GUIDE FOR EDUCATORS

FOR THE 'SMART AND MOBILE' QUIZ ON THE SUBJECT OF DISTRACTION IN ROAD TRAFFIC

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Contents

Foreword

Dear teacher,

this is the educational guide “Smart and mobile” from the Young Mobility Ambassadors campaign. In addition to the quiz “Distraction in traffic safety”, this guide was also created for use in school lessons.

In addition to the quiz, this document can serve as background knowledge for you as well as being used separately in lessons. For this reason, we will follow the 10 quiz questions thematically in order.

You can find more information about the quiz at:

www.swarco.com/de/young-mobility-ambassadors

1 Distraction in traffic safety

Distraction in road traffic plays a particularly important role in the age groups of teenagers and young adults. The road safety quiz "Distraction in road traffic" and this guide for educators were developed for use in the classroom to raise awareness of the potential dangers and minimize the risk of accidents.

1.1 Relevance on the topic for students

The topic of traffic safety is particularly important for students. Many young people are about to obtain their driving licence or are already novice drivers. At the same time, this age is characterised by many changes and development processes that are particularly challenging for children and young people. It is crucial at this stage to understand the potential dangers of distractions and learn how to avoid such situations. This applies to all types of active road use, from walking, cycling, scooter, moped and motorbike riding to driving a car. The statistics clearly show that young drivers have an increased risk of being involved in accidents, especially if they are distracted by social interactions or technical devices. Being aware of these risks and developing safe driving habits can help to reduce the number of road accidents and save lives in the long term.

1.2 Didactical concept of the teacher guide

The traffic safety quiz is designed according to appealing didactic principles to make the learning process interactive and varied. The quiz is designed in multiple-choice question format, with four possible answers per question, one of which must be correct. For each question, the students receive a short accompanying text that explains the scientific background of the correct answer in more detail. Teachers are provided with in-depth explanatory texts for each question, in which current scientific studies are reported and thus provide a well-founded, knowledge-based background for dealing with the individual questions in greater depth in the classroom. This type of knowledge transfer is intended to cover and address both cognitive and social-emotional aspects of traffic safety. Each question is designed not only to ask for facts, but also to encourage critical thinking and the application of knowledge in real-life traffic situations.

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1.3 Integration into school lessons and traffic safety education

This quiz offers an excellent opportunity to be used as a supplementary teaching tool in school lessons and in mobility and traffic safety education for school children. Here are some suggestions on how the quiz can be integrated into the classroom:

1.3.1 Introduction on the topic of distraction

Aim: To raise awareness of the different types of distractions and their impact on safe driving.

Activity: Start with an open discussion or brainstorming session about the most common sources of distraction when driving. Based on this, you can then go on to discuss other forms of mobility and associated sources of distraction. Use illustrative examples and current statistics to make the topic tangible.

Materials: Presentations, short videos or case studies can support and deepen the discussion.

1.3.2 Interactive learning phase

Aim: To promote dialogue and discussion about traffic safety.

Activity: Let the students work on the quiz alone or in small groups. This allows them to compare their answers, discuss them and learn from each other.

Methodology: Use an input device (mobile phone, computer or similar) to complete the quiz digitally, or print out the questions and have the groups work together on the answers.

1.3.3 Reflection and consolidation

Aim: To deepen understanding and clarify open questions.

Activity: After completing the quiz, discuss the results together as a class. Discuss the correct answers and explain the background in detail.

Materials: Flipcharts or whiteboards to record the most important points and work on them together.

1.3.4 Project work such as participation in the SWARCO Young Mobility Ambassadors competition

Aim: In-depth exploration of the topic, transferring what has been learnt into practice and developing creative solutions.

Activity: Have the students work on projects in groups in which they develop campaigns to reduce distraction at the wheel or prepare presentations on specific distraction factors. These projects can then be presented and discussed in class.

Materials: Access to computers, internet research, presentation software

By combining theoretical knowledge, creative knowledge transfer and in-depth reflection and discussion, this quiz helps to sensitise students to the dangers of distractions in road traffic and at the same time provides them with strategies to make safer decisions. This not only increases their knowledge of traffic safety, but also raises their responsibility and awareness of their own role in road traffic. By actively involving students in the learning process, they are better able to internalise and put into practice what they have learned, which ultimately contributes to a safer traffic environment for everyone.

2 Traffic safety quiz: Distraction in road traffic

Welcome to this traffic safety quiz! This quiz is all about the various distraction factors in road traffic and their significant impact on the safety of all road users. Distractions in road traffic, especially behind the wheel of a car, are among the most common causes of road accidents and can come from a variety of sources such as mobile phones, conversations with passengers, eating and drinking and even experiencing strong emotions. The aim of this traffic safety quiz is to raise awareness of different types of distraction, their dangers for one's own traffic safety and that of other road users and to help young people make safer decisions on the road.

2.1 Question 1

Does distraction play a major role as an accident risk in road traffic?

a) Distraction does not play a major role.
b) Yes, distraction is one of the main causes of accidents.
c) Distraction is only a problem for young drivers.
d) Distraction is only dangerous in bad weather conditions.

Correct answer: b) Yes, distraction is one of the main causes of accidents.

2.1.1 Detailed background knowledge for educators

Distraction in road traffic poses a significant risk and is one of the leading causes of road accidents worldwide. According to Statistics Austria (2024), inattention or distraction as the suspected main cause of accidents was blamed for 30.7% of all road traffic accidents resulting in personal injury in Austria in 2023. This resulted in a total of 10,988 accidents in urban areas and on open roads. As a result, 92 fatalities were recorded. Many studies have shown that distractions while driving can significantly reduce driving performance (Arevalo-Tamara et al., 2022; Atwood et al., 2018; Brome et al., 2021; Chee et al., 2021; Mustapic et al., 2021; Nowosielski et al., 2018; Oviedo-Trespalacios et al., 2019; Zokaei et al., 2020).

Typical distractions in road traffic include visual, auditory, manual and cognitive distractions (Al-Rousan et al, 2021; Kinnear & Stevens, 2015; Kumar et al, 2020; Papakostas et al, 2021; Ponte et al, 2021). In their study, Kinnear and Stevens (2015) describe four sources of distraction in more detail: Visual distractions occur when drivers take their eyes off the road and look in a different direction to pursue a secondary activity inside or outside the vehicle. This can be, for example, reading a text message on a mobile phone or navigating using a navigation device. Drivers' ability to recognise hazards is impaired by distractions that take their eyes off the road. This leads to a deterioration in lane keeping, more unpredictable steering wheel manoeuvres and slower speeds (Bruyas, 2013; Horrey & Wickens, 2004; Caird et al, 2014; Liang & Lee, 2010; Engström et al, 2005). Cognitive distractions manifest themselves in an impairment of focussing on the driving task, for example through intensive conversations or daydreams. Auditory distractions, such as listening to music too loudly or making phone calls while driving, can also impair attention. This form of distraction is usually associated with other distractions. Cognitive distractions can subsequently lead to less balanced steering wheel movements and hard braking (Bruyas, 2013; Caird et al., 2018; Harbluk et al., 2007; Liang & Lee, 2010; Schaap et al., 2013). As a specific example, the study by Caird et al. (2018) can be cited, in which it was shown that the cognitive workload of incidental conversations can limit the recognition of changes in both younger drivers (average age = 21.4 years) and older drivers (average age = 68.4 years) and impair the availability of attentional resources. Manual distractions manifest themselves when hands are taken off the wheel to perform another activity, such as eating or drinking or changing the radio station. Manual distractions are usually observed in combination with visual or cognitive distractions.

A particularly common example of a distraction-related accident is a rear-end collision. In this context, study results suggest that the type of driver distraction also has an influence on the type of accident. Neyens and Boyle (2007) used national accident data to investigate the effect on young drivers and concluded that distraction caused by mobile phones led to a higher probability of rear-end collisions. Rear-end collisions often result from the inattention of drivers who use their mobile phones and therefore notice the braking of the vehicle in front too late. A comparable result was obtained by Wilson et al. (2003) as part of an observational study. A study by Carney et al. (2016), which examined over 400 rear-end collisions involving teenagers that were recorded by in-vehicle recording devices, found that over 75% of teenage drivers involved in moderate to severe rear-end collisions had exhibited potentially distracting behaviour. The most frequently observed behaviours were using a mobile phone, focusing attention on something outside the vehicle and interacting with passengers.

In a study by Leung et al. (2012), the influence of mobile phone use and alcohol consumption on driving performance in a driving simulator was investigated. The driving performance of the study participants was measured in different conditions, namely without using a mobile phone, with a hands-free phone call, with a cognitively demanding hands-free phone call and with texting while driving. The performance achieved was compared with driving performance under the influence of alcohol. It was found that the performance during the hands-free call was comparable to that under the influence of a blood alcohol concentration of BAC = 0.04, i.e. 0.4 per mille. Under the condition of the cognitively demanding conversation and texting while driving, the performance was even comparable with the results of a blood alcohol concentration of 0.07 to 0.10 (0.7 to 1 per mille).

A study in a driving simulator by Dyke and Fillmore (2015) found that distraction while driving leads to a significant increase in the extent to which driving performance is impaired by alcohol. The extent of impairment due to alcohol is therefore at least twice as high under distracting conditions than without distraction. These results indicate a significant interaction between distraction and alcohol consumption and illustrate the increased risks they pose in combination. The results of both studies provide valuable insights into the potential effects of distraction and alcohol consumption on driving performance, both independently and in interaction with each other. The studies highlight the complex risks associated with driving under the influence of alcohol or while distracted, as well as the additional dangers arising from the combination of these factors.

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2.2 Question 2

Which age group is particularly affected by distraction in road traffic?

a) Children under the age of 10
b) Young people between the ages of 11 and 15
c) Young people between the ages of 16 and 25
d) Senior citizens over 65 years of age

Correct answer: c) Young people between the ages of 16 and 25

2.2.1 Detailed background knowledge for educators

Young people between the ages of 16 and 25 are particularly vulnerable to distractions on the road. This age group is in a critical phase of cognitive and emotional development, which affects their ability to control attention and self-regulation. The results of numerous studies show that distraction is a significant factor in road accidents, particularly among young people. A representative survey of drivers in Austria, Switzerland and Germany shows that 18 to 24-year-olds report over 16 per cent more distraction incidents than middle-aged drivers (25-64 years) and even over 40 per cent more than senior citizens (Kubitzki, 2011).

The current evidence base shows a clear problem. In a recent study by Pourebrahim et al. (2021), it was shown that the relevance of distraction factors varies depending on the age group. It was found that the use of mobile phones is a key factor in accidents in all age groups. For young drivers in particular, however, this form of distraction is the main cause of rear-end collisions, as young drivers use mobile phones more frequently than average. Further evidence in favour of this thesis is provided by a study on distracted driving by the insurance company Allianz. This study shows that young drivers between the ages of 18 and 24 are particularly at risk of distraction. In a survey, 30% of drivers in this age group stated that they talk on their mobile phones while driving. Furthermore, four out of ten people surveyed stated that they type or read electronic messages with their mobile phone in their hand (Allianz Versicherungs-AG, 2023).

A study by Klauer et al (2014) demonstrated that teenage drivers have a two-fold increased risk of being involved in accidents caused by distraction compared to adult drivers. The results of the study suggest that performing secondary tasks, including dialling or reaching for a mobile phone, texting, reaching for an object other than a mobile phone, looking at a roadside object and eating, is associated with a significantly increased risk of a crash or near-crash in novice drivers. Bharadwaj et al (2023) also come to a similar conclusion in their study looking at the traffic safety of young drivers aged 16 to 19. The results of the study suggest that mobile phone use, external distractions, eating and drinking, personal hygiene and reaching and handling objects in the vehicle significantly increase the likelihood of being involved in a safety-critical road traffic incident.

A study by Oritz et al. (2017) aimed to investigate different patterns of distraction and their prevalence among pedestrians and drivers, as well as the resulting potential for conflict. Based on observational data collected at four intersections in Washington, D.C., the study authors were able to show that the age group of 16 to 25-year-olds had the highest probability of distraction in road traffic. Specifically, the probability of distraction was 2.2 times higher than in the 36-65 age group.

The neurological basis of this vulnerability can be explained by the developmental stages of the brain. Specific areas of the brain responsible for executive functions such as planning, decision-making and impulse control continue to develop into young adulthood (Blakemore & Choudhury, 2006; Giedd et al., 1999; Johnson et al., 2009), an age which, according to accident statistics, is associated with a decrease in the risk of road accidents. In line with this finding, statistics show that the number of accidents decreases significantly from the age of 25 (Statistik Austria, 2024).

The findings presented suggest that young drivers are a particularly vulnerable group in road traffic. To increase traffic safety and reduce the risk of accidents, measures to reduce distractions, such as stricter laws against the use of mobile phones while driving, awareness campaigns and the promotion of safe driving practices, are crucial.

2.2.1.1 Scientific literature supporting the quiz answers

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2.3 Question 3

Which part of our brain helps us to react quickly when there is a potential danger on the road?

a) Temporal lobe
b) Brain stem
c) Hypothalamus
d) Prefrontal cortex

Correct answer: d) Prefrontal cortex

2.3.1 Detailed background knowledge for educators

The human brain is a complex network of specialised structures which, taken as a whole, enable people to react quickly and effectively to dangers on the road. The prefrontal cortex plays a crucial role in this, especially in young novice drivers. Research suggests that the prefrontal cortex is associated with mental workload, inhibitory control, decision making and executive functions that allow us to control our behaviour, thinking, emotions and attention at will and according to the situation. These factors are essential for effective hazard recognition in road traffic (Bednarz et al., 2022; 2021; Gharib et al., 2020; Horswill, 2016). Studies using functional near-infrared spectroscopy have shown that younger drivers have lower prefrontal cortex activity compared to older drivers. This indicates a lack of maturation in this brain region, which may contribute to the higher accident risk observed in young drivers (Foy et al., 2016). Furthermore, increased activation of the prefrontal cortex has been shown to be associated with a higher mental workload during driving tasks (Schweizer et al., 2013). Cognitive distraction while driving thus ties up resources of the front brain, which are important for mental processing, while the areas of the rear brain responsible for visual alertness and attention are affected.

The prefrontal cortex

The prefrontal cortex is responsible for the coordination of higher-order cognitive processes and executive functions. Executive functions comprise a range of higher-order cognitive abilities that are required for goal-oriented behaviour. These include the ability to plan, inhibit reactions, working memory and attention (Anderson et al., 2001). This region of the brain enables the processing of complex information in the shortest possible time and the execution of corresponding actions. In dangerous traffic situations, the prefrontal cortex supports the consideration of different options for action and decision-making with regard to avoiding collisions and accidents (Foy et al., 2016; Jäncke et al., 2008; Yoshino et al., 2013a, b).

The development of the prefrontal cortex begins in early childhood and continues into young adulthood. Studies in developmental psychology have shown that the maturation of the prefrontal cortex is closely linked to the improvement of cognitive abilities and impulse control (Paik, 1998). This is particularly relevant for the ability to react adequately and promptly in road traffic, as fully developed cognitive control is required to make quick decisions under time pressure.

Recent studies have shown that the prefrontal cortex plays a key role in reacting to unexpected dangers (see Gharib et al., 2020; Moran et al., 2020). A study by Moran et al. (2020), for example, shows that the prefrontal cortex is active when processing visual information from road traffic and thus promotes the ability to make quick decisions. The research results suggest that the prefrontal cortex not only plays a decisive role in planning actions, but also in adapting quickly to changing conditions.

The prefrontal cortex plays an essential role in rapid hazard perception in road traffic, as it is involved in the executive functions and mental workload that are essential for efficiently recognising and reacting to hazards. Studies have shown that activation of the prefrontal cortex is associated with faster reaction times to hazards, especially in young drivers (Bednarz, 2022). Furthermore, research results suggest that the prefrontal cortex is associated with inhibitory control, which is a decisive factor for driving safety. Increased activation of the prefrontal cortex is associated with a higher mental workload while driving (Foy et al., 2016). Furthermore, the function of the prefrontal cortex in hazard perception is supported by evidence showing that hazard perception skills can be improved through training and testing, which ultimately reduces the risk of accidents (Horswill, 2016).

The prefrontal cortex also plays a crucial role in decision-making in traffic situations, especially in young and inexperienced drivers (Aoi et al., 2020). Studies have shown that activation of the prefrontal cortex in young drivers is related to mental workload and inhibitory control, factors associated with road accidents. Lower activity was observed compared to older drivers (Aoi et al., 2020).

The development of neuroimaging techniques, in particular functional magnetic resonance imaging (fMRI), has led to neurobiological models that provide important explanations in this context. These models suggest that risky behaviour in adolescence results from the earlier functional maturation of reward-related circuits compared to control-related circuits in the brain. It is hypothesised that reward-related and control-related circuits make separate contributions to decision-making, and that an imbalance in the adolescent brain is caused by DIFFERENCES in the developmental pattern of these circuits (Casey et al., 2008; Ernst et al., 2006; Galvan et al., 2006). The results of the Leijenhorst et al. (2010) study support the hypothesis that risky behaviour in adolescence is associated with an imbalance caused by divergent developmental trajectories of the reward and control circuits in the brain.

In a study by Schweizer et al. (2013), data on complex brain activity in the context of distracted driving and driving at different levels of complexity were collected using neuroimaging methods. The authors were able to prove that the brain activations observed during driving can be attributed to various cognitive functions. Differences were found between the posterior visual-spatial attention system and the anterior, frontal-lobal functions, which play a decisive role in multitasking and divided attention. The results showed a pattern of increased frontal activation associated with cognitive distraction. This response shift between the posterior and anterior networks can be explained by the increased frontal activation. This pattern has already been observed in a previous study by Hsieh et al. (2009) in participants performing a visual event recognition task while passively watching a driving video under auditory distraction, as well as when performing divided attention tasks involving both visual and auditory modalities compared to single modality tasks (Schubert & Szameitat, 2003; Johnson & Zatorre, 2006).

The interaction between anterior and posterior brain regions must therefore be considered in the context of competition for limited resources and a redistribution of attention between the anterior, executive attention in multitasking and the posterior, visual-responsive attention system (Rees et al., 1997; Wickens, 2008). Consequently, the brain is confronted with a "bottleneck" when multiple tasks compete simultaneously for shared and limited resources and restrict the resources available for individual tasks (Dux et al., 2006; Just et al., 2001). This view suggests that during cognitive distraction while driving to support mental processing in the frontal brain, resources of the posterior brain that are important for visual vigilance and visual attention are tied up and are therefore no longer available to the same extent.

In this context, eye tracking studies have shown that the use of hands-free devices while talking on the phone impairs attention to visual information (Strayer et al., 2003). These distracted drivers are affected by "inattentional blindness", which can be described because of a narrowing field of vision (Maples et al., 2008). The consequence of this is that information in the driving environment is perceived but not adequately processed (Strayer, 2007). As a result, important visual cues for safe driving are overlooked (Jacobson & Gostin, 2010). The results of epidemiological studies on real-life collisions show that drivers who use hands-free devices are just as frequently involved in accidents as drivers who use their phones in their hands (McEvoy et al., 2005; Redelmeier & Tibshirani, 1997). The study by Schweizer et al. (2013) thus provides important evidence that underpins earlier behavioural observations. These indicate that multitasking while driving can impair visual attention and alertness. This is due to reduced brain activation that supports critical visual processing areas.

To summarise, it can therefore be stated that the prefrontal cortex plays a key role in coping with workloads and performing executive functions. This is particularly evident when it comes to quickly recognising and reacting to potential dangers in road traffic.

2.3.1.1 Scientific literature supporting the quiz answers

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2.4 Question 4

Why are our friends and other people around us sometimes distractions on the road?

a) They give us directions
b) They can engage us in conversation
c) They can distract our attention from the road
d) They help us to concentrate

Correct answer: c) They can distract our attention from the road

2.4.1 Detailed background knowledge for educators

The presence of passengers can become a significant distraction in road traffic, as they potentially take attention away from the road. The distraction can take different forms, including conversations, physical interactions or emotional interactions. Distractions result in an additional mental workload and impair drivers' cognitive functions, leading to a slowing of their reflexes and reaction times to potential accident-causing events (Papantoniou et al., 2015; Stutts, 2001). It is therefore essential for drivers to focus their attention on the road and their surroundings while driving in order to recognise potential dangers in good time and react appropriately.

Research by Royal (2003) on the prevalence of different types of distractions while driving in two representative samples of more than 4,000 US drivers found that the most common reported distraction was talking to passengers. 81% of US drivers surveyed reported doing this on at least some journeys. An online study by Lansdown (2012) demonstrated that the vast majority (91%) of UK drivers reported using the in-car entertainment system on a daily or weekly basis. Respondents' self-reported data indicated that 81% interacted with adult passengers, 51% drank, 46% ate and 34% interacted with children while travelling. In their study, Stutts et al (2001) found that the most frequently cited sources of driver distraction were people, objects or events outside the vehicle (29.4% of distracted drivers), turning on the radio, cassette or CD player (11.4%) and other occupants in the vehicle (10.9%). Other specific distractions, such as moving objects in the vehicle, other objects brought into the vehicle, adjusting vehicle or climate controls, eating and drinking, mobile phones and smoking were each only mentioned in one to four per cent of cases. A study by Koppel et al, (2011) provided new evidence on the influence of children's behaviour on driver distraction. A key finding of this study was that most journeys involved some form of potential driver distraction (98%), with some distracting activities potentially doubling the driver's crash risk. Furthermore, while children were a significant source of distraction for the driver (12%), drivers were significantly more likely to engage in potentially distracting activities unrelated to children.

Gershon et al (2017) equipped private vehicles of 83 teenage novice drivers with data collection systems to document driving performance, including engagement in secondary tasks and characteristics of the driving environment. The research found that 58% of the analysed road clips of teenage novice drivers included a potentially distracting secondary task. The most frequently observed secondary tasks were interactions with a companion, verbal communication (without a companion), external distractions, texting and using a mobile phone. Secondary tasks were significantly more likely to be performed by people with primary access to the vehicle and when driving alone. Social norms, risky driving behaviour of friends and parental restrictions showed a significant correlation with the prevalence of secondary tasks. A meta-analysis by Theofilatos et al. (2018) demonstrated that the interaction between driver and passenger causes a significant proportion of road accidents (3.55% of accidents, regardless of the age of the passenger, and 3.85% when children and adolescents were excluded as passengers).

However, a detailed analysis of the current study situation shows that the presence of co-drivers does not have the same effects for all drivers. Orsi et al (2013) reported a significant age difference in the injury consequences of car accidents. The likelihood of being injured in an accident was higher for drivers aged 25 and over when travelling alone, while drivers under 25 had a higher likelihood of injury when travelling with one or more passengers. Preusser et al (1998) and Regan and Mitsopoulos (2001) demonstrated that young drivers have an increased accident risk when travelling with passengers of the same age. The accident risk increases with each additional person of the same age travelling with them. Lee and Abdel-Aty (2008) found that younger drivers who were accompanied by young passengers were more likely to cause accidents and were involved in accidents at high speeds.

Having a teenage passenger is thus identified as a risk factor that is associated with an increased accident risk, especially for novice drivers and teenage drivers (Klauer et al., 2011; Ouimet et al., 2015; Williams, Ferguson & McCartt, 2007). Teenage passengers can increase the risk of accidents through social influence, either by exerting pressure to increase the risk or by adhering to social norms that favour riskier driving (Ouimet et al., 2015). In a study by Ouimet et al. (2010), it was shown that driving with a chaperone significantly increases the likelihood of young people being involved in fatal road accidents. This showed that the risk increases with the number of passengers. However, Foss and Goodwin (2014) also demonstrated that the presence of passengers reduces the tendency of young drivers to engage in secondary tasks.

Social interactions in the car can also lead to increased emotional arousal. Emotional arousal can impair the ability to react as it influences the cognitive processing of information. The narrowing of the focus of attention, which is caused by emotional excitement, leads to drivers paying less attention to peripheral visual or auditory stimuli (Eckhardt et al., 2012). Steinhauser et al. (2018) conducted a driving simulator study in which tonal states of anger, happiness and calm were evoked by a combination of autobiographical imagery and music. The aim of the study was to investigate the effects of emotions on drivers. To this end, participants were subjected to two driving tasks involving braking, accelerating and lane keeping. The results of the study showed that emotions can either directly influence driving behaviour or indirectly influence drivers' attention processes while driving. For example, anger leads to aggressive driving.

The presence of friends and passengers can subsequently be a potential source of distraction, which significantly increases the risk of accidents, especially among young people. Young and inexperienced drivers are particularly susceptible to this type of distraction, as they may be less able to balance the demands of driving and social interactions appropriately.

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2.5 Question 5

What is the most common source of distraction in road traffic?

a) Advertising posters on the roadside
b) Other road users
c) Daydreams
d) Mobile phones

Correct answer b) Mobile phones

2.5.1 Detailed background knowledge for educators

Frequently occurring sources of distraction in road traffic vary between different road users and forms of mobility. Mobile phones are a particularly common source of distraction for all mobility groups and pose a high risk to traffic safety. The use of mobile phones by drivers is a widespread source of distraction, although exact prevalence figures are difficult to determine. In Austria in 2023, for example, 129,781 reports were issued for mobile phone use at the wheel, with the highest number registered in Lower Austria (30,378) and Upper Austria (22,665) (BMI, 2024). Distractions in road traffic pose a significant risk for all road users, with the spread of mobile technologies combined with increasing complexity, especially in urban traffic, leading to an increase in the frequency and severity of these distractions.

Car drivers

Car drivers can be distracted both inside and outside the vehicle. The use of mobile phones is one of the most common causes of driver distraction. The detrimental effects on driving performance have been documented in numerous studies (Caird et al, 2014a, b; Caird et al, 2018; Choudhary et al, 2020; Oviedo-Trespalacios et al, 2016; Papantoniou et al, 2017; Simmons et al, 2016; Stavrinos et al, 2018; Theofilatos et al, 2018; Zhang et al, 2019). This manifests itself in a significant increase in the risk of accidents and injuries when using a mobile phone while driving. Ren et al. (2021), for example, state that the probability of injury increases threefold when using a mobile phone. This increase in risk is likely to apply consistently to different subgroups and means of transport. In a study by Chen et al. (2020), the influence of voice-assisted and manual text messaging (each with two levels of difficulty) on drivers' performance in terms of safety distance and collision avoidance ability was investigated. The results demonstrated that the probability of a rear-end collision increased by a factor of 2.3 and 3.56 when voice-activated and manually composed text messages were used. In their study, Fu et al. (2020) found a 2.41 to 2.77-fold increase in the probability of a rear-end collision. In addition to using a mobile phone while driving, there are other potential sources of distraction, such as reaching for objects, talking to passengers, eating and drinking, adjusting the navigation device or reading billboards. These actions are also associated with an increased risk of accidents (Ponte et al., 2021; Lansdown et al., 2021; Sorum & Pal, 2022).

Cyclists

Cyclists are also confronted with a variety of potential sources of distraction. Mobile phones are a major source of distraction (Jiang et al., 2021; Stelling-Konczak et al., 2017; Wilbur & Schroeder, 2014; Wolfe et al., 2016). The use of mobile phones, which are often used for navigation, listening to music or communication while cycling, significantly impairs the ability of cyclists to move safely through traffic. The study by Wolfe et al. (2016) shows that auditory distractions have a higher prevalence among cyclists than visual or tactile distractions. Of the 1,974 cyclists analysed, 31.2% were distracted. Auditory distractions were the most common form of distraction at 17.7%, followed by visual distractions at 13.5% and tactile distractions at 13.5%. A study by Wilbur et al. (2014) demonstrated that cyclists who used mobile phones or portable music players had a higher prevalence of unsafe cycling behaviour and a higher risk of injury.

Listening to music through headphones is another common distraction for cyclists. De Waard et al (2011) reported that cyclists wearing headphones had reduced auditory perception, making it more difficult to perceive traffic signals or sounds of approaching vehicles. Furthermore, the use of mobile phones and hands-free devices also leads to a reduction in reaction time in addition to the impairment of auditory perception. Interaction with traffic is also a significant distraction, as cyclists have to navigate through heavy traffic and interact with other road users, which can divert their attention from the road (Useche et al., 2018).

Moped riders / motorcyclists

Research on the distraction and inattention of motorcyclists is significantly limited compared to that on car drivers. The limited research literature on the topic of distraction and inattention of motorcyclists focuses mainly on the use of mobile phones, their prevalence and factors associated with distraction (cf. e.g. De Gruyter et al, 2017; Gupta et al, 2022; Ledesma et al, 2023; Nguyen et al, 2020; Oviedo-Trespalacios et al, 2019; Pérez-Núñez et al, 2014; Rusli et al, 2020; Truong et al, 2018; Truong et al, 2019; Wang et al, 2023; Widyanti et al, 2020). It should also be noted that the studies were predominantly conducted in non-European countries, meaning that the findings can only be transferred to the European transport context to a limited extent.

The use of mobile phones while riding a motorbike leads to a significant impairment of vehicle control and the ability to react adequately and in good time to unexpected dangers on the road. This significantly increases the risk of accidents. Truong, Nguyen and De Gruyter (2016) found that 8.4% (n = 24,759) of motorcyclists in Hanoi (Vietnam) used their mobile phones while driving. An observational study in three Mexican cities found that 0.64% (n = 4,244) of motorcyclists used their mobile phones while driving (Pérez-Núñez et al., 2014). De Gruyter et al. (2017) report that students who ride motorbikes are more likely to use their mobile phones to communicate with friends. The study by De Gruyter et al. (2017) shows that using a mobile phone, whether to communicate with a partner or to text a friend, increases the likelihood of traffic accidents. In Malaysia, younger drivers and men were found to be more likely to use mobile phones while driving than other age groups and genders (Oxley et al., 2013). Due to the risks associated with mobile phone use while driving and the high prevalence of this practice in low- and middle-income countries, future research efforts need to address this issue more intensively.

Pedestrians

Pedestrians are not immune to the risks of distraction either, which is reflected in a large number of publications. Mobile phones are also one of the most frequent and therefore most important sources of distraction in road traffic in this mobility group. The use of mobile phones, especially writing and reading text messages, surfing the internet and making phone calls, significantly impairs the ability of pedestrians to move safely, prudently and with foresight in road traffic (Alagbé et al, 2023; Basch et al, 2015; Ferguson et al, 2013; Lennon et al, 2016; Oritz et al, 2017; Quon et al, 2019; Simmons et al, 2020; Syazwan et al, 2017; Thompson et al, 2013; Wells et al, 2018; Williamson et al, 2015; Yadav & Velaga, 2022).

The study by Simmons et al. (2020) shows that the use of mobile phones leads to an increase in collisions and near misses among pedestrians and that less attention to road traffic was found when texting while crossing the road. Alagbé et al. (2023) also came to a similar conclusion. Their study found that distracted pedestrians have a higher risk of accidents when crossing roads. In a Malaysian study, Syazwan et al. (2017) reported that 84.8% of pedestrians were distracted by mobile phones when crossing the road. The distraction significantly affected the crossing time. Thompson et al. (2013) also report that an observational study by Basch et al. (2015) quantified distracted pedestrian behaviour at intersections in Manhattan. The analysis of the data revealed that wearing headphones was the most common distraction observed. A total of 21,760 pedestrians were observed as part of the study. It was found that 32% of pedestrians who crossed the road on green and 42% of pedestrians who crossed the road on red were wearing headphones, talking on a mobile phone or looking at an electronic device. In a systematic literature review, Yadav and Velaga (2022) confirm the previously presented study results, according to which distraction by mobile phones leads to risky behaviour when crossing the road. According to the results of the study, women show less risky behaviour than men. Among pedestrians, the younger age group is also observed to use mobile phones more frequently when crossing the road (Williamson & Lennon, 2015; Ferguson et al, 2013; Quon et al, 2019; Lennon et al, 2016). In addition to endangering their own safety, another problem that arises from distracted behaviour as pedestrians in road traffic is that distracted pedestrians often come into conflict with drivers (Oritz et al., 2017).

In all mobility groups, mobile phones prove to be by far the most common source of distraction, which impressively underlines the omnipresent influence of mobile technology on traffic safety. However, the nature and consequences of distraction vary greatly from road user to road user. Understanding the specific distractions faced by car drivers, cyclists, moped riders and pedestrians is crucial to developing effective measures to improve traffic safety.

2.5.1.1 Scientific literature supporting the quiz answers

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2.6 Question 6

When I'm a pedestrian in traffic with headphones on, do I have the same reaction time as without?

a) No, my reaction time can deteriorate
b) Only if the music is quiet
c) Only if I only use in-ear headphones
d) Yes, my reaction time remains unchanged

Correct answer a) No, my reaction time can deteriorate

2.6.1 Detailed background knowledge for educators

Wearing headphones and listening to loud music while walking in traffic can significantly affect the reaction time and safety of pedestrians. The relevance of the topic for traffic safety is illustrated by a study by Lichtenstein et al. (2012), which aimed to identify and describe pedestrian-vehicle accidents in which pedestrians were wearing headphones. The study analysed pedestrians injured or killed in collisions with trains or motor vehicles between 2004 and 2011. The cases in which pedestrians were wearing headphones were extracted and summarised. A total of 116 reports of death or injury to pedestrians wearing headphones were included in the analysis. The majority of victims were male (68%) and under 30 years old (67%). Most vehicles involved in the accidents were trains (55%) and 89% of the cases occurred in urban neighbourhoods. In 74% of the case reports, it was stated that the victim was wearing headphones at the time of the accident. In many cases (29%) it was stated that a warning had been sounded before the accident. In an experimental study in which 138 students were asked to cross an interactive virtual road, Schwebel et al. (2012) investigated the effects of talking on the phone, listening to music and texting on the safety of pedestrians. The study concluded that the behaviours could affect the safety of the test subjects when crossing the road by distracting them from the road environment and thus increasing the risk of collisions with vehicles.

The finding suggests that adolescents and children are at greater risk when distracted due to the increasing use of mobile phones and their reduced experience of road traffic. A 2013 observation of 34,325 adolescents crossing streets in school zones found that approximately one in five high school students and one in eight middle school students were distracted (Ferguson et al., 2013). The most frequently observed activities were texting and reading text messages and wearing headphones (39% each), followed by talking (20%) and playing games (2%). Stavrinos et al (2018) conducted a systematic review and meta-analysis of the effects of distraction on distraction-rich walking, cycling and driving in children and teenagers. In terms of the quality of crossing, they found that young people aged 17 to 25 who were distracted tended to wait longer to cross the road. They also missed more opportunities to cross (Byington & Schwebel, 2013) and walked slower than when they were not distracted (Parr et al., 2014).

Studies have shown that distractions, such as listening to music through headphones, can lead to a slower reaction to auditory and visual stimuli in road traffic. As a result, pedestrians walk more slowly and react more poorly to dangers in their environment (Takakura & Miura, 2023). In addition, the use of headphones by pedestrians has been shown to be a serious problem for traffic safety, as they can mask important acoustic signals, such as the sound of approaching vehicles, which increases the risk of accidents (Ghosh et al., 2023).

In an experimental study by Lee et al. (2020), it was investigated whether vehicle warning sounds such as car horns and bicycle bells can be perceived by pedestrians when they listen to music from headphones at the same time. A total of five different sound measurements were carried out in order to better understand the influence of the music from the headphones on the amount of sound perceived by pedestrians. The analysis of the laboratory measurement data showed that the sound level and the spectrum response of the warning sound in combination with music was almost identical to that of the music alone. The sound of the warning sound with music was also very similar to the measurement with music alone. Furthermore, the noise level of the alarm signal was significantly lower than that of the music signal. These results demonstrate that pedestrians are unable to identify the warning sound of the vehicle from behind while listening to music from headphones. Therefore, it is essential for pedestrians to be aware of the potentially harmful effects of wearing headphones and listening to loud music while participating in road traffic. This ensures their safety and ability to react to potential dangers.

Studies have also shown that music, regardless of the preferred music genre, tends to worsen reaction times and is therefore a form of distraction that can impair traffic safety (Wang et al., 2022). In the study by Liu et al. (2021), it was shown that auditory distractions increase the reaction time of pedestrians by 67%. Martiusheva et al. (2022) also point out that wearing headphones with loud music slows down reaction time in road traffic, as this impairs important cognitive functions.

The type of music and its volume can also have an influence on pedestrian behaviour in road traffic. For example, it has been shown that fast and loud music increases walking speed, while music volume and walking speed have an effect on physical performance (Edworthy & Waring, 2006). It has also been shown that faster pieces of music have a negative effect on risk-taking and accident frequency (Brodsky, 2001). In addition, it has been shown that the volume of music has an influence on the ability to react in road traffic (Paridon & Springer, 2012). The effect of volume can also be observed in other road users and is therefore likely to be a relevant source of distraction for all road users. An example of a corresponding study is that of Farrell (2021), in which the influence of music volume on reaction time was investigated. The tactile reaction time of 20 college students was recorded while the Neil Diamond classic "Sweet Caroline" was played at a volume of 0 dB, 20 dB, 40 dB and 80 dB. The results show a significant increase in simple reaction time with increasing music volume, which supports the hypothesis that a higher volume impairs a person's ability to react to a stimulus.

2.6.1.1 Scientific literature supporting the quiz answers

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2.7 Question 7

On average, how many things can road users perceive in detail per second on the road?

a) 1 thing
b) 3 things
c) 7 things
d) 12 things and more

Correct answer b) 3 things

2.7.1 Detailed background knowledge for educators

For road users, human perception and attention play a decisive role and have a significant influence on traffic safety and performance in road traffic. The ability to perceive and react to different stimuli is an essential prerequisite for us to be able to make timely and correct decisions in road traffic.

Human perception is controlled by cognitive processes that filter, prioritise and process sensory information. According to Miller's Law, introduced by cognitive psychologist George A. Miller in 1956, the average person can store about seven items (plus or minus two) in their working memory at any given time. However, this number can vary considerably in complex, dynamic environments, such as road traffic, where attention has to be divided between several stimuli.

Visual attention as a driver

Visual perception plays a crucial role when driving, as it requires constant attention to the surroundings. Drivers use both focal and peripheral vision to observe the road, other vehicles, pedestrians, traffic signs and potential hazards. Studies have shown that drivers make about two to three eye movements per second, each lasting about 300 to 400 milliseconds (Bian et al., 2004). The rapid eye movements allow drivers to continuously update their visual perceptions and process multiple objects simultaneously. Ignoring critical information while driving can lead to an increased risk of a vehicle accident.

Cognitive load and information processing

The cognitive load associated with road use can affect drivers' perception and processing of information. Engström, Johansson and Östlund (2005) were able to prove that increased visual and cognitive stress, such as complex traffic situations or multitasking, impairs a road user's ability to process information effectively. In stressful situations, the brain prioritises critical stimuli, while less relevant information may be ignored.

Human attention is therefore defined by its natural limits. In a dynamic environment such as driving, the ability to process multiple stimuli is limited by the cognitive load and mechanisms of selective attention. With this in mind, while it is difficult to determine the exact number of things a road user can perceive per second, it can be assumed that an average driver can perceive and process about three different elements or events per second under typical driving conditions (Cohen, 1998). This order of magnitude can be considered relatively independent of walking or driving speed.
The number of possible fixations includes visual cues, movements and changes in the environment that are crucial for driving decisions. These elements can include, for example, vehicles in neighbouring lanes, traffic signals and signs, pedestrians and cyclists, road conditions (e.g. potholes or obstacles) and movements in their peripheral field of vision. The ability to perceive these elements can vary greatly depending on the context, for example at a busy junction compared to a quiet country road. It is also influenced by the driver's experience and situational awareness.

Improving perception and recognition through awareness and training

Despite the challenges associated with distractions, certain strategies can help to improve drivers' awareness and recognition skills. Training awareness processes as well as the use of advanced driver assistance systems can help reduce the impact of distractions.

Training programmes that focus on situational awareness and hazard perception can optimise drivers' ability to process information and respond appropriately to threats. In an older study, McKenna and Crick (1994) were already able to show that drivers who were trained in hazard perception were better able to recognise and react to potential hazards.

Driver assistance systems

The integration of driver assistance systems, such as collision warning systems and lane departure warning systems, into vehicles enables an improvement in drivers' perception skills through real-time feedback and warnings. These systems can help compensate for the limitations of human perception, especially in situations where drivers are under stress or distracted (Banerjee et al., 2020; Liu et al., 2022). The use of machine learning techniques and personalised models enables driver assistance systems to effectively detect driver distractions and intervene when necessary. This increases the overall safety of drivers and reduces the risk of accidents on the road.

In the reported study, it was found that the number of things a person can consciously perceive in road traffic is influenced by various factors. These include cognitive load, visual attention and distraction. Although drivers are able to perceive and process several things at the same time, distractions can significantly impair this ability and increase the risk of accidents. The promotion of awareness training and the implementation of advanced driver assistance systems are promising approaches to improving perception and recognition in road traffic. Continued research into the cognitive processes underlying driving can help to develop more effective safety measures and technologies.

2.7.1.1 Scientific literature supporting the quiz answers

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2.8 Question 8a

If a driver is travelling at 50 km/h in a local area and reads a text message for 1.5 seconds, he or she is driving xx metres as if flying blind.

a) 8 metres
b) 17 metres
c) 28 metres
d) 34 metres

Correct answer c) 28 metres

2.8.1 Detailed background knowledge for educators

At a speed of 50 km/h, a driver who reads a text message for one and a half seconds covers around 28 metres in the local area without looking at the traffic. This is known as driving blind. On the motorway, at a speed of 130 km/h, this already means a blind flight of 36 metres per second. The estimate presented here is based on the average speed stated in the question and the time spent reading the text message.

Driver distraction while driving poses a significant risk to traffic safety and can lead to serious accidents. Performing various secondary activities, such as fetching a handkerchief, drinking water, entering an address into a navigation system or sending a text message, distracts drivers from the road and often requires the use of both hands, increasing the risk of an accident.

A field study conducted by the ÖAMTC in cooperation with ADAC, Neurotraffic, ISWF, MedUni Vienna, KTM and Circ (Gatscha, Seidenberger & Klösch, 2020) aimed to investigate the possible effects of different secondary activities on the driving behaviour and traffic safety of car, bicycle and e-scooter drivers. For example, picking up a handkerchief caused drivers to drive blind for an average of 3 seconds (or 35 metres). It should be noted that more than a third of them drove into oncoming traffic. Drinking while driving was reported as a frequent activity by 71% of the participants, which led to considerable visual distractions and longer periods without hands on the steering wheel. In addition, considerable distances were travelled without control. The average distance travelled while "flying blind" was 22.3 metres for males and 30.5 metres for females. When carrying out this activity, both hands were removed from the steering wheel on average twice for a total of 5-6 seconds, covering a distance of between 80-100 metres.

Using a smartphone to read messages or surf the internet resulted in significant deviations in driving performance, which manifested themselves in an unsteady driving style and difficulties in maintaining the recommended speed. In addition, the participants frequently took their eyes off the road, which led to considerable blind driving. A third of the participants crossed the centre line and thus spent approx. 3.5-4 seconds in oncoming traffic. This corresponds to a distance of almost 44 metres for male participants and 26 metres for female participants.

Entering navigation data was identified as the most challenging task, with only 10% of participants being able to stop in time before a suddenly appearing obstacle. Regardless of gender, they took their eyes off the road at least four times on average until the obstacle suddenly appeared, which corresponded to a cumulative averted gaze of just over 6 seconds or over 100 metres on average.

The instructors' documentation showed that 21% of the test subjects failed to stop at a stop sign, 11% did not accurately apply the brakes. There was a significant increase in the number of drivers failing to use hand signals when entering or exiting a turn. Also the slowing of the general driving speed was a noticeable change or indication of a possible influence of distractions. The latter can have a negative impact on personal traffic safety and communication with other road users when cycling.

2.8.1.1 Scientific literature supporting the quiz answers

Gatscha, M., Seidenberger, M. & Klösch, G. (2020). *Kurzbericht Ablenkungsstudie.* ÖAMTC.

2.9 Question 8b

What does this mean for you as a pedestrian, scooter rider, cyclist, moped or motorbike rider, car driver?

The results from question 8a can be applied to different forms of mobility. This shows that the combination of observed frequencies of distracted driving (Maier et al., 2024) and the resulting "blind flights" as a car driver at different speeds (Gatscha et al., 2020) represents a high-risk overall situation that is associated with considerable traffic safety risks for different road users.

2.9.1 Detailed background knowledge for educators

Pedestrians

The risk for pedestrians increases considerably when drivers are distracted, and their attention is impaired. Drivers who do not look at the road for 28 metres quickly find themselves in the situation of overlooking a person crossing the road. In urban areas where there is a high volume of pedestrians, this can lead to serious accidents. The risk is significantly higher at pedestrian crossings and junctions in particular.

Cyclists and scooter riders

Cyclists and scooter riders are at increased risk in road traffic as they have less protection than car drivers. A distracted car driver could easily overlook a cyclist or scooter rider crossing the carriageway or travelling on the same road. This can lead to side collisions, which in many cases result in serious injuries.

Moped riders and motorcyclists

Similar to cyclists, moped riders and motorcyclists are exposed to an increased risk, but there is also the danger of higher speeds. A distracted car driver who does not react in time can cause serious accidents, as the impact energy is significantly greater at higher speeds. It should also be noted that motorcyclists are more difficult for other road users to recognise due to their narrower silhouette. This further increases the risk of accidents.

Car drivers

Even for other car drivers, the distraction of a car driver poses a major risk. A vehicle that drives uncontrolled for almost 28 metres can run into oncoming traffic, veer off the road or react too late to sudden traffic situations. This significantly increases the probability of rear-end collisions and collisions.

2.9.1.1 Scientific literature to which the quiz answer refers

Gatscha, M., Seidenberger, M. & Klösch, G. (2020). *Kurzbericht Ablenkungsstudie.* ÖAMTC.

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2.10 Question 9

What influence do our feelings have on our safety in road traffic?

a) Our feelings have no influence on our safety in road traffic.
b) Positive emotions always improve our driving performance and safety on the road.
c) Negative emotions such as anger and stress can impair our attention and decision-making, which increases the risk of accidents.
d) Emotions only affect our physical coordination, not our decision-making or attention.

Correct answer c) Negative emotions such as anger and stress can affect our attention and decision-making, which increases the risk of accidents.

2.10.1 Detailed background knowledge for educators

Mastering the task of driving requires the integration of a variety of skills, including cognitive, physical and emotional. Emotions, whether positive or negative, have a decisive influence on performance on the road. Understanding the impact of emotions on driving behaviour is crucial to improving traffic safety, reducing accidents and optimising the overall driving experience.

The effects of various emotions such as anger (Ābele et al., 2020; Bogdan et al., 2016; Herrero-Fernández et al., 2021; Stephens & Groeger, 2014), anxiety (Guo et al., 2019; Shahar, 2009), fear (Barnard & Chapman, 2016; Schmidt-Daffy, 2013) and joy (Zimasa et al., 2017) on driving safety have already been the subject of scientific research. Some researchers have also investigated the divergent role of positive and negative emotions in the decision-making process of drivers in terms of valence (Du et al., 2020; Trick et al., 2022). Furthermore, emotions can vary depending on individual characteristics such as gender, age, driving competence, tendency to anger, attitude towards safety and stress level, which ultimately influences the effectiveness of emotional activation and driving performance (Wang et al., 2022).

In road traffic, drivers pursue two main goals: reaching a destination on time (arrival goal) and driving safely (safety goal) (Roidl et al., 2013). Blocking these goals, for example due to traffic jams or dangerous behaviour by other road users, is very likely to lead to anger and frustration, which in turn can result in aggressive behaviour. This includes constant honking or deliberately blocking other drivers. Compared to situations where you are not at the wheel, driving is also more likely to lead to outward anger and aggressive behaviour. This is because the targets of anger and aggression are usually other road users and because of the shell-like structure of the car, there is anonymity on both sides (Lawton & Nutter, 2002).

Attention and concentration

Negative emotions such as anger, stress and sadness can significantly impair drivers' attention and concentration. When the driver is emotionally agitated, for example by anger, cognitive resources are often used to investigate the cause of the anger instead of observing the road. The resulting distraction increases the likelihood of overlooking important traffic signs, road signs or other road users. In this context, recent research has shown that a number of human cognitive functions, including attention allocation, reasoning, judgement and decision-making, can be impaired by anger (see Blanchette & Richards, 2010).

Zhang et al. (2016a) conducted a meta-analysis to examine the relationship between anger at the wheel and driving performance. Anger at the wheel was found to be a positive predictor of a number of driving errors in this meta-analysis. An increased risk of accidents was also demonstrated. The correlation between anger at the wheel and risky driving was more pronounced in young drivers than in older drivers. One possible explanation for this positive correlation could be the digressive thinking that goes hand in hand with negative emotions such as anger. Smallwood et al (2009), for example, were able to show that participants who felt negative emotions made more mistakes, had more thoughts unrelated to the task and were also less able to correct their performance after a mistake. Alternatively, the positive correlation between anger and errors can be attributed to the tunnel vision associated with anger (Friedman & Förster, 2010). There is evidence that angry drivers search a constricted area, which increases the risk of not recognising potential traffic hazards in time and consequently making mistakes.

Decision-making and risk perception

Emotions such as anger and frustration can lead to impulsive and aggressive decisions, which can result in impaired cognitive performance. In road traffic, there is a risk of drivers adopting risky behaviour such as speeding, tailgating or abrupt lane changes. These behaviours are often carried out without considering the potential consequences, which increases the likelihood of accidents. In particular, angry people tend to perceive a lower risk, while at the same time showing a more positive attitude towards taking risks (Lerner & Keltner, 2001; Taubman-Ben-Ari, 2012). This could explain the positive correlation found between anger at the wheel and risky driving (Zhang et al., 2016a).

Driving behaviour

A high level of emotional excitement can lead to an impairment of physical coordination and a reduction in fine motor skills. This can manifest itself in jerky or unpredictable driving manoeuvres, difficulties in maintaining a lane or difficulties in accelerating and braking smoothly. Anger has been shown to lead to an increase in driving speed, increased acceleration, poorer control of the vehicle's lateral position and an increase in traffic offences (running red lights and crossing lines) (Abdu et al., 2012; Mesken et al., 2007; Roidl et al., 2014; Techer et al., 2017). A study by Zhang et al. (2016b) confirmed that anger leads to increased braking when merging lanes and to a reduction in the safety distance (Zhang et al., 2016b).

The influence of positive emotions on driving performance

In addition to emotions with negative valence, positive emotions can also worsen driving performance and lead to more driving errors (e.g. poorer lane keeping, more aggressive driving and traffic offences) (see Jeon et al., 2014) and higher speeds (see Rhodes et al., 2015). In this context, it should be noted that studies have found a reduction in risk perception through positive (humorous) emotions. This is illustrated by subjectively reported accident probabilities in general, the probability of personal injury and concern in relation to various road accidents (Hu et al., 2013; Lu et al., 2013). However, other studies have shown that different valences have different effects on driving behaviour. For example, it was found that drivers who listen to happy music are more distracted than drivers who listen to sad music (Pêcher et al., 2009).

In a study by Zhang et al. (2020), the effects of emotions on driving performance and risk perception were investigated. For this purpose, a typical scene with a braking/follow-up situation was simulated. In this study, an attempt was made to determine interactive effects between anger and individual factors, with particular attention being paid to character traits of anger and driving experience as influencing variables. The results demonstrated that the test subjects were more likely to engage in risky behaviour when they were both angry and happy. However, only the happy conditions showed a lower perception of accident risk. In addition, the experienced drivers showed poorer control of the lateral vehicle position under the happy conditions than under the neutral and angry conditions.

In summary, it can be said that emotions play a central role in driving behaviour and influence attention, decision-making, risk perception, physical coordination and general safety. Both negative and positive emotions can have a detrimental effect and lead to an increased risk of accidents and impaired driving behaviour (Cunningham & Regan, 2016; Steinhauser et al., 2018). Education, self-regulation techniques related to strong emotions and technological tools can improve understanding of the effects of emotions and aim to regulate them and reduce emotion-related driving accidents, ultimately increasing traffic safety. The safety of all road users can only be ensured if drivers are aware of their emotional state and take proactive measures to manage it.

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2.11 Question 10

What things can distract us in the car?

a) A combination of cognitive, visual, manual, auditory, technology-based and environmental distractions.
b) Only external environmental factors such as billboards and accidents.
c) Mainly manual activities such as adjusting the radio or eating.
d) Mainly auditory distractions, e.g. loud music or conversation.

Correct answer a) A combination of cognitive, visual, manual, auditory, technology-based and environmental distractions.

2.11.1 Detailed background knowledge for educators

The task of driving is complex and requires constant attention and coordination. Although vehicle safety technology has made significant advances in recent years, driver distraction remains one of the leading causes of road accidents around the world. Distractions can have different causes, both inside and outside the vehicle. In the following, the main categories of distractions - cognitive, visual, manual and auditory distractions - are introduced and their effects on driving performance are presented based on the scientific literature.

Cognitive distractions

Cognitive distractions are activities that distract the driver's mental focus from the road. These can include daydreaming, deep thinking or even conversations with passengers. A study by Strayer et al. (2003, 2006) showed that cognitive distractions, such as talking on a hands-free device, impair driving performance to a similar extent as driving under the influence of alcohol. This is due to the fact that monitoring the driving environment, recognising hazards and making quick decisions are impaired by having a conversation.

Visual distractions

The distraction of the driver by visual stimuli is referred to as visual distraction. This occurs when the driver's attention is diverted from the road. This category includes actions such as reading a text message, looking at a GPS device or observing an event outside the vehicle. In their study, Gershon et al. (2019) collected data on the real-life driving behaviour of a cohort of 82 young people between 2010 and 2014 who had just successfully obtained their driving licence. The results showed that of a wide range of secondary tasks, only manual mobile phone use and reaching/handling objects while driving were associated with an increased risk of accidents. The duration of the driver's visual absence from the road was found to be a significant factor in the accident risk associated with manual mobile phone use. However, it was of secondary importance for the risk associated with reaching for/handling objects while driving.

Manual distractions

Manual distractions are defined as performing tasks with the hands outside the steering area, such as eating, drinking or adjusting controls in the vehicle. These actions impair the driver's ability to maintain full control of the vehicle. Bharadwaj et al. (2023) and Young and Salmon (2012) point out that manual distractions significantly increase the risk of an accident, as they are often accompanied by visual and cognitive distractions and thus create a combined effect. For example, texting while driving requires visual, manual and cognitive distraction, making it one of the most dangerous distractions.

Acoustic distractions

Acoustic distractions include all noises that distract the driver's attention from driving. This can range from loud music and ringing phones to conversations with passengers. A systematic literature review and meta-analysis conducted by Caird et al. (2018) included a total sample of 4,382 drivers aged between 14 and 84 years. The analysis of the data showed that talking on a mobile phone or hands-free device led to reduced performance in reaction time, stimulus recognition and collisions compared to baseline driving. A similar pattern of effect sizes was found for conversations with passengers. A cross-sectional study by Huisingh et al. (2015) with systematic traffic observations at 11 selected intersections showed that of 3,265 drivers observed, 32.7% carried out distracting activities while driving. The most frequently observed distractions were interacting with another passenger (53.2% when a passenger was present), talking on the phone (31.4%), distractions from outside the vehicle (20.4%) and texting or dialling a phone number (16.6%).

Technological distractions

The progressive integration of technologies in motor vehicles, such as smartphones, infotainment systems and advanced driver assistance systems, has led to an increase in sources of distraction. While these technologies are intended to increase comfort and safety, they can also require a high level of visual, manual and cognitive attention. In their systematic literature review published in 2021, Hung and colleagues focused on distraction in road traffic in the context of driver assistance systems. The majority of the studies presented in the literature review demonstrate a link between driver assistance systems and increased engagement in secondary tasks and improved performance on secondary tasks. Ten papers show that drivers tend to divert their attention to secondary tasks and away from driving tasks. The results presented underline the continued importance of the role of the human driver despite vehicle automation, especially in the context of driver distraction. They also highlight the relevance of users' understanding of the functions and limitations of driver assistance systems for the appropriate and effective use of these systems.

Distractions from the surroundings

External factors such as roadside billboards, accidents and views of the landscape can also distract the driver's attention from the task at hand. These distractions are particularly problematic because they are often unpredictable and can lead to sudden shifts in attention. An eye-tracking study conducted by Dukic et al. (2013) aimed to investigate the effects of these electronic billboards on visual behaviour and driving performance. The data on drivers' visual behaviour showed that they had a significantly longer dwell time, a greater number of fixations and a longer maximum fixation duration when driving past an electronic billboard compared to other signs on the same stretch of road.

The study by Vrkljan and Jeleč (2021) addressed this issue with a particular focus on young people aged 18 to 25. Young people in this age group appear to invest more resources in interacting with roadside advertising, which suggests that they are less able to distinguish between relevant and irrelevant information. Combined with lower driving experience, susceptibility to roadside distractions, such as static or changing advertising signs, may increase trafic safety risk among young drivers. Therefore, this study focused on the effects of roadside advertising signs on young drivers, particularly on their cognitive workload while driving in an urban environment littered with roadside advertising signs. The study used a driving simulator, a wireless mobile EEG device to measure the electrical activity of the brain and eye tracking goggles to measure eye movements while driving. The study was conducted with 20 young drivers aged between 18 and 25. The results of the EEG study indicated a significant difference in the cognitive workload of young drivers in relation to roadside advertising. This showed a higher cognitive workload when driving in an environment with billboards. The simulator research results showed a statistically significant change in driving speed - drivers accelerated while driving through an environment saturated with roadside billboards. The ETG and questionnaire research results revealed three common characteristics of static roadside billboards that attract more attention from drivers: larger billboards (mega billboards), well-known brands and provocative design.

Summarizing the reported study results, it can be stated that driver distraction is a multi-layered problem that includes cognitive, visual, manual and auditory elements. The increasing presence of in-vehicle technologies and external environmental factors further complicates the problem. Driver distraction can only be effectively reduced through a combination of public education, legislative measures and technological innovation. Knowledge of the causes and effects of these distractions allows measures to be derived to improve traffic safety and reduce the number of accidents. The scientific literature emphasizes the urgent need for continuous research and development in this area in order to keep pace with the development of driving environments and technologies.

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