seconds

15	Who has the right of way to go first ? a) the cyclist b) the vehicle

16	Indicate the priority levels, starting with the first having right of way: a) green, blue, white b) white, blue, green c) green,white,blue

| 17 | Indicate the priority levels, starting with the first having right of way:

a) blue, white, green

b) green, white, blue

c) green, blue, white | |

| 17 | Indicate the priority levels, starting with the first having right of way:

a) blue, white, green

b) green, white, blue

c) green, blue, white | |

18	You are:		Male		Female	
			o		o	

19	You are aged:	under 18	18-22	23-25	above 25
		o	o	o	o

20	For how long have you been an active driver?	under 6 months	6m.- 1 year	1 to 2 years	2 to 3 years	3-5 years	5- 7 years
		o	o	o	o	o	o