

# Road Safety – a New Look at the Factors That Influence Road Traumatism

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**Abstract:** *The creation of a safe system is crucial to a more stable urban environment and the improvement of society's well-being. The primary components for successfully reducing the number of traffic accidents and road traumatism in general are the capacity of state institutions and the management of processes that involve road safety. Despite the massive amount of funds invested in designing safe roads, as well as restrictive elements along the road infrastructure and especially control, the share of drivers who view speeding as natural is growing. The purpose of the paper is to identify the invisible factors that push drivers to drive with excessive speed within urbanized environments. Emphasis is put on the significance of the personality characteristics, competence and behavior of drivers. The inferences from this study can help determine the direction of development for road safety in Bulgaria.*

**Key words:** *road safety, road traumatism, accidents, human factor, excessive speed*

## 1. Introduction

While the number of traffic casualties in Bulgaria has dropped by 5% over the last 3 years (2021-2023), there has been an 11% increase in the number of injured people, and a 12% increase in the number of serious accidents [1]. In Sofia, the number of casualties and injured vulnerable traffic participants such as pedestrians and cyclists has grown in recent years. While the reasons for these alarming numbers are often found in human mistakes, traffic organization and road infrastructure are equally as important. The latter is designed to give cars the right of way, despite the growing number of violations and reckless drivers and the increasingly inadequate implementation of traffic laws. Quite often vulnerable participants are accused of jaywalking, looking at their phones while on the cross-walk, cycling in pedestrian zones, but in the majority of cases it is the fault of drivers who either drive with excessive speed or deny pedestrians the right of way.

In practice, most traffic accidents (TA) are directly or indirectly involved with the human factor, i.e. the way drivers behave while driving. The implementation of a multitude of preventive measures for limiting road traumatism does not always help improve road safety. In order to achieve maximum effect, the restrictive measures need to be in synergy with rules and effective sanctions for traffic law violations. Effective traffic safety training and regular communication campaigns are required as well. Depending on the reasons for traffic accidents, there are risk factors which are always subject to scrutiny such as speeding, neglecting the use of seatbelts and helmets in the case of cyclists and motorists, and driving under the influence of alcohol and narcotic substances. Emphasizing the human factor as a generator for change and a primary element for preventing emotional actions while driving is fundamental to the creation of a safe transport system. Accidents result from a multitude of factors which interact under the influence of a specific reason that is the cause of conflict situations – denying right of way, failure to observe roadway markers, ignorance of the meaning of road signs, and ultimately misjudging the road environment. Most systems that classify the reasons for traffic accidents focus on the mistakes and actions of traffic participants [2]. The purpose of this article is to show how people's behavior or emotional state can result in misjudgment of the transport situation, which in turn leads to the occurrence of traffic accidents.

## 2. Methods and Data Processing

The study utilizes data from a questionnaire survey conducted by the author on location during the occurrence of TA within the city of Sofia, more specifically in the Druzhba and Mladost residential districts. Accidents where there were no casualties, only injuries and material damage, have been studied. In most cases bilateral protocols have been drawn up without the participation of MTC "Traffic Police" representatives. Individual interviews have

been conducted with drivers and other traffic participants (passengers, pedestrians, cyclists and, in some cases, people who had witnessed the accidents). The main questions are focused on information regarding the reasons for the accidents, namely:

- The actual traffic situation before, during and after the accidents;
- What is the physical and psychological state of the people involved in the accidents (sometimes it is a personal judgment of the author of the research);
- Background of the journey; purpose of the journey; is it routine or is it incidental;
- Driving habits and practice; driver occupation and age; years of driving experience;

During the interviews there were difficulties in regards to determining the level of education of the participants, whereas gender was not taken into account for subjective reasons. The volume of the information depended primarily on the actual psychological state of the people involved in the accidents. In order to determine all the factors that led to the occurrence of the accidents, quantitative and qualitative analyses have been implemented, especially with the cooperation of MTC "Traffic Police" personnel. The method that was utilized to process the data is analysis of the collected content.

## 3. General Formulation of the Issue of Road Safety in Bulgaria

The issue of road traumatism is exacerbated by the rapid motorization in Bulgaria, the low quality of the safety of road traffic systems, and the lack of institutional capacity (even for management of results). From a socio-economic perspective, Bulgaria is paying a heavy price for automotive mobility, which is the reason for economic losses that amount to approximately 2% of the GDP [3]. In that regard, measures for improving road safety and reducing the number of casualties and people injured in traffic accidents are being undertaken in Bulgaria. Practical measures which have proven to be effective in specific aspects of safety in terms of drivers' behavior, creating a safe infrastructure, renewing the vehicle fleet and imposing speed limits are being implemented systematically. The national strategy for improving traffic safety along Bulgarian roads for the 2021-2030 period [4] is primarily focused on the way drivers behave while driving. There are multiple factors that influence drivers' behavior, namely experience, age, emotions, occupation, driving conditions, fatigue, attitude towards traffic rules and traffic situations. The behavior itself can be characterized as ranging from normal through risky to aggressive, which changes alters the ability of drivers to assess risks correctly and make the right decisions when driving in different situations. Making a decision about aggressive or normal (calm) driving is

crucial to improving road safety and reducing road traumatism [5]. The way drivers behave gives us information about the connection between risk perception and improving the ways we use personal vehicles on a daily basis.

The analysis of the road safety data based on the number of deaths per 100 000 or 1 million shows a drop in these indicators (deaths resulting from TA) in both Europe and Bulgaria. This data is visualized in Table 1 [6].

**Table 1:** Number of casualties, injured people and serious traffic accidents for the 2021-2023 period

Years	Deaths per 1 million	Casualties	Injured	Serious TA
2021	81	561	7609	6080
2022	78	531	8422	6609
2023	82	525	9101	6993

Source: Ministry of Interior

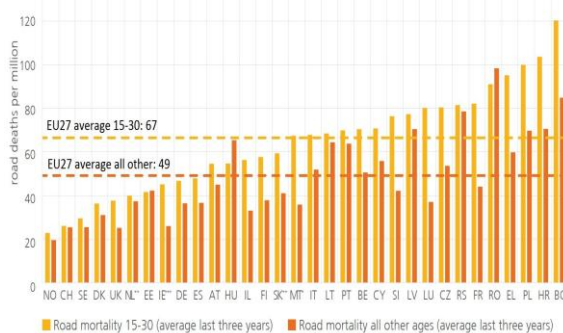


Fig. 1 Number of casualties and injured people in the EU for the 2019 – 2023 period.

Source: Eurostat, ETSC [7-8]

Generally, the population in Europe has increased by a little under 1% (from 736 million to 742 million) over the last 10 years, whereas the vehicle fleet in Europe has grown by 20% (from 200 million to 250 million). In other words, more people + more cars = more accidents [9]. For Bulgaria, the statistics for the last 10 years are stranger, namely less people – a 13% drop (by 800 000) in the population, and a 13,3% increase in the number of cars (400 000 more, from 2,6 million to 3 million) [10].

A common misconception is that, in order to solve the issue of road mortality, low-income countries need to become high-income economies first and focus their efforts on building and developing higher-class roads (respectively higher speed), which will help improve the economic efficiency of transport. In actuality, speeding leads to increased traffic jams and as a whole the benefits are insignificant, especially over short distances, like in an urban environment. The rule is to invest in road safety, which, in addition to being cost-effective, can also help low-income and medium-income countries become high-income countries. The risks of death and injuries from TA in countries with low level of economic development are systematically higher compared to countries with high level of development.

#### 4. Analysis of the Factors That Influence Traffic Accidents

Excessive speed is a fundamental factor when it comes to securing road safety, and as such, it is the leading cause for approximately 40% of all risks that driving involves. The role of

excessive speed is examined in terms of the way it influences drivers' behavior when they react to various critical situations. Speed influences safety even when we are driving within the speed limit but in a way that is still too fast for specific road conditions, i.e. if the roads are poorly lit during nighttime, if weather conditions change drastically, or if the traffic is temporarily reorganized due to repair work. In addition to being a violation of the Road Traffic Act, speeding has a number of consequences, namely:

- Even the slightest distraction or road obstacle increases the probability of losing control over the car;
- Considerably increased braking distance, including longer reaction time;
- Heavier economic and social consequences due to the increased degree of severity of the collision and respectively the heavier injuries;
- And, of course, increased fuel consumption.

Ultimately, speeding endangers the lives of the drivers, their companions and all the people present in the environment where the cars are being driven.

The main factors analyzed during the post-accident polling of the participants within two residential districts in Sofia (Druzhba and Mladost) include: personality traits of drivers, social pressure, use of alcohol and narcotic substances, the road infrastructure and its accompanying environment, the vehicles themselves and listening to music. It has been determined that one of the main reasons that influence the occurrence of TA is driver negligence, which is caused by busy everyday life, talking on the phone, listening to music, and the transport environment itself. The first factor, which can be defined as a "personality" factor, is associated with our way of life, value systems and the attitudes we have before we get in our cars. All of them influence decision-making and govern our emotional control when we are in a risk situation. Analysis of the answers in the questionnaire interview has outlined the role of instructors which can study drivers' self-reflection and determine the risk tendencies and personality traits that affect their driving. The personality factor is also associated with the driver's profession. A CNN Money survey [11] shows the influence that people's professions have when they find themselves involved in risky situations and incidents. The study identifies 40 professions which have the most predisposition to involvement in traffic accidents. Something interesting about this study is the professions occupying the Top 5 spots and the ones occupying the Bottom 5 spots. The top spots in the list of the most dangerous drivers are occupied by students, doctors, lawyers, architects and real estate brokers. What people who work fields have in common is overstrain, which is associated with their everyday commitments, as well as using mobile phones as a means of distraction, considering the nature of their jobs. For Bulgaria specifically, in addition to the aforementioned signs, there is another one, namely the profitability of these professions, which makes the people working in these fields indulge in speeding when driving. Although students are an exception to that rule, the reason why they are at the top of the list is due to inexperience and self-validation in front of their colleagues. The main reasons why young drivers are the ones most frequently involved in traffic accidents include:

- Inexperience;
- Driving with other teenagers;
- Negligent or sleepy driving;
- Excessive speed;
- Driving in an intoxicated state;
- Driving at night;
- Incorrect use of seatbelts and helmets.

Another thing that drivers who work in these fields have in common in terms of their frequent involvement in accidents is their

ambition and excessive confidence in their ability to control things around them, which makes them take bigger risks.

Pilots, firefighters, farmers and housekeepers are classified as drivers who pose the least amount of risk. A common trait of people who work in the first two fields is that they are well-trained in terms of the dangers of driving. Furthermore, firefighters take part in cleanup and provide first aid at sites where serious accidents occur, not to mention they are very much aware of the consequences of speeding. People's personality traits and the way they behave when driving are crucial in regards to the other two professions. In Bulgaria, the same can be said for people who work in the first two fields and housekeepers to a certain extent. The rule of profitability and ambition applies more to farmers. Slight corrections are made to the top and bottom spots of the list in regards to the two categories – involvement in traffic accidents and speeding, but without resulting in accidents, only penalties in accordance with the Road Traffic Act (slips and acts).

Compliance with general traffic movement (social pressure) is another factor that influences road traumatism. When we are out on the road, especially at the large boulevards with dividing stripes between individual traffic lanes, we tend to comply with the movement of the other participants. When we are overtaken with sound signals, glares and/or vulgar gestures during certain moments of our journey, some drivers accelerate as a result of this "social pressure". The interviews with the drivers have determined that this pressure can also work in reverse, towards steadying the traffic. This can be achieved when the other traffic participants create conditions where aggressive drivers can overtake at places where it is convenient and safe to do so, thus helping steady the traffic and decrease road tension.

The growing number of problems in a society, such as the pandemic from 4 years ago, the inflation processes in Europe and Bulgaria, war conflicts, and general injustice in society, has caused many people to develop various psychological and chronic disorders, which in turn has forced them to resort to medication, and in some cases, particularly with young people, to the use of alcohol and narcotic substances. As a result, vehicles and by extension driving have become a type of outlet for this disappointment and the anxiety that comes with it, thus triggering road rage, which leads to speeding and overreacting to even the smallest provocations. The increased use of these medications impedes drivers' judgment, influences their mood and causes them to make the wrong decisions when they are driving. The fact of the matter is that most of us have disregarded traffic limits at one point, simply because we have never been in an accident caused by the speed at which we drive. In actuality, most drivers do not have an adequate judgment about the danger they can cause when speeding. The majority of them disregard speed limits due to the fact that they have never found themselves in a critical situation as a result of that. This sense of safety is based on the fact that luck, time and the tolerance of other traffic participants have kept aggressive drivers from finding themselves in a critical situation despite speeding. Judgment about the way of driving is determined in accordance with drivers' perceptions of what is safe, not what is actually on the road and the things that can happen. Bad habits, lack of experience, excessive confidence, negligence and to a certain extent complacency impede correct and adequate assessments of road risks. When it comes to speeding, the main misconception is that the faster we drive, the more difficult it is to cognitively process the rapidly changing road situation. The majority of the interviewed drivers have turned out to be people who have never used public transport and rely solely on their personal vehicles to travel within the urban transport system, which is the primary reason why they are more inclined to go over the speed limit to "make up for lost time", greatly overestimating the benefits of saving time in the process.

The design of the roads in the studied regions is of vital (key) importance for speeding, respectively traffic accidents. The streets in Sofia are designed on the basis of increasing transmissivity, i.e. a city oriented towards cars, not the safety of vulnerable traffic

participants – pedestrians and cyclists. For instance, the expansion of "Alexander Malinov" Blvd. in Mladost, "Ivan Geshov" Blvd. in Sofia's center, "Jawaharlal Nehru" and "Tsaritsa Giovanna" Blvd. in Lyulin and "Buxton Brothers" Blvd. with more lanes and better visibility gives confidence that we can travel at higher speed. In actuality, however, the possibility of driving more safely at higher speed based on improved visibility, is an illusion. In an urban environment, the design of more narrow streets, combined with trees and vegetation, increases uncertainty, which is a prerequisite for reducing speed. In fact, as Charles Marohn shows in his study on "85% of speed", roads between populated areas are different compared to streets in an urban environment [12]. Roadways in cities are far more complex and, in a way, they are a platform for building wealth within a community. This concept suggests that most drivers do not determine their speed on the basis of a specific number, but rather on the basis of how safe the environment seems to them. As such, the implementation of "85% of speed" is inappropriate when streets in an urban environment are designed and the approach of letting violations go unpunished (condonation) is frequently used. This in turn causes drivers to misjudge and misperceive the complexity of the environment in which they drive. The engineering expansion of the streets in Sofia creates comfort zones, makes turns smoother, and additional elements, which in principle are interurban roads and highways, are designed. This creates a deceptive feeling that the environment is simple, that you can relax as a driver, that you can dull your attention and not be vigilant. In actuality, speed increases and accidents become more frequent, i.e. the wrong signal is given that safe driving with excessive speed is possible through designing streets. As a result of this wrong idea, drivers make the wrong decision due to incorrect assessment of the situation, which leads to frequent crashes. The latest technological solutions, such as electric cars, further exacerbate this problem, as their design includes powerful engines and perfectly insulated coupes, which is a prerequisite for smooth and unnoticeable speeding. With these cars, power is supplied instantaneously, quietly and mainly in an exciting manner. This once again provides us with a false sense of safety and is a serious prerequisite for ending up in critical situations.

In conclusion, streets in an urban environment need to be designed in a way that will make drivers feel uncomfortable if they decide to endanger their safety, as well as the safety of the other traffic participants, by increasing speed.

Road traumatism is strongly influenced by listening to music in cars. Strong and fast musical rhythms elevate the pulse, which in turn affects the manner of driving. A study conducted by the South China University of Technology has determined that drivers who listen to loud music in their cars drive faster, have an elevated pulse, are more easily distracted and diverge more frequently from the traffic lane [13]. In regards to the surveyed drivers in Sofia (post-TA), results have shown that almost all of them (89%) had their radio or music device on, but all of them answered that this did not influence their behavior prior to the occurrence of the accident. The questionnaire survey shows that drivers who listen to music with a higher tempo in their cars and do not use public transport to traverse the urban environment are more frequently involved in accidents.

## 5. Conclusion

Deaths and heavy injuries caused by traffic accidents can be prevented if they are controlled effectively, so they do not exceed the permissible levels of injury for people. Of course, the easiest thing to do is to point out and accuse the obvious traffic violators, namely the young people who most frequently race on the streets and aggressively violate the rules. Identifying risk patterns of behavior during driving through clear policies in the training of young drivers is a prerequisite for reducing future road accidents.

The questionnaire survey has shown that the implementation of a system approach to road safety needs to take into account drivers' behavior in the context of traffic conditions, the changing environment and all factors that contribute to the prevention of

crashes. Road safety in urban conditions can be achieved with certain specific measures such as dynamic determination of speed limits, various forms of "intelligent" law enforcement, limiting speed through street design (3D cross-walks), automatic emergency braking of vehicles as a key component for preventing collisions.

The safety of vulnerable participants can be improved through positive approaches that take into account the limitations of human capabilities while simultaneously helping drivers react adequately, correctly and in a timely fashion when unforeseen road dangers suddenly arise. Examples in that regard are purposeful, accessible real-time information regarding traffic in Sofia, warnings about changes in the traffic situations due to repairs, new traffic organization, conflict intersections, even the dangers of bad meteorological situations. Road infrastructure safety can be achieved by turning it into an intelligent one, based on intelligent speed management systems and the avoidance of factors that cause distraction. The achievement of these recommendations requires effective actions oriented towards results and resource collateral in road safety management. This involves shared responsibility of all traffic participants, as well as the creation of a system for designing, planning, commissioning, managing and using intelligent transport systems that provide safety despite human fallibility.

The mission for "zero mortality" on Bulgarian roads (in particular in Sofia) can be an achievable goal if safety policies, which are adapted to new challenges such as urban traffic jams, the increasingly aggressive behavior of drivers and the dwindling resources for infrastructure maintenance, are implemented [14]. As Nikolova writes, "society desires the implementation of transport policies that guarantee the security of human life by implementing actions for increasing road safety" [15].

Decisions involve better and more intelligent speed management, improving the parameters of the infrastructure regarding the safety of vulnerable traffic participants and providing innovative systems for fast travel via public transport in an urban environment. A step in the right direction when it comes to reducing road traumatism is studying the possibility for implementing "coaching" as a training method in the development of driving skills and a basis for preventing negative behavior during driving. In conclusion, we all know that there is a difference between existing possibilities and realized (utilized) possibilities in terms of road safety management.

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