

Are self-driving cars a safer solution?

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Abstract

Traffic accidents result in the death of approximately 1.3 million people each year. The occurrence of these crashes is influenced by both human behaviour and environmental factors. Therefore, it is important to address these factors and promote safe driving behaviours to reduce the risk of accidents and improve road safety. One potential solution to the problem might be provided by autonomous technology. Self-driving cars can greatly improve road safety by eliminating human errors that lead to accidents such as speeding, distracted driving, and driving under the influence of alcohol or drugs. They are equipped with advanced sensors and technologies that can detect and respond to potential hazards more quickly and effectively than a human driver. Additionally, they can ensure that all passengers are wearing seat belts and can even enforce the use of child restraints. Self-driving cars have the potential to reduce the number of accidents caused by poor road design and reckless driving and can be programmed to obey traffic laws. Despite advances in self-driving car technology, challenges such as safety concerns, infrastructure and regulatory development, and public trust in the technology remain significant obstacles that must be addressed before widespread deployment can be achieved. This study aims to assess the safety and the perception thereof of self-driving cars compared to traditional vehicles by analysing relevant international literature and official data on the topic.

Keywords: self-driving cars, road safety, identification, quantum computers

1 Introduction

According to WHO (2022) About 1.3 million people die each year due to road traffic crashes. Traffic accidents are caused by a combination of human behaviour and environmental factors, and addressing these factors and promoting safe driving behaviours is crucial for reducing the risk of accidents and ensuring road safety for all. Numerical measurement of road safety is important to evaluate and compare problems, assess solutions, and select problems for treatment. The goal is to reduce fatalities and serious injuries on roads and create safer transportation systems.

As of 2021, the technology for self-driving cars has advanced significantly and has the potential to offer many benefits, such as improved road safety, reduced congestion, and increased mobility for people who are unable to drive. However, there are still significant challenges that need to be overcome before self-driving cars can be widely

deployed, such as ensuring their safety, developing the necessary infrastructure and regulations, and building public trust in the technology.

Current articles endeavours to analyse whether self-driving cars are indeed a safer option of transport than traditional vehicles in the light of relevant international literature and official data published on the topic.

2 Road safety

Road safety refers to measures and strategies aimed at reducing the risk of accidents and injuries occurring on roads and highways. This includes both the design and maintenance of roads, as well as the behaviour of road users such as drivers, pedestrians, and bicyclists. Effective road safety measures can improve road conditions, increase the visibility of road users, promote safe behaviours, and provide adequate response in case of an emergency (Elvik, 2008). The goal of road safety is to reduce the number of fatalities and serious injuries on roads and to create safer and more accessible transportation systems for all.

The improvement of road safety in highly motorized countries has been significant in the past 30-35 years. However, no country is completely satisfied with their safety record and some issues, such as speeding and high accident rates among young drivers, persist despite attempts to address them. Since road safety problems are complex by nature and can be viewed from different perspectives, numerical measurement of road safety is important, since it enables evaluation and comparison of problems, assessment of potential solutions and aid in selecting problems for treatment. Accordingly, road safety problems can generally be interpreted as risk factors. They may exist even when not perceived or recognised.

There are nine dimensions of road safety that are important to be analysed; the numerical measurement of which can facilitate adequate measures to improve the current situation.

1. Magnitude refers to the contribution of a problem to the total number of accidents or killed or injured road users (Albalade, Fageda, 2019). It is a measure of the importance of the problem in terms of its impact on road safety. For example, a problem that contributes to a large proportion of accidents or injuries would have a high magnitude, while a problem that contributes to a small proportion of accidents or injuries would have a low magnitude. Magnitude can be measured numerically using the population attributable risk, which represents the proportion of accidents or injuries that can be attributed to a particular problem. The higher the population attributable risk, the greater the magnitude of the problem (Moslem, 2020).

2. Severity measures the gradient of the attributable risk associated with a problem with respect to levels of injury severity. It is a measure of the seriousness of the problem in terms of the harm it can cause to road users (Sinha et al, 2020). Severity can be measured numerically by comparing the attributable risk associated with a problem

across different levels of injury severity, or by comparing the shares of injuries by different levels of severity. The gradient of the attributable risk associated with a problem with respect to levels of injury severity can also be used as a measure of severity. In general, the higher the attributable risk associated with a particular problem, the greater its severity (Eboli, Forciniti, Mazzula, 2020).

3. Externality in road safety refers to the impact of a problem on road users who are not directly involved in the problem. It occurs when the travel or behaviour of one group of road users imposes an additional risk on other groups of road users who are not directly involved. Externality can be measured numerically by estimating the net contribution to the overall risk of a road user group attributable to risks imposed by other groups (Albalade, Fageda, 2021). This involves assessing the degree to which the risk faced by a particular road user group is influenced by the behaviour of other groups. Externality is an important dimension to consider in road safety because it highlights the need to address problems that may be caused by a particular group of road users but that impact other groups as well (Tang, Ommeren, 2022).

4. Inequity refers to the unequal distribution of risk among different groups of road users. It is concerned with the idea that the burden of road crashes is not evenly shared among road users, and that certain groups may be more vulnerable to crashes than others. Inequity can arise from differences in exposure to risk, as well as differences in the severity of crashes experienced by different groups (Lin, Shi, Li, 2021). In scientific terms, inequity can be measured by comparing the distribution of crashes or injuries across different groups of road users to their distribution of exposure to risk. For example, if one group of road users has a higher incidence of crashes relative to their exposure to risk than another group, this would suggest that the burden of risk is unfairly distributed. Inequity can also be measured by comparing the distribution of risk with the distribution of benefits derived from transport. This can help identify situations where certain groups are exposed to higher levels of risk than can be justified by the benefits they derive from transport (Heydari et al, 2019).

5. Complexity measures the extent to which the specific contributions of individual risk factors to the overall risk can be identified. In scientific terms, complexity in the context of road safety refers to the extent to which the specific contributions of individual risk factors to the overall risk represented by a problem can be identified (Tapiro, Oron-Gilad, Parmet, 2020). This dimension considers factors such as the number of risk factors that contribute to a problem and the level of correlation among them. The more factors that contribute to a problem, the more complex it is. Additionally, if there are correlations among the factors that prevent their unique contributions from being identified or if there are interactions among the risk factors with respect to their effect on accident rate, the problem is considered more complex. Finally, if the sum of known factors is more than what is needed to explain the overall risk, the problem is considered over-determined or highly complex. The level of complexity is important because it affects the ability to develop effective solutions to the problem. If the problem is highly complex, it may be more difficult to identify the most effective solution, as well as to implement it successfully (Heydari et al, 2019).

6. Spatial dispersion captures the degree to which accidents are geographically concentrated or dispersed. It reflects the extent to which accidents occur in a specific location or over a wider area. If accidents are highly concentrated in a small geographic area, this suggests that there may be particular factors or characteristics of that area that are contributing to the accidents. On the other hand, if accidents are more dispersed, this may suggest that there are multiple factors or characteristics that contribute to accidents across a wider area (Ziakopoulos, Yannis, 2020). Spatial dispersion can be measured by determining the distance between accident hotspots or clusters that have been identified statistically. This can help to identify areas where interventions may be most effective in reducing the overall number of accidents, such as improving road design or addressing specific risk factors in those locations. By understanding the spatial distribution of accidents, policymakers and planners can make informed decisions about how to allocate resources and implement interventions to improve road safety in a targeted and effective way (Hezaveh, Arvin, Cherry, 2019).

7. Temporal stability refers to changes over time with respect to the magnitude of a road safety problem. It is a measure of the consistency or variability of the problem over a given period. For instance, if the number of accidents or injuries due to a particular risk factor varies significantly from year to year, the temporal stability of the problem is considered low. On the other hand, if the problem remains consistent over time, the temporal stability is considered high (Yu et al, 2020). Temporal stability is an essential dimension of road safety problems because it influences the effectiveness of road safety policies and interventions. If a problem is unstable over time, policies and interventions may need to be adjusted frequently to address changing circumstances. Conversely, if a problem is stable over time, policies and interventions can be designed and implemented more effectively, as they are based on reliable data and trends. Temporal stability can be measured using time-series data, which involves collecting data at multiple time points and analysing how the problem changes over time. Time-series analysis can provide insights into trends, patterns, and cycles in the problem and can help policymakers and researchers identify the most effective interventions to address the issue (Se et al, 2021).

8. Perceived urgency is the extent to which road safety issues are considered important and require immediate attention by various stakeholders involved in road safety, such as policymakers, road users, and community members (Large et al 2019). Perceived urgency measures the strength of support in the population for stronger action or regulations to solve a problem. Accordingly, it reflects the level of public concern and support for addressing specific road safety problems and implementing effective solutions. For example, stakeholders may perceive a particular road safety problem, such as speeding or distracted driving, as urgent if it has resulted in a high number of accidents, fatalities, or injuries, or if there is a strong demand from the community to address the problem. Perceived urgency can also be influenced by factors such as media coverage, advocacy efforts, and political pressure, which may draw attention to certain road safety issues and elevate their priority on the agenda of stakeholders (Elvik, 2010).

9. Amenability to treatment, in the context of road safety, refers to the extent to which a road safety problem can be effectively addressed through interventions or treatments that have been shown to be effective in reducing the magnitude of the problem (Elvik, 2008). It depends on factors such as the complexity of the problem, the availability of effective treatments, and the perceived urgency to take action. A problem that is highly amenable to treatment is one for which there are well-established interventions that have been shown to be effective and can be easily implemented. In contrast, a problem that is not amenable to treatment may be difficult to address because effective interventions have not yet been identified or are not practical to implement. The amenability to treatment is an important consideration in road safety policymaking, as it can help policymakers prioritize which problems to address first and which interventions to implement. By focusing resources on problems that are more amenable to treatment, policymakers can maximize the impact of their efforts to improve road safety (Mohan, 2019).

3 Traffic accidents

About 1.3 million people die each year due to road traffic crashes, with over half of all deaths occurring among pedestrians, cyclists, and motorcyclists (WHO, 2022). Road traffic injuries are also the primary cause of death for children and young adults aged 5-29 years. Low- and middle-income countries account for 93% of these fatalities, despite having only 60% of the world's vehicles. Road traffic injuries also result in significant economic losses for individuals, families, and nations. These losses stem from the costs of treatment and lost productivity for those killed or disabled by injuries and for family members who need to take time off work or school to care for the injured. In most countries, road traffic crashes cost around 3% of their gross domestic product (Tiwari, 2022). In line with the urgency and extent of the problem, the United Nations General Assembly has set a target to reduce the global number of deaths and injuries from road traffic crashes by 50% by 2030 (UN, 2019).

Traffic accidents are often caused by a combination of human behaviour and environmental factors, including road design, vehicle design, weather conditions, road infrastructure, and lack of enforcement. Addressing these factors and promoting safe driving behaviours is crucial for reducing the risk of accidents and ensuring road safety for all.

The main causes of traffic accidents are mostly human related (Szumska, Grej, Grab-ski, 2020, Bucsuházy et al, 2020), such as speeding, distracted, or under influence driving under influence, or the neglect of the use of protective gear.

An increase in average speed is directly related to the likelihood of a crash occurring and the severity of its consequences. Even a 1% increase in mean speed results in a 4% increase in the risk of a fatal crash and a 3% increase in the risk of a serious crash (Aarts, Van Schagen, 2008). The death risk for pedestrians hit by car fronts rises rapidly as speed increases, with a 4.5 times higher risk from 50 km/h to 65 km/h. In car-to-car side impacts, the fatality risk for car occupants is as high as 85% at 65 km/h.

Distracted driving is a growing concern for road safety. Drivers using mobile phones are four times more likely to be involved in a crash than those not using a mobile phone. Using a phone while driving slows reaction times, makes it difficult to stay in the correct lane, and to keep the correct following distances (Consiglio et al. 2003). Hands-free phones are not much safer than hand-held phone sets, and texting considerably increases the risk of a crash.

Driving under the influence of alcohol or any psychoactive substance or drug significantly increases the risk of a crash that results in death or serious injuries. Even at low levels of blood alcohol concentration (BAC), the risk of a road traffic crash increases significantly. The risk of a fatal crash increases fivefold among those who have used amphetamines (Simonsen et al, 2022).

The use of helmets, seatbelts, and child restraints can greatly reduce the risk of fatal and serious injuries in road traffic crashes. Correct helmet use can reduce the risk of fatal injuries by 42% and head injuries by 69% (Abdi et al, 2022). Wearing a seatbelt can reduce the risk of death among drivers and front seat occupants by 45-50%, and among rear seat occupants by 25%. The use of child restraints can reduce the risk of death by 60%.

Of course, in multiple cases the severity of the traffic accidents is not (solely) influenced by the drivers' behaviour, but other external stakeholders/factors, such as the vehicles themselves, the roads or the legislative background is also to be blamed.

The design of roads and vehicles can have a considerable impact on road safety. Roads should be designed with the safety of all road users in mind, with adequate facilities for pedestrians, cyclists, and motorcyclists. Measures such as footpaths, cycling lanes, safe crossing points, and traffic calming measures can reduce the risk of injury among these road users (Sun et al, 2019). Safe vehicles play a critical role in averting crashes and reducing the likelihood of serious injury. UN regulations on vehicle safety, including front and side impact regulations, electronic stability control, and airbags and seatbelts, can potentially save many lives.

Enforcement of traffic laws is critical to reducing road traffic fatalities and injuries related to specific behaviours. Laws addressing risk factors such as drink-driving, seatbelt wearing, speed limits, helmets, and child restraints must be established, regularly updated, and enforced at the national, municipal, and local levels, with appropriate penalties defined (Castillo-Manzano et al, 2019). If laws are not enforced, they are unlikely to be complied with and will have little chance of influencing behaviour.

4 The potential of autonomous cars

Autonomous cars, also known as self-driving cars, are vehicles equipped with sensors and computer systems that allow them to drive independently without human input. The cars are able to make decisions based on information from their surroundings, such as setting speed, direction, and distance. The development of autonomous cars represents a significant advancement in the automotive industry and is expected to greatly

improve the safety, efficiency, and sustainability of transportation (Madarász, Szikora, 2018a, 2020).

Autonomous vehicles have the potential to significantly improve road safety by reducing the number of accidents caused by human error. For example, self-driving cars can eliminate issues such as distracted driving, impaired driving, and reckless driving (Papadoulis, Quddus, Imprialou, 2019).

Self-driving cars have the potential to provide solutions to the problems highlighted in the previous chapter by eliminating human error, self-driving cars can reduce the number of accidents caused by speeding, distracted driving, and driving under the influence of alcohol or drugs (Wang et al, 2020; Conningham, Regan, 2015). Self-driving cars can also improve road safety by ensuring that all passengers are wearing seat belts and are properly restrained.

Self-driving cars have been proposed as a solution to the problem of human error in driving, which is the main cause of traffic accidents. Self-driving cars use advanced sensors, machine learning algorithms, and artificial intelligence to navigate roads, avoid obstacles, and make decisions on behalf of the driver (. By eliminating human error, self-driving cars have the potential to reduce the number of accidents on our roads and make them safer for everyone.

One of the main advantages of self-driving cars is that they can eliminate the problem of speeding. Self-driving cars can be programmed to obey speed limits, and they can adjust their speed based on traffic conditions and road hazards. This means that the risk of a fatal crash or serious injury can be reduced. Self-driving cars can also reduce the risk of crashes caused by distracted driving, which is a growing concern for road safety. Additionally, autonomous vehicles are equipped with advanced safety features and technologies, such as sensors, cameras, and GPS, that can detect and respond to potential hazards more quickly and effectively than a human driver. Self-driving cars can detect distractions and intervene to prevent accidents, making our roads safer for everyone.

Driving under the influence of alcohol or drugs significantly increases the risk of a crash that results in death or serious injuries. Self-driving cars can eliminate this risk entirely, as they do not drink or take drugs. Self-driving cars can also improve road safety by ensuring that all passengers are wearing seat belts and are properly restrained. Self-driving cars can detect whether passengers are wearing seat belts and can alert them if they are not.

The use of helmets, seat belts, and child restraints can greatly reduce the risk of fatal and serious injuries in road traffic crashes. Self-driving cars can ensure that all passengers are wearing seat belts and can even enforce the use of child restraints. This can help to reduce the number of fatalities and serious injuries on our roads.

Additionally, the design of roads and vehicles can also have a considerable impact on road safety. Self-driving cars can navigate roads and avoid obstacles more effectively than human drivers, which means that they can reduce the risk of crashes caused by poor road design. Self-driving cars can also be designed to be safer than traditional

cars, with features such as electronic stability control, airbags, and seat belts. This can help to reduce the number of fatalities and serious injuries on our roads.

Enforcement of traffic laws is critical to reducing road traffic fatalities and injuries related to specific behaviours. Self-driving cars can be programmed to obey traffic laws and can alert authorities if they detect unsafe driving behaviours. This can help to ensure that traffic laws are being enforced and can reduce the number of accidents caused by reckless driving.

Which means that self-driving cars have the potential to make our roads safer for everyone and to reduce the number of fatalities and serious injuries on our roads.

5 Perceptions and limitations

The perceived security of self-driving cars refers to how safe and reliable people believe autonomous vehicles to be (Lazányi, 2023). Currently, many people are still sceptical about the safety and reliability of self-driving cars, and this perception is shaped by a variety of factors such as media coverage, personal experiences, and lack of knowledge about the technology. The level of trust in self-driving technology is influenced by various factors such as personal experiences, media coverage, and education about the technology (Szatmáry, Szikora, 2023). In general, people are more likely to trust autonomous cars if they have a positive experience with the technology or if they are provided with clear and transparent information about how the technology works and its benefits (Szikora, Madarász, 2017; Madarász, Szikora, 2018b).

Studies have shown that people are generally more concerned about the safety of autonomous cars compared to traditional vehicles, due in part to high-profile accidents involving self-driving vehicles. This is most cases a magnification of the actual failure, but in many aspects the lack of trust may still be grounded (Szikora, Madarász 2018a, 2018b).

Building trust in self-driving technology is crucial for the widespread adoption of autonomous vehicles (Lazányi, 2018; Lazányi, Marácz, 2017). This can be achieved through ongoing research and development, regular safety evaluations, and increased public education and awareness about the technology.

To conclude, trust in self-driving technology is an important factor in determining the future of autonomous vehicles (Szikora, Madarász, 2017). While some people have high levels of trust in the technology, others remain sceptical, and it will be important for manufacturers and regulators to work together to address public concerns and build confidence in the safety and reliability of self-driving cars.

Self-driving cars raise several security concerns, including:

- **Hacking susceptibility:** The growing dependence on computer systems in autonomous vehicles renders them susceptible to cyberattacks and hacking, resulting in unauthorized access to sensitive data and control over the vehicle's movements.

- Human intervention requirement: While self-driving vehicles are designed to operate autonomously, they occasionally require human intervention in unanticipated or challenging circumstances, which may result in system failures.
- Liability ambiguity: In the event of a self-driving vehicle-caused accident, assigning responsibility can be challenging, which creates legal and liability concerns.
- Privacy concerns: Autonomous cars generate vast quantities of passenger data, raising privacy concerns. This information may be utilized for targeted advertising, surveillance, and other applications.
- Technical limitations: The operation of self-driving vehicles is dependent on a complex set of sensors, cameras, and software systems, and any flaws in these components may result in errors or malfunctions.
- Sensor malfunctions: The sensors utilized in self-driving cars, including cameras, lidar, and radar, may fail, leading to insufficient information and incorrect data input.
- Algorithmic errors: Self-driving vehicles rely on algorithms to make decisions and navigate roads, and any flaws or defects in these algorithms may result in system failures.
- System failures: Self-driving cars depend on intricate systems and algorithms to operate, and any system malfunction or failure can lead to dangerous and unpredictable consequences.
- Environmental challenges: Self-driving cars face numerous challenges in real-world environments, including road conditions, weather, and other drivers. Changes or disruptions to these conditions can result in system failures.
- Lack of standards and regulations: Currently, self-driving vehicles have limited standards and regulations, which can result in inconsistent and unreliable technology.
- Regulatory challenges: Self-driving cars are a novel technology, and there are currently inadequate regulations in place to oversee their usage and development. This poses difficulties in guaranteeing public safety and safeguarding individual rights.

Taking these into account, self-driving technology failure can be caused by a variety of technical, environmental, and regulatory factors. It is important for manufacturers and regulators to address these challenges and continue to improve the technology to ensure its reliability and safety. Overall, security issues surrounding autonomous cars require careful consideration and ongoing efforts to develop solutions to ensure their safe and secure deployment. However, as the technology continues to evolve and improve, it is possible that people's perceptions of the security of self-driving cars will change.

Thus, it is difficult to say whether autonomous cars are definitively safer than normal cars, as there are still many unknowns about the long-term safety of autonomous vehicles. However, proponents of autonomous vehicles argue that, in theory, they have the potential to be safer than traditional cars because they can remove the risk of human error, which is a leading cause of accidents. On the other hand, autonomous technology

is still developing and there have been high-profile accidents involving autonomous vehicles, so more data is needed to determine the overall safety of these cars.

6 Conclusion

In conclusion, self-driving cars have the potential to revolutionize the way we travel and improve road safety in significant ways. By eliminating human error, such as speeding, distracted driving, and driving under the influence of alcohol or drugs, self-driving cars can reduce the number of accidents caused by these factors. Equipped with advanced sensors and technologies, autonomous vehicles can detect and respond to potential hazards more quickly and effectively than human drivers, potentially saving countless lives.

Moreover, self-driving cars can improve passenger safety in other ways, such as by ensuring that all passengers are wearing seat belts and can even enforce the use of child restraints. These vehicles can be programmed to obey traffic laws and reduce the number of accidents caused by poor road design and reckless driving. By leveraging the latest advancements in technology, self-driving cars can offer a safer and more convenient mode of transportation for people of all ages and abilities.

However, for the widespread adoption of self-driving cars, it is crucial to build trust and confidence in the technology. While some people have high levels of trust in autonomous vehicles, others remain sceptical, and it will be important for manufacturers and regulators to work together to address public concerns and build confidence in the safety and reliability of self-driving cars. This can be achieved through ongoing research and development, regular safety evaluations, and increased public education and awareness about the technology.

While there are valid security concerns surrounding autonomous vehicles, such as hacking susceptibility and liability ambiguity, these challenges can be addressed through continued efforts to improve the technology and establish standards and regulations to ensure their safe and secure deployment. As the technology continues to evolve and improve, it is possible that people's perceptions of the security of self-driving cars will change.

In summary, self-driving cars represent a promising new era of transportation that has the potential to greatly enhance road safety and improve the quality of life for people around the world. While there are still many unknowns about the long-term safety of autonomous vehicles, the benefits they offer are too significant to ignore. By leveraging the latest advancements in technology and working to build trust and confidence in the technology, self-driving cars can become a safer and more efficient mode of transportation for generations to come.

References

1. Aarts, L., & Van Schagen, I. (2006). Driving speed and the risk of road crashes: A review. *Accident Analysis & Prevention*, 38(2), 215-224.
2. Abdi, N., Robertson, T., Petrucka, P., & Crizzle, A. M. (2022). Do motorcycle helmets reduce road traffic injuries, hospitalizations and mortalities in low and lower-middle income countries in Africa? A systematic review and meta-analysis. *BMC public health*, 22(1), 824.
3. Albalade, D., & Fageda, X. (2019). Congestion, road safety, and the effectiveness of public policies in urban areas. *Sustainability*, 11(18), 5092.
4. Bucsuházy, K., Matuchová, E., Zúvala, R., Moravcová, P., Kostíková, M., & Mikulec, R. (2020). Human factors contributing to the road traffic accident occurrence. *Transportation research procedia*, 45, 555-561.
5. Castillo-Manzano, J. I., Castro-Nuño, M., López-Valpuesta, L., & Pedregal, D. J. (2019). From legislation to compliance: The power of traffic law enforcement for the case study of Spain. *Transport policy*, 75, 1-9.
6. Cunningham, M., & Regan, M. A. (2015). Autonomous vehicles: human factors issues and future research. In *Proceedings of the 2015 Australasian Road safety conference*, 14-16.
7. Eboli, L., Forciniti, C., & Mazzulla, G. (2020). Factors influencing accident severity: an analysis by road accident type. *Transportation research procedia*, 47, 449-456.
8. Elvik, R. (2008). Dimensions of road safety problems and their measurement. *Accident Analysis & Prevention*, 40(3), 1200-1210.
9. Elvik, R. (2008). Dimensions of road safety problems and their measurement. *Accident Analysis & Prevention*, 40(3), 1200-1210.
10. Elvik, R. (2010). Why some road safety problems are more difficult to solve than others. *Accident analysis & prevention*, 42(4), 1089-1096.
11. Heydari, S., Hickford, A., McIlroy, R., Turner, J., & Bachani, A. M. (2019). Road safety in low-income countries: state of knowledge and future directions. *Sustainability*, 11(22), 6249.
12. Hezaveh, A. M., Arvin, R., & Cherry, C. R. (2019). A geographically weighted regression to estimate the comprehensive cost of traffic crashes at a zonal level. *Accident Analysis & Prevention*, 131, 15-24.
13. Large, D. R., Kim, H., Merenda, C., Leong, S., Harvey, C., Burnett, G., & Gabbard, J. (2019). Investigating the effect of urgency and modality of pedestrian alert warnings on driver acceptance and performance. *Transportation research part F: traffic psychology and behaviour*, 60, 11-24.
14. Lazányi, K. (2018). Are we Ready for Self-Driving Cars-a Case of Principal-Agent Theory. In *2018 IEEE 12th International Symposium on Applied Computational Intelligence and Informatics (SACI)* (pp. 000251-000254). IEEE.
15. Lazányi, K. (2023). Perceived Risks of Autonomous Vehicles. *Risks*, 11(2), 26.
16. Lazanyi, K., & Maraczi, G. (2017). Dispositional trust—Do we trust autonomous cars?. In *2017 IEEE 15th International Symposium on Intelligent Systems and Informatics (SISY)* (pp. 000135-000140). IEEE.
17. Lin, L., Shi, F., & Li, W. (2021). Assessing inequality, irregularity, and severity regarding road traffic safety during COVID-19. *Scientific reports*, 11(1), 1-7.
18. Madarász, N., & Szikora, P. (2018a). Are we really prepared for full autonomy. In *Available: 16th International Conference on Management, Enterprise and Benchmarking Proceedings: MEB* (pp. 233-240).

19. Madarasz, N., & Szikora, P. (2018b). Opportunities and dangers of self driving cars. In Proceedings of FIKUSZ Symposium for Young Researchers (pp. 280-288). Óbuda University Keleti Károly Faculty of Economics.
20. Madarász, N., & Szikora, P. (2020). Az önvezető autók–a jövő már a jelen?. Taylor, 12(1), 78-87.
21. Mohan, D. (2019). Traffic safety: Rights and obligations. *Accident Analysis & Prevention*, 128, 159-163.
22. Moslem, S., Farooq, D., Ghorbanzadeh, O., & Blaschke, T. (2020). Application of the AHP-BWM model for evaluating driver behavior factors related to road safety: A case study for Budapest. *Symmetry*, 12(2), 243.
23. Papadoulis, A., Quddus, M., & Imprialou, M. (2019). Evaluating the safety impact of connected and autonomous vehicles on motorways. *Accident Analysis & Prevention*, 124, 12-22.
24. Se, C., Champahom, T., Jomnonkwao, S., Karoonsoontawong, A., & Ratanavaraha, V. (2021). Temporal stability of factors influencing driver-injury severities in single-vehicle crashes: A correlated random parameters with heterogeneity in means and variances approach. *Analytic methods in accident research*, 32, 100179.
25. Simonsen, K. W., Hasselstrøm, J. B., Hermansen, S. K., Rasmussen, B. S., Andreasen, M. F., Christoffersen, D. J., & Linnet, K. (2022). The incidence of psychoactive substances and alcohol among impaired drivers in Denmark in 2015–2019. *Forensic science international*, 333, 111207.
26. Sun, L. L., Liu, D., Chen, T., & He, M. T. (2019). Road traffic safety: An analysis of the cross-effects of economic, road and population factors. *Chinese journal of traumatology*, 22(05), 290-295.
27. Szatmáry, R., & Szikora, P. (2023). Factors influencing technostress. In 2023 IEEE 21st World Symposium on Applied Machine Intelligence and Informatics (SAMI) (pp. 000299-000306). IEEE.
28. Szikora, P., & Madarász, N. (2017). Self-driving cars—The human side. In 2017 IEEE 14th international scientific conference on informatics (pp. 383-387). IEEE.
29. Szikora, P., & Madarász, N. (2018a). Önvezető autó–a társadalomnak tényleg szüksége van rá?. Taylor, 10(4. szám), 102-112.
30. Szikora, P., & Madarász, N. (2018b). Y generáció félelmei az önvezető autóktól= Y generation's fears from self-driving cars. *Közép-Európai Közlemények*, 11(2), 79-87.
31. Szumska, E., Frej, D., & Grabski, P. (2020). Analysis of the causes of vehicle accidents in Poland in 2009-2019. *LOGI–Scientific Journal on Transport and Logistics*, 11(2), 76-87.
32. Tapiro, H., Oron-Gilad, T., & Parmet, Y. (2020). Pedestrian distraction: The effects of road environment complexity and age on pedestrian's visual attention and crossing behavior. *Journal of safety research*, 72, 101-109.
33. Tiwari, G. (2022). Meeting the challenge of the second decade of road safety: evidence supported by quality research. *International journal of injury control and safety promotion*, 29(4), 421-422.
34. UN Statistics (2019). Global indicator framework for the sustainable development goals and targets of the 2030 agenda for sustainable development. *Developmental Science and Sustainable Development Goals for Children and Youth*, 439. Downloaded from: https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%20refinement_Eng.pdf
35. Wang, J., Zhang, L., Huang, Y., Zhao, J., & Bella, F. (2020). Safety of autonomous vehicles. *Journal of advanced transportation*, 2020, 1-13.

36. World Health Organization. (2022). Regional approach to the decade of action for road safety 2021-2030.
37. Yu, M., Zheng, C., Ma, C., & Shen, J. (2020). The temporal stability of factors affecting driver injury severity in run-off-road crashes: A random parameters ordered probit model with heterogeneity in the means approach. *Accident Analysis & Prevention*, 144, 105677.
38. Ziakopoulos, A., & Yannis, G. (2020). A review of spatial approaches in road safety. *Accident Analysis & Prevention*, 135, 105323.