



Faculty of Engineering
University of Kragujevac



Ministry of Science, Technological
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Motor Vehicles & Motors 2026
ECOLOGY -
VEHICLE AND ROAD SAFETY
- EFFICIENCY
Proceedings**



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FOREWORD

For 47 years, a traditional international gathering - originally known as a Symposium and, since 2006, as the "Motor Vehicles and Motors" Congress - has been held biennially at the Faculty of Engineering (formerly the Faculty of Mechanical Engineering) of the University of Kragujevac. This year, the 11th International Congress "Motor Vehicles and Motors" took place in Kragujevac on October 8th–9th, 2026, under the traditional motto: "Ecology – Vehicle and Road Safety – Efficiency".

A large number of authors from both the country and abroad responded to the organizers' invitation, resulting in numerous high-quality submissions across the event's core areas: "Power Train Technology," "Vehicle Design and Manufacturing," "Vehicle Dynamics and Intelligent Control Systems," "Driver/Vehicle Interface, Information Systems, and Assistance Systems," and "Transport Challenges in Emerging Economies." Additionally, two topics were officially introduced for the first time: "Artificial Intelligence in Automotive Technology" and "Autonomous Vehicles".

A total of 63 papers were accepted for presentation following a rigorous peer-review process. The presentations were organized into sessions, including a newly introduced poster session dedicated to students and young researchers.

The Congress organizers extend their special gratitude to the distinguished scientists in the fields of motor vehicles and transportation who agreed to deliver three inspiring introductory lectures addressing the heart of contemporary issues in the sector: prof. dr Ralph Putz (Landshut University of Applied Sciences, Germany), prof. dr Aleksandar Stevanović (University of Pittsburgh, USA), and prof. dr. Isak Karabegović (Academy of Sciences and Arts of Bosnia and Herzegovina, Bosnia and Herzegovina).

We extend our sincere gratitude to the esteemed members of the Congress Scientific Committee—who also served as reviewers for the papers submitted for presentation—for their significant contribution to the overall quality of the accepted papers.

The organization of the Congress was once again supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, the Faculty of Engineering of the University of Kragujevac, and the International journal "Mobility & Vehicle Mechanics" and we sincerely thank them for their support.

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PREDGOVOR

Već 47 godina, svake druge godine, na Fakultetu inženjerskih nauka (nekada Mašinskom fakultetu) Univerziteta u Kragujevcu održava se tradicionalan međunarodni skup, nekada nazivan Simpozijum, a od 2006. godine - Kongres „Motorna vozila i motori“. Ovogodišnji, 11. Međunarodni kongres „Motorna vozila i motori“ održan je u Kragujevcu od 8. do 9. oktobra 2026. godine, uz tradicionalni moto „Ekologija – Vozilo i bezbednost na putu – Efikasnost“.

Na poziv organizatora odazvao se veliki broj autora iz zemlje i inostranstva, što je donelo veliki broj prijavljenih kvalitetnih radova iz glavnih oblasti skupa: „Tehnologija pogonskog sistema“, „Dizajn i proizvodnja vozila“, „Dinamika vozila i inteligentni upravljački sistemi“, „Interfejs vozač/vozilo, informacioni sistemi i sistemi za pomoć“, „Transportni izazovi ekonomija u usponu“, uz prvi put zvanično promovisane teme – „Veštačka inteligencija u automobilskoj tehnologiji“ i „Autonomna vozila“.

Ukupan broj od 63 radova je prihvaćen za prezentaciju posle rigoroznog procesa recenziranja. Rad je organizovan po sekcijama, uz prvi put promovisanu poster sekciju namenjenu za studente i mlade istraživače.

Organizatori Kongresa su posebno zahvalni istaknutim naučnicima iz oblasti motornih vozila i saobraćaja koji su pristali da održe tri inspirativna uvodna predavanja koja zadiru u srž savremenih pitanja vezana za vozila i saobraćaj, a to su: prof. dr Ralph Putz (Landshut University of Applied Sciences, Nemačka), prof. dr Aleksandar Stevanović (University of Pittsburgh, SAD) i prof. dr Isak Karabegović (Akademija nauka i umjetnosti Bosne i Hercegovine, Bosna i Hercegovina).

Veliku zahvalnost dugujemo našim dragim članovima Naučnog odbora Kongresa, ujedno i recenzentima radova prijavljenih za prezentaciju na Kongresu, koji su mnogo doprineli ukupnom kvalitetu konačno prihvaćenih radova.

Organizaciju Kongresa i ovog puta su podržali: Ministarstvo nauke, tehnološkog razvoja i inovacija Republike Srbije, Fakultet inženjerskih nauka Univeziteta u Kragujevcu i Međunarodni časopis „Mobility & Vehicle Mechanics“, na čemu im se iskreno zahvaljujemo.

Naučni odbor i Organizacioni odbor Kongresa MVM2026

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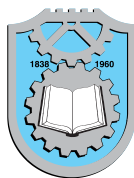
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THE IMPACT OF “DRUNK BUSTERS” ON THE ADEQUATE PERFORMANCE OF TASKS

ABSTRACT: Driving under the influence of alcohol has become a major issue in modern society, significantly contributing to the occurrence of traffic accidents. Traffic accidents caused by drivers under the influence of alcohol often result in more severe consequences. In the first part of the study, data obtained from the Traffic Safety Agency were analyzed, with alcohol impairment identified as a contributing factor to traffic accidents. Based on the conducted analysis, it was determined that 6.61% of all traffic accidents in 2025 occurred as a result of driving under the influence of alcohol. In addition, an experimental study was conducted involving twelve participants. Initially, the participants completed a short questionnaire, after which they performed a series of predefined tasks while wearing alcohol impairment simulation goggles. Of the participants involved in the experiment, 42% reported having driven under the influence of alcohol, while only one participant had previously been sanctioned by the police. During the experiment, participants completed four different tasks while wearing alcohol impairment simulation goggles. The goggles simulated three levels of intoxication: 0.06–0.08 BAC, 0.08–0.15 BAC, and 0.15–0.25 BAC. For the majority of participants, the most challenging tasks were performed while wearing goggles simulating a blood alcohol concentration of 0.08–0.15 BAC. Since the participants were required to evaluate the difficulty of each task, the results suggested that their self-assessments were not entirely objective. Therefore, it can be concluded that future studies should focus on observing participants' behavior and movement patterns during task performance, as well as measuring the time required to complete each assigned task.

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KEYWORDS: traffic safety, alcohol, traffic accident, Drunk Busters

UTICAJ PRIMENE “PIJANIH NAOČARA” NA ADEKVATNO IZVRŠAVANJE RADNJI

REZIME: Danas je vožnja pod dejstvom alkohola postala glavni problem savremenog društva, a što uzrokuje nastanak saobraćajnih nezgoda. Posledice saobraćajnih nezgoda koje je prouzrokovao vozač pod dejstvom alkohola imaju teže posledice. U prvom delu istraživanju, analizirani su podaci Agencije za bezbednost saobraćaja gde je kao uzročnik pojave saobraćajne nezgode uzet uticaj alkohola. Na osnovu izvršene analize dolazi se do zaključka da se 2025. godine 6,61% saobraćajnih nezgoda dogodilo upravo zbog vožnje pod dejstvom alkohola. Takođe, u radu je izvršeno ispitivanje dvanaest ispitanika koji su prvo popunjavali kratak upitnik, a zatim izvršili definisane radnje u kojima su nosili „pijane naočare“. 42% ispitanika koji je učestvovao u eksperimentu je vozilo pod dejstvom alkohola, dok je samo jedan bio kažnjen od strane policije. Tokom eksperimenta ispitanici su izvršavali četiri različita zadatka i tokom svakog zadatka su nosili „pijane naočare“. Prvo su nosili naočara koje se simulirale nivo pijanstva 0,06 to 0,08 BAC, zatim 0,08 to 0,15 BAC i na kraju 0,15 to 0,25 BAC. Gotovo svim ispitanicima je bilo najteže da izvrše zadatak dok su nosili naočare koje simuliraju nivo pijanstva 0,08 to 0,15 BAC. Kako su ispitanici trebali da ocene koliko im je zapravo bio težak da izvrše svaki zadatak, došlo se do zaključka da nisu bili iskreni. Dolazi se do zaključka da pri budućim istraživanjima treba gledati ponašanje/kretanje pri izvršenju zadatka, kao i da se meri vreme koliko je potrebno da izvrše zadati zadatak.

KLJUČNE REČI: bezbednost saobraćaja, alkohol, saobraćajna nezgoda, pijane naočare

INTRODUCTION

Driving under the influence of alcohol is one of the greatest concerns in road traffic safety. Operating a vehicle while intoxicated can result in severe injuries to road users and may even lead to fatal outcomes. Research indicates that the likelihood of severe injuries and fatalities is approximately 3.5 times higher in traffic accidents involving at least one participant under the influence of alcohol (Ogden, E. J. D. and Moskowitz, H. 2004). This issue is observed worldwide (Chan, Y. S. and Tsai, W. D. 2024). Behavioral changes caused by alcohol consumption significantly increase the risk of traffic accidents. Accidents involving an intoxicated participant are also frequently associated with speeding violations (Johnson, S. 2025; Soner, S. et al. 2022). According to data from the World Health Organization, between 16% and 21% of road traffic fatalities are attributed to driving under the influence of alcohol (World Health Organization, 2023).

The same amount of alcohol does not affect every individual in the same way, as its effects depend on a person's psychophysical condition (Sayette, M. A. 2017). To accurately assess these effects, participants would need to consume an identical amount of alcohol, after which their behavior and responses in characteristic situations could be evaluated. However, conducting such experiments in real traffic conditions is neither safe nor recommended. Therefore, investigations of this kind can only be performed using driving simulators. Yu, Y. et al. (2025) examined 30 young and middle-aged participants who were divided into two groups: a group that consumed alcohol (BAC (blood alcohol concentration): 50 mg/100 ml) and a control group that did not consume alcohol. The authors concluded that participants who had consumed alcohol exhibited more aggressive driving behavior and paid less attention to events occurring on their left and right sides, indicating a reduced level of situational awareness.

Alcohol intoxication impairs brain function (Ogden, E. J. D. and Moskowitz, H. 2004) and adversely affects safe driving performance (Jongen, S. et al. 2014). Consequently, drivers under the influence of alcohol may overestimate their driving abilities and thereby increase the likelihood of causing a traffic crash (Zhao, Y. et al. 2024). Furthermore, it has been established that driving performance deteriorates when the blood alcohol concentration reaches 0.07%, even though drivers are often unaware of this decline in their abilities (Garrisson, H. et al. 2022). Despite strict regulations and penalties imposed for driving under the influence of alcohol, alcohol-impaired drivers continue to be involved in a substantial proportion of traffic accidents worldwide (World Health Organization, 2023).

Driving under the influence of alcohol remains a highly relevant topic in the field of road traffic safety. Traffic accidents involving at least one intoxicated participant attract considerable attention from the World Health Organization, as well as from researchers whose work focuses on traffic safety. The key questions addressed in this study, and which require further investigation, are as follows:

- What is the severity of traffic accidents involving at least one participant under the influence of alcohol?
- What is the number of traffic accidents involving at least one participant under the influence of alcohol in the territory of the Republic of Serbia?

- How do participants behave when exposed to simulations of different levels of alcohol intoxication?
- What measures can be implemented to reduce the incidence and consequences of driving under the influence of alcohol?

The introductory section presents the severity of injuries sustained in traffic accidents involving at least one participant under the influence of alcohol, thereby addressing the first research question. The third chapter provides an overview of the situation in the Republic of Serbia with regard to the number of traffic accidents involving at least one alcohol-impaired participant. The effects of alcohol on human performance are examined in the fourth chapter, which describes an experiment conducted with a group of participants using Drunk Busters. Drunk Busters are goggles which simulate the visual and cognitive effects of drunkenness. This is followed by a discussion of measures aimed at reducing both the occurrence and consequences of driving under the influence of alcohol, thereby addressing the fourth research question. Finally, the paper concludes with the key findings and conclusions derived from the conducted research.

RESEARCH METHODOLOGY

The methods employed in this study can be classified into three categories: statistical, survey-based, and experimental methods. The statistical method was applied to analyze traffic accidents in the Republic of Serbia involving at least one participant under the influence of alcohol. In addition, statistical techniques were used to process and evaluate the results obtained from the experimental phase of the research. The survey-based research was conducted through the administration of a structured questionnaire consisting of pre-designed questions.

Statistical method

In this study, descriptive statistics were employed to analyze the state of road traffic safety in the Republic of Serbia during the period from 2021 to 2025. In addition, descriptive statistical methods were used to process and interpret the data obtained from both the survey and experimental investigations.

Survey method

The survey study was conducted to obtain a clearer understanding of the participants involved in the experimental research. Specifically, it was designed to collect information regarding their driving experience, including the number of years they had held a driver's license, as well as their previous experience with driving under the influence of alcohol. In addition, the survey examined whether participants had ever been sanctioned by the relevant authorities for alcohol-impaired driving.

Experimental method

The experimental investigation consisted of the performance of four tasks, and that:

1. Following a predefined path (Figure 1a);
2. Inserting a key into a lock (Figure 1b);
3. Colour-matching task (Figure 1c), and
4. Carrying a tray with glasses (Figure 1d).

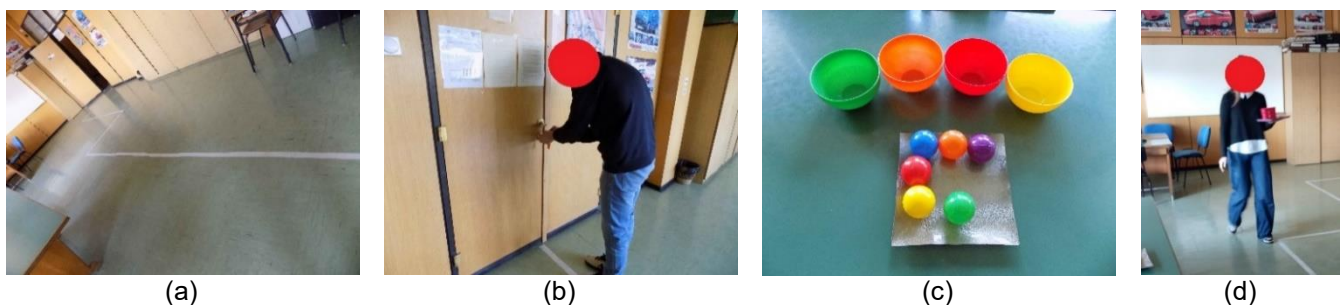


Figure 1 The tasks

The first task required participants to follow a predefined path, which, in the context of driving, corresponds to maintaining the vehicle within its designated lane without crossing into the opposing traffic lane. The second task can be associated with unlocking a vehicle door or inserting the key into the ignition to start the engine. The subsequent task involved matching colors, which, in practical driving situations, corresponds to recognizing and correctly interpreting traffic signal lights. The final task defined in this study required participants to carry a tray with glasses from one table to another, necessitating that they independently determine an appropriate path to the adjacent table

while ensuring that the glasses remained securely on the tray. In the context of driving, this task may be associated with the simultaneous execution of multiple actions that a driver must perform accurately and without error under real-world driving conditions.

The characteristics of Drunk Busters

During the performance of these tasks, the participants wore Drunk Busters, which simulate the effects of alcohol intoxication (Figure 2). The simulated levels of intoxication provided by the Drunk Busters were as follows:

- 0.06 to 0.08 BAC – blue Drunk Busters;
- 0.08 to 0.15 BAC – black Drunk Busters, and
- 0.15 to 0.25 BAC – red Drunk Busters.

The tasks were performed sequentially under different simulated levels of intoxication. Participants first completed all tasks while wearing Drunk Busters simulating the lowest level of intoxication, followed by the medium level, and finally the highest level of simulated intoxication.



Figure 2 Drunk Busters

The Drunk Busters (0.06 to 0.08 BAC) simulate the effects of a relatively low blood alcohol concentration. In addition, they reproduce the impact of this level of alcohol impairment under twilight conditions, thereby further increasing the difficulty of performing various tasks. The main characteristics of these goggles include:

- Tinted lenses that provide participants with a realistic simulation of nighttime driving conditions.
- Distortion of depth perception, causing distant objects to appear much closer than they actually are.
- A narrowed field of vision.

The Drunk Busters simulating a blood alcohol concentration of 0.08 to 0.15 BAC produce the following effects in participants:

- Double vision and impaired ability to accurately judge the distance of objects.
- Increased reaction time.
- Difficulty walking, particularly while maintaining a straight path.
- Reduced judgment and decision-making ability.

The Drunk Busters simulating a blood alcohol concentration of 0.15 to 0.25 BAC also replicate alcohol impairment under conditions of reduced visibility (twilight). They can be considered a combination of the characteristics exhibited by the previous two models. Their primary features include:

- Double vision accompanied by impaired spatial perception and inaccurate estimation of object location.
- Simulation of tunnel vision through a reduction in peripheral vision.
- Increased difficulty walking, particularly along a straight line.
- Disorientation and impaired decision-making ability.

ANALYSIS OF ROAD TRAFFIC SAFETY IN THE REPUBLIC OF SERBIA DURING THE PERIOD FROM 2021 TO 2025

This chapter presents an analysis of road traffic safety in the Republic of Serbia during the period from 2021 to 2025, with a particular focus on drivers under the influence of alcohol. The analysis was conducted from two perspectives: the occurrence of traffic accidents and the resulting consequences. The input data used in this study were obtained from the Integrated Database of Road Traffic Safety Characteristics maintained by the Road Traffic Safety Agency of the Republic of Serbia.

Analysis of Road Traffic Safety from the aspect of the number of traffic accidents

The analysis of traffic accidents involving at least one driver under the influence of alcohol is presented in Figure 3 for the period from 2021 to 2025. With regard to alcohol-impaired driving as one of the contributing factors to traffic

accidents, it can be observed that the highest number of fatalities during the analyzed period was recorded in 2022, followed by a subsequent decline in the following years. Similarly, the number of traffic accidents involving injured persons also showed a decreasing trend over the observed period. In contrast, the number of traffic accidents resulting solely in property damage was highest in 2021 and then decreased continuously until 2024. However, in 2025, the number of property-damage-only accidents increased compared to 2024, although it remained slightly lower than the level recorded in 2023.

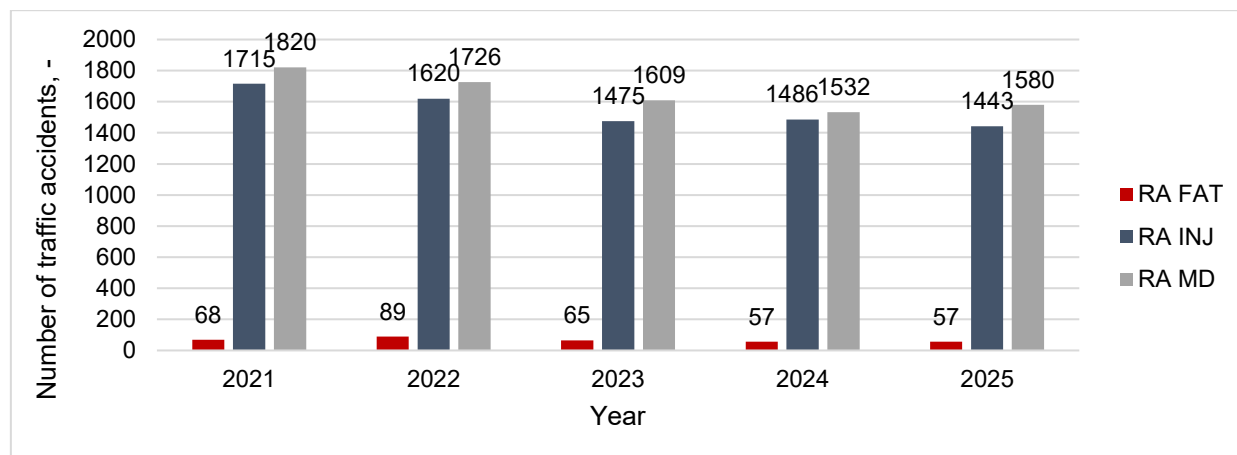


Figure 3 The number of traffic accidents with RA FAT, RA INJ and RA MD in period from 2021. to 2025.

Considering only the year 2025, the total number of fatal traffic accidents amounted to 862. The proportion of fatal traffic accidents involving at least one participant under the influence of alcohol accounted for 6.61% of the total number of fatal accidents. The total number of traffic accidents involving injured persons was 21,026, of which 6.86% involved at least one alcohol-impaired participant. Furthermore, the total number of property-damage-only traffic accidents was 25,372, with accidents involving at least one participant under the influence of alcohol representing 6.23% of this category. When considering the total number of traffic accidents regardless of severity, the proportion of accidents in which alcohol was identified as a contributing factor amounted to 6.52%.

Analysis of road traffic safety from the aspect of accident consequences

It is particularly important to determine the number of casualties involved in traffic accidents in order to gain a clearer understanding of the consequences suffered by road users. The number of fatalities during the analyzed period, classified according to the location at which death occurred, is presented in Figure 4. The highest number of fatalities occurred at the scene of the traffic crash. The second largest category consisted of individuals who succumbed to their injuries within 30 days following the crash. The smallest number of fatalities was recorded among individuals who died while being transported to the hospital as a result of injuries sustained in the traffic crash.

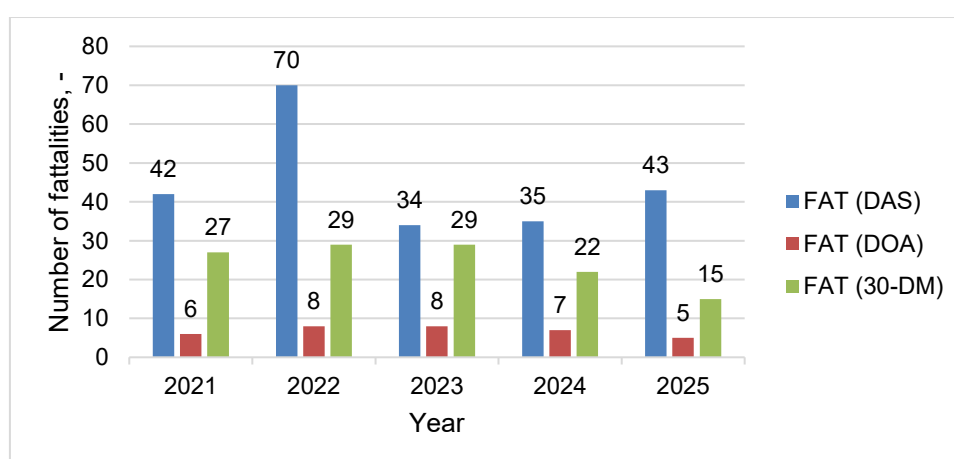


Figure 4 Number of fatalities in period from 2021. to 2025.

The total number of injured persons by injury severity category during the period from 2021 to 2025 is presented in Figure 5. The lowest number of injured persons was recorded in 2025. Furthermore, it can be observed that the overall number of injured persons generally decreased throughout the analyzed period, despite a slight increase in 2024 compared to 2023. A similar trend can be observed for the number of persons who sustained minor injuries, which also showed an overall decline during the study period. In contrast, the number of persons who sustained serious injuries exhibited greater variability. The highest number of seriously injured persons was recorded in 2024, while the lowest number was observed in 2023.

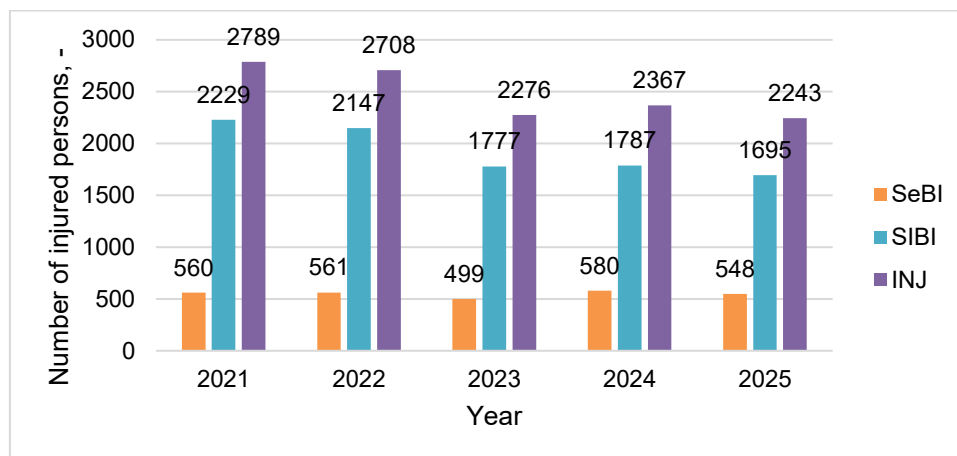


Figure 5 Number of injured persons in traffic accidents in period from 2021. to 2025.

RESULTS AND DISCUSSION OF THE SURVEY RESEARCH

The survey conducted as part of this study aimed to provide a better understanding of the characteristics of the participant group. The participants consisted of third- and fourth-year undergraduate students enrolled in academic study programs. The sample comprised twelve participants in total. One of the essential eligibility criteria for participation in the study was possession of a valid driver's license. The first survey question addressed the gender distribution of the participants. The study included seven female participants and five male participants. The following question concerned the length of time participants had held a driver's license. Given that the sample consisted of university students, it was expected that most participants would have less than five years of driving experience, as shown in Figure 6.

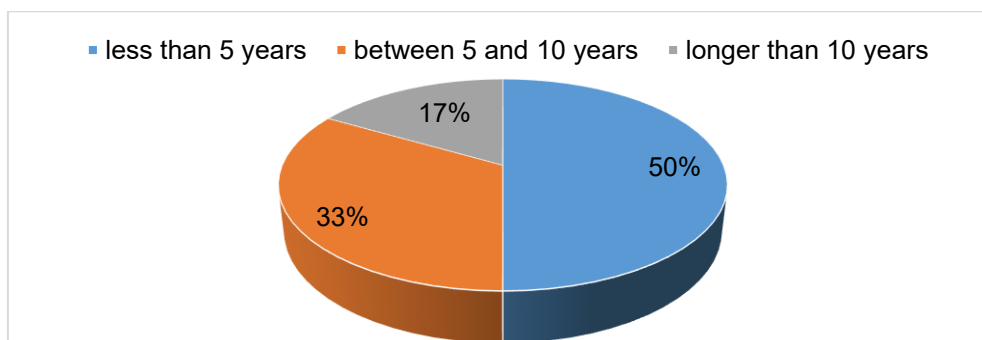


Figure 6 Duration of driving license possession

However, the length of time an individual has possessed a driver's license does not necessarily reflect the extent of their driving activity. For this reason, participants were asked the following question: "How many kilometers do you drive annually as a driver?" The largest proportion of participants (54%) reported driving between 1,000 km and 10,000 km per year, as shown in Figure 7. In contrast, 23% of participants reported driving more than 10,000 km annually, while the remaining 23% drove less than 1,000 km per year.

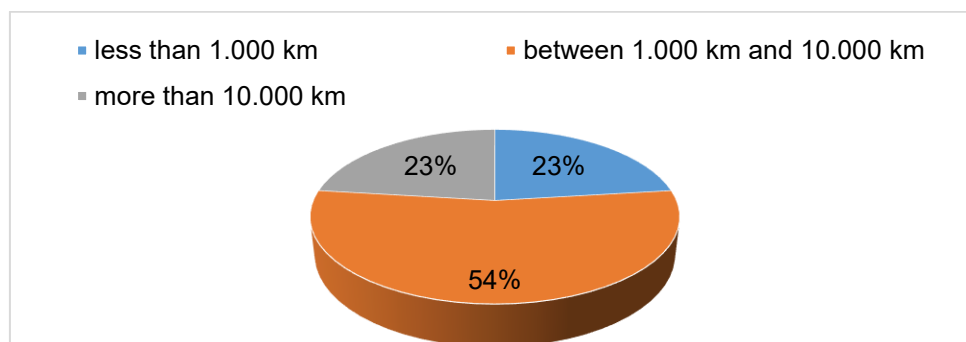


Figure 7 The average number of kilometres per year

As the core objective of this research is to examine the effects of alcohol on drivers, one of the essential survey questions was: "Have you ever driven under the influence of alcohol?" A total of 42% of participants responded affirmatively. This proportion of positive responses is particularly concerning, as it indicates that a substantial share

of the surveyed drivers had previously engaged in alcohol-impaired driving. The final survey question asked participants: “Have you ever been penalized by the police for driving under the influence of alcohol?” Only one participant provided an affirmative response to this question. This finding suggests that, although a considerable proportion of respondents admitted to driving under the influence of alcohol, only a small number had been sanctioned by law enforcement authorities for such behavior.

PRESENTATION AND ANALYSIS OF THE EXPERIMENTALLY OBTAINED RESULTS

The experiment consisted of four phases, which were described in the Research Methodology section. Participants were required to evaluate each task using a rating scale ranging from 1 (impossible to perform) to 5 (easy to perform). In studies of this nature, it is often expected that participants may not provide entirely objective self-assessments. Therefore, in addition to collecting subjective ratings, researchers recorded participants' behavior during task performance, including observations of their movements, walking patterns, and overall task execution. To ensure participant anonymity while enabling data tracking, each participant was assigned a unique identification code. The code consisted of two components: a letter and a number. The letter indicated the participant's gender, with F representing female participants and M representing male participants. The numerical component corresponded to the order in which the participant performed the experimental tasks.

Following a predefined path

The task consisted of picking up the glasses from a table, putting them on, turning around, walking to the starting point of the designated path, and then following the path itself. After completing the task, the participants evaluated its level of difficulty, as presented in Table 1. A number of participants did not provide entirely objective assessments of their performance. For example, participant F2 walked along the path very cautiously, taking small steps and maintaining a stooped posture. Participant F4 had to remove the Drunk Busters in order to reach the starting point of the path. Participant M1 walked with a wide stance to maintain balance and avoid falling. An interesting case was participant M3, who rated the task of following the path while wearing Drunk Busters simulating a BAC of 0.06–0.08 as easy to perform. However, he misjudged the distance to a door and collided with it. Several situations observed and recorded during the experiment are illustrated in Figure 8.

Table 1 Participants' evaluation of following a predefined path according to the applied Drunk Busters intoxication level

	0.06 to 0.08 BAC	0.08 to 0.15 BAC	0.15 to 0.25 BAC
F1	2	1	1
F2	3	3	3
F3	3	2	3
F4	4	3	4
F5	4	4	4
F6	3	2	3
F7	3	2	2
M1	3	3	2
M2	3	3	1
M3	5	3	3
M4	3	2	3
M5	4	2	3



Figure 8 Participants' behavior while following the predefined path

Inserting a key into a lock

The task of inserting a key into a lock consisted of four steps: putting on the glasses, picking up the key from the table, walking to the door, and inserting the key into the lock. Since the participants first put on the Drunk Busters, the next step was to locate the key on the table. Although they generally knew where the key had been placed, they were unable to determine its exact position visually and therefore searched for it by feeling around the table until they found it. Before attempting to insert the key into the lock, many participants examined the key by touch because they could not clearly perceive its orientation. Participants who initially failed to do so often experienced several unsuccessful attempts at inserting the key and subsequently resorted to feeling the key to determine its correct orientation. Most participants required a considerable amount of time to insert the key into the lock, and some even crouched down in an attempt to make the task easier. In addition to feeling the key, participants frequently felt around the lock itself in order to identify the correct insertion point. The participants' evaluations of the difficulty of this task are presented in Table 2, while Figure 9 illustrates selected situations observed during the experiment.

Table 2 Participants' evaluation of the key-insertion task according to the applied Drunk Busters intoxication level

	0.06 to 0.08 BAC	0.08 to 0.15 BAC	0.15 to 0.25 BAC
F1	1	1	1
F2	2	2	3
F3	3	3	2
F4	5	4	4
F5	4	4	4
F6	3	3	3
F7	3	2	2
M1	4	4	3
M2	2	2	1
M3	3	2	3
M4	1	3	1
M5	5	2	2



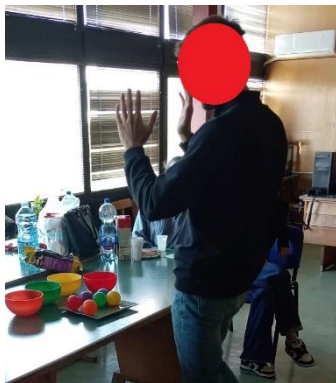
Figure 9 Inserting a key into a lock

Color-matching task

The colour-matching task required participants to place coloured balls into bowls of the corresponding colour. At the beginning of the task, participants stood with their backs turned to the balls and bowls. While a participant was putting on the Drunk Busters, the experimenter rearranged the positions of both the balls and the bowls. Table 3 presents the participants' evaluations of the task difficulty according to the applied level of simulated intoxication. Several noteworthy observations were recorded during the experiment. Participant M1, while wearing Drunk Busters simulating a BAC of 0.08–0.15, placed the orange ball into the red bowl and the red ball into the orange bowl. A similar error was made by participant M4 while wearing Drunk Busters simulating a BAC of 0.15–0.25. Furthermore, participant M2, while wearing the BAC 0.15–0.25 glasses, missed the bowl entirely and placed the ball beside it. Missing the bowl at least once was a common occurrence among all participants. Because the Drunk Busters created a perception of double vision, participants frequently misjudged the location of the objects when attempting to grasp a ball. To compensate for this effect, many participants extended their hands in front of them and visually assessed their hand position in an attempt to estimate its actual location. Figure 10 illustrates participants performing the defined task during the experiment.

Table 3 Participants' evaluation of the color-matching task according to the applied intoxication level of the Drunk

	Busters		
	0.06 to 0.08 BAC	0.08 to 0.15 BAC	0.15 to 0.25 BAC
F1	5	2	2
F2	5	4	3
F3	5	4	3
F4	5	4	4
F5	5	5	5
F6	4	3	3
F7	4	2	2
M1	5	3	3
M2	5	4	1
M3	5	5	5
M4	5	3	2
M5	5	4	3

**Figure 10** Color-matching task

Tray-carrying

The tray-carrying task required participants to transport a tray with glasses from one table to another. The task consisted of the following steps: putting on the glasses, picking up the tray from the table, carrying the tray with one hand to a table located on the opposite side of the room, and placing the tray with the glasses on the table. Table 4 presents the participants' evaluations of task difficulty according to the applied level of intoxication simulated by the Drunk Busters. Participant M3, while wearing Drunk Busters simulating a BAC of 0.06–0.08, dropped the glasses while placing the tray on the table. In contrast, participant M2, while wearing Drunk Busters simulating a BAC of 0.15–0.25, dropped the glasses during the walking phase of the task. Participant F2, while wearing Drunk Busters simulating a BAC of 0.08–0.15, nearly missed the table and almost dropped the tray onto the floor. To avoid this, the participant moved a hand around until the table was located by touch and then successfully placed the tray on it. Participant M4, while wearing Drunk Busters simulating a BAC of 0.08–0.15, misjudged the distance to the table and collided with it. Furthermore, due to feelings of instability and reduced confidence, several participants carried the tray using both hands instead of the prescribed single-hand technique.

Table 4 Participants' evaluation of the tray-carrying task according to the applied intoxication level of the Drunk

	Busters		
	0.06 to 0.08 BAC	0.08 to 0.15 BAC	0.15 to 0.25 BAC
F1	1	3	2
F2	4	4	3
F3	4	3	3
F4	4	3	4
F5	5	4	4
F6	4	3	4
F7	2	2	2
M1	5	4	3
M2	4	2	1
M3	3	4	5
M4	5	3	3
M5	5	4	3

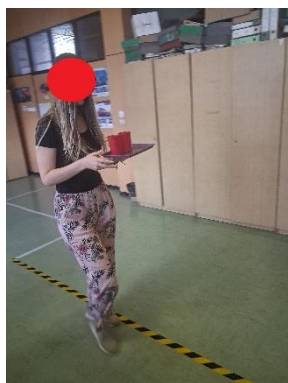


Figure 11 Tray-carrying

CORRELATION ANALYSIS

To determine the relationship between two variables, a correlation coefficient is employed. Correlation analysis provides information regarding both the existence and the strength of the relationship between variables. In order to examine the relationship between driving experience and task performance under the different Drunk Busters conditions, as well as the relationship between participants' sex and task performance under the same conditions, both the Pearson correlation coefficient and the Spearman rank correlation coefficient were applied. Table 5 presents the interpretation thresholds for correlation coefficients according to the recommendations of Cohen, J. (1988).

Table 5 The analysis of the values of correlation coefficients (Cohen, J. 1988)

Pearson	Correlation	Spearman
<0.09	Very weak	<0.09
0.10÷0.29	Weak	0.10÷0.19
0.30÷0.49	Moderate	0.20÷0.29
≥0.50	Strong	≥0.30

Since the assessment of task difficulty was based on participants' subjective evaluations, these results should be interpreted with caution. As discussed previously, observations of participants' behavior during the experiment indicated that these evaluations were not entirely objective. Nevertheless, considering the interpretation of effect sizes in psychology and the social sciences, Funder D. C. and Ozer, D. J. (2019) proposed guidelines that may be regarded as relatively stringent. They argue that correlation coefficients ranging from 0.10 to 0.30 are often both empirically supported and theoretically meaningful, while emphasizing that statistical significance remains an essential criterion for interpretation.

The results of the Pearson and Spearman correlation (Table 6 and 7) analyses indicate that there is no statistically significant relationship between driving experience, or participants' sex, and successful task performance under the different levels of simulated alcohol impairment (0.06 to 0.08 BAC, 0.08 to 0.15 BAC, and 0.15 to 0.25 BAC). Specifically, in all analyzed cases, the significance values exceeded the threshold of 0.05 ($p > 0.05$), indicating that the observed correlations were not statistically significant and that no systematic relationship between the examined variables could be confirmed.

Table 6 Correlation analysis (Pearson)

		Driving experience		Gender	
		Correlation coefficient	Sig. (2-tailed)	Correlation coefficient	Sig. (2-tailed)
Following predefined path ^a	0.06 to 0.08 BAC	-0.400	0.198	0.302	0.339
	0.08 to 0.15 BAC	0.000	1.000	0.111	0.732
	0.15 to 0.25 BAC	-0.078	0.809	-0.340	0.280
Inserting a key into a lock	0.06 to 0.08 BAC	0.000	1.000	0.000	1.000
	0.08 to 0.15 BAC	0.198	0.538	-0.060	0.854
	0.15 to 0.25 BAC	0.287	0.365	-0.339	0.280
Colour-matching task	0.06 to 0.08 BAC	0.100	0.757	0.378	0.226
	0.08 to 0.15 BAC	-0.254	0.426	0.110	0.734
	0.15 to 0.25 BAC	0.119	0.713	-0.191	0.553
Carrying a tray with goggles	0.06 to 0.08 BAC	-0.154	0.634	0.395	0.204
	0.08 to 0.15 BAC	0.310	0.327	0.176	0.585
	0.15 to 0.25 BAC	0.036	0.912	-0.068	0.834

Examination of the Pearson correlation coefficients revealed that most of the obtained values fell within the categories of very weak or weak correlations, whereas a smaller number of cases exhibited moderate negative or positive associations. The most pronounced negative correlation was observed between driving experience and the lane-following task under the simulated blood alcohol concentration of 0.06 to 0.08 BAC ($r = -0.400$), whereas the most pronounced positive correlation was identified between participants' sex and the tray-carrying task under the same level of simulated alcohol impairment ($r = -0.395$), Table 6. However, neither correlation reached the threshold of statistical significance ($p = 0.198$ and $p = 0.204$), and therefore neither can be considered reliable evidence of a true association between the examined variables.

The Spearman correlation analysis yielded results that were largely consistent with those obtained from the Pearson correlation analysis, Tables 6 and 7. The correlation coefficients generally indicated very weak to moderate associations, with the highest values observed for the relationship between participants' sex and the tray-carrying task under the simulated blood alcohol concentration of 0.06 to 0.08 BAC ($\rho = 0.414$), as well as between driving experience and the key-insertion task under the simulated blood alcohol concentration of 0.15–0.25 BAC ($\rho = 0.395$). However, neither of these correlations reached statistical significance ($p > 0.05$), further confirming the absence of a reliable monotonic relationship between the analyzed variables.

Table 7 Correlation analysis (Spearman)

		Driving experience		Gender	
		Correlation coefficient	Sig. (2-tailed)	Correlation coefficient	Sig. (2-tailed)
Following a predefined path	0.06 to 0.08 BAC	-0.309	0.328	0.248	0.437
	0.08 to 0.15 BAC	0.132	0.683	0.132	0.683
	0.15 to 0.25 BAC	0.040	0.902	-0.359	0.251
Inserting a key into a lock	0.06 to 0.08 BAC	0.070	0.828	0.000	1.000
	0.08 to 0.15 BAC	0.257	0.420	-0.077	0.811
	0.15 to 0.25 BAC	0.395	0.204	-0.329	0.296
Colour-matching task	0.06 to 0.08 BAC	0.071	0.827	0.378	0.226
	0.08 to 0.15 BAC	-0.178	0.580	0.076	0.814
	0.15 to 0.25 BAC	0.209	0.515	-0.180	0.575
Carrying a tray with goggles	0.06 to 0.08 BAC	0.004	0.990	0.414	0.181
	0.08 to 0.15 BAC	0.297	0.349	0.212	0.509
	0.15 to 0.25 BAC	0.112	0.729	-0.077	0.812

Although some of the correlation coefficients were classified as moderate according to the criteria proposed by Cohen, J. (1988), the absence of statistical significance warrants caution in their interpretation. Furthermore, given that the assessments of task difficulty were based on participants' subjective evaluations, the results should be regarded as indicative rather than as definitive evidence of an underlying relationship. In accordance with the recommendations of Funder D. C. and Ozer, D. J. (2019), correlations of relatively small magnitude may still be theoretically meaningful; however, only when they are supported by statistical significance, which was not the case in the present study.

Based on the obtained results, it can be concluded that neither driving experience nor participants' sex constituted factors that significantly influenced the successful performance of the analyzed psychomotor tasks under the different levels of simulated alcohol impairment. These findings suggest that the effect of simulated alcohol impairment on participants' performance was relatively independent of these two demographic characteristics, indicating that participants of different sexes and varying levels of driving experience exhibited similar patterns of task performance.

MEASURES FOR REDUCING THE NUMBER OF TRAFFIC ACCIDENTS

One of the simplest ways to prevent driving under the influence of alcohol is the installation of passive alcohol detection systems. These devices measure alcohol vapors within the vehicle cabin. Their purpose is to prevent alcohol-impaired driving; when the detected alcohol vapor concentration exceeds a predefined threshold, the vehicle is automatically disabled (Lukas, S. E. et al., 2017). Such systems are relatively inexpensive because they do not require costly components (Spaho, E. et al., 2024). Despite their low cost, laboratory testing has demonstrated that they provide a high level of measurement accuracy (Romero-González, J. S. et al., 2019). Another approach to preventing alcohol-impaired driving involves the installation of systems that measure the alcohol concentration in a driver's breath. If the measured concentration exceeds the permitted limit, the system prevents the driver from starting the vehicle (Gasparesc, G. 2018). However, these systems have a significant limitation: they are unable to distinguish whether the detected alcohol originates from the driver, the front-seat passenger, or another occupant of the vehicle (Kai, L. et al., 2024).

Another approach to preventing driving under the influence of alcohol involves the use of intelligent monitoring systems capable of detecting whether a driver has consumed alcohol. To ensure reliable detection, these systems collect and analyze multiple types of information simultaneously. The system consists of sensors and cameras, as illustrated in Figure 12. The sensor is installed on the steering wheel, while the cameras are positioned above the driver (Xu, Y. et al. 2026). In this configuration, the system continuously monitors the driver's breath alcohol concentration, facial expressions, and heart rate. The collected data are subsequently processed using advanced analytical and intelligent technologies, enabling the system to determine whether the driver is likely to be under the influence of alcohol and to initiate appropriate preventive measures when necessary.

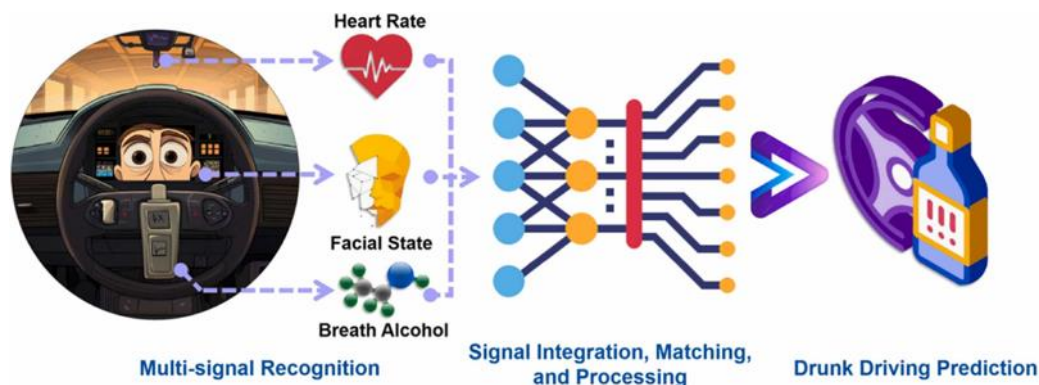


Figure 12 Intelligent system for detecting driving under the influence of alcohol (Xu et al., 2026)

CONCLUSIONS

The impact of alcohol on road traffic safety remains a highly relevant research topic. Drivers operating vehicles under the influence of alcohol tend to exhibit more aggressive behavior and are more likely to be involved in accidents that result in severe consequences. Based on the conducted research, the following conclusions can be drawn:

- Driving under the influence of alcohol is a widespread problem observed throughout the world.
- Previous studies have shown that the likelihood of severe injuries and fatalities is approximately 3.5 times higher in traffic accidents involving at least one participant under the influence of alcohol.
- The same amount of alcohol does not affect all individuals in the same manner.
- Drivers operating vehicles under the influence of alcohol tend to overestimate their driving abilities.
- From the perspective of crash occurrence, the number of traffic accidents involving injured persons decreased during the period from 2022 to 2025, with the lowest number recorded in 2025. The number of fatalities was also lowest in 2025.
- The number of property-damage-only traffic accidents in 2025 was higher than in 2024 but slightly lower than in 2023.
- In 2025, traffic accidents involving fatalities and at least one alcohol-impaired participant accounted for 6.61% of all fatal accidents.
- From the perspective of crash consequences, the highest number of fatalities occurred at the crash scene, followed by deaths occurring within 30 days after the crash, while the lowest number of fatalities occurred during transportation to a hospital.
- Among all injured persons, the largest proportion sustained minor injuries.
- The survey results indicated that 42% of participants had driven under the influence of alcohol at least once, which is a highly concerning finding. However, only one participant reported having been sanctioned by the police for this offense.
- Based on the experimental investigation and the participants' evaluations of task difficulty, it can be concluded that not all participants provided objective assessments when their ratings were compared with their actual performance during the defined tasks.
- Most participants reported that the most difficult tasks were those performed while wearing Drunk Busters simulating a BAC of 0.08–0.15.
- Correlation analysis demonstrated that there was no statistically significant relationship between driving experience or participants' sex and task performance.
- All newly manufactured vehicles should be equipped with systems capable of monitoring alcohol vapors in the driver's breath and preventing vehicle operation when alcohol is detected above the permitted threshold.
- Since not all drivers can afford new vehicles equipped with such technologies, greater emphasis should be placed on raising public awareness of the dangers of driving under the influence of alcohol and the severity of its consequences through educational programs, public campaigns, advertisements, surveys, and similar initiatives.

Future studies should not rely on participants' subjective evaluations of task difficulty. Instead, the experimenter should assess and document the manner in which each task is performed, providing a more objective evaluation of participant performance. Furthermore, if the key-insertion task is included in future experiments, the time required to successfully insert the key into the lock should also be measured. Incorporating task completion time as an additional performance indicator would provide a more comprehensive assessment of the effects of alcohol impairment on participants' motor and cognitive abilities.

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