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ROAD SAFETY RESEARCH

KILLER SCREENS?

THE USE OF MOBILE PHONE AND INFOTAINMENT SCREENS AS A HIDDEN CAUSE OF ROAD ACCIDENTS

Association for More Reasonable Road Traffic

Hungary

30 April 2024

photos: NetCarShow.com, Unsplash, Volvo Car Corporation, WheelsAge

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INTRODUCTION

"A vehicle can be driven by a person who is in a state capable of driving the vehicle safely," stipulates 1/1975. (II. 5.) KPM-BM[1] joint decree on the rules of road traffic, i.e. in the 4th section of the Road Traffic Code. In the previous section of the law, titled The general provisions on traffic participants, it was stated: *"the driver of the vehicle may not use a mobile radiotelephone held in his hand while driving. The driver of a two–wheeled or three–wheeled vehicle which is not a motor vehicle, shall not use mobile telephones held in hand while driving, including when stopping for traffic reasons."* It is clear from the verbiage that this is not a modern law as the explanatory text in the section for road traffic related concepts looks somewhat outdated: *"mobile radiotelephone: an apparatus (end device) suitable for using the Public Mobile radiotelephone service."* Actually this—and other campaigns and police presence—is the source from which drivers should be able to formalize their responsible, conscious set of behaviours that make them a truly safe and flexible participant in traffic.

Our experience says they are unable to do this.

This study is based on our empirical—and generalizing[2]—observation that drivers drive inattentively and the primary direct and indirect cause of that is screen use. This observation is supported by a number of international studies usually concluding that one of the most common distractions for drivers is the use of mobile phones3, which has already entered the field of view of European Union decision-makers (see page 11). The social media and video sharing platforms of the Hungarian Public Roads and, more recently, the MKIF motorway operator are teeming with videos recorded by public cameras showing drivers who do not brake at all or only in the last moment when approaching maintenance vehicles. The MÁV (Hungarian Railways) also regularly reports accidents in gateways when the signs of the barrier are ignored. These incidents also reinforce the assumption that drivers did not pay attention to the road or traffic signals before the accident.

Another important motivation to launch our research was that according to our understanding, police forces in Hungary do not or cannot do much in preventing or monitoring driver distraction, while accident prevention measures do not seem to be effective in this field even though distracted driving is a growing problem in Hungary, too.

As the use of mobile phones has become a concept to be interpreted in a wider spectrum over the years—especially so after its introduction in the traffic code—new distracting

[1] Traffic Code III.i.

[2] The co-workers of our Association are not present in domestic transport in a representative way. We are very keen on journalist on this topic but we cannot be everywhere and we are not able to see every single motorist—this is the reason why we use the term "generalizing"

[3] Despina Stavrinos, Jennifer L. Jones, Annie A. Garner, Russell Griffin, Crystal A. Franklin, David Ball, Sharon C. Welburn, Karlene K. Ball, Virginia P. Sisiopiku, Philip R. Fine, Impact of distracted driving on safety and traffic flow, Accident Analysis & Prevention, Volume 61, 2013, Pages 63–70, https://doi.org/10.1016/j.aap.2013.02.003.

factors (devices) have appeared in vehicles: most notably the infotainment systems with visually active screens. It is advantageous for car manufacturers (primarily from a cost-saving point of view) to install these systems in vehicles not only to perform new functions, but also to replace conventional systems, while increasing touchscreens and displays pose a threat to road safety.

As the use of mobile phones has become a broader concept over the years—certainly since its inclusion in the traffic code—new distractions (devices) have appeared in vehicles: most notably, glittery-flashy infotainment systems. It is to the advantage of car manufacturers (mainly for cost-saving reasons) to install these systems in vehicles not only to provide new functions but also to replace traditional control systems, while ever larger touchscreens and displays are a threat to road safety.

After analysing a number of studies we can state that screen use, such as the duration and frequency of smartphone use alone, does not necessarily cause distraction but specific smartphone usage patterns may be decisive. For ex-ample, distraction is mainly experienced when smartphone use is highly fragmented: smartphone interactions occur frequently and scattered over time[4].

We are urged by Vision Zero, the European Union's long-term goal of bringing the number of road traffic deaths as close to zero as possible by 2050. As a milestone, the EU has set a 50% reduction target for the number of people killed and seriously injured in road accidents by 2030, set out in the EU road safety policy framework for 2021-2030.

All of this was a good of enough reason for us to look closely at the issue with our own opinion poll and study other relevant research materials. At the end of our study we draw conclusions and make specific recommendations to 1) the official regulators of road safety in Hungary on how to combat this phenomenon, 2) to European decision-makers on how to change the regulations on screen use (including vehicle homogenization requirements), 3) to the police on how to effectively monitor screen usage as a cause and source of accidents.

Vision Zero drives us not only because of its primary goals, namely to reduce the number of serious accidents on the roads, but also because we believe that the focus in the application of the strategy has been lost and certain processes started that impede the flexibility and speed of road transport unreasonably, especially with unreasonable speed limits. It is therefore important to focus on the underlying problem rather than the treatment of symptoms as soon as possible and to make effective decisions based on these.

László Fábián,
motoring and transport journalist with 30 years of experience,
Chief Operating Officer of the Association for More Reasonable Road Traffic

[4] Siebers, T., Beyens, I., & Valkenburg, P. M. (2024). The effects of fragmented and sticky smartphone use on distraction and task delay. Mobile Media & Communication, 12(1), 45–70. https://doi.org/10.1177/20501579231193941

BACKGROUND

According to a 2017 study by the University of Chicago, smartphones have enormous potential to improve our well-being but their constant presence can come at a cost to our cognitive abilities. The University's research tested the so-called "brain drain" hypothesis assuming that the presence of one's own smartphone could take up intellectual resources, leaving fewer resources for other tasks and decreasing cognitive performance. The results of two experiments show that even if people manage to maintain sustained attention to a task—so when they avoid the temptation to look at their phones—, available cognitive capacity is reduced by the presence of these devices. These cognitive losses are highest in individuals with the highest level of smartphone addiction.

According to an other terminology, a person has an average of seven brain channels available to receive information (channel capacity)—this is actually the bandwidth of the brain (depending on age and individual characteristics, this number actually varies: 7 ± 2.) When we monitor the road and the signs we have booked 1-2 channels. Listening to music in the car or having a conversation: another 1-2 channels. And we don't even have a headache, a stomach-ache, no child is crying in the back seat, or we don't worry about dinner or even something more serious. Touching the smartphone screen and making a call occupies additional channels (at least 2-3) but even more can be distracted from our duty, i.e. driving with attention.

Such a serious risk factor should be more clearly reflected in the ATL and BTL[5] accident prevention campaigns, in the daily police routine and in the public awareness of traffic participants as a cause for accidents, and also in accident statistics based on accident reports.

But it doesn't happen. This is confirmed by the response of Dr. Gábor Boros, police colonel, chief police officer, Acting Registrar who claims that

> ***"No statistical data are collected on the use of screens while driving and their effects on road safety in relation to road traffic accidents (hereinafter referred to as accidents), so we cannot comment on the proportion of their contribution to the occurrence of accidents."***

From this it is already possible to suspect that the police do not investigate the causes of accidents related to distracted driving and these are not indicated on accident data sheets which causes serious distortion in the statistics (establishing the causes of accidents), so the direction of accident prevention strategies is also inappropriate. But not

[5] BTL stands for Below the Line marketing communications. This type of communication is done through non-traditional marketing channels, unlike ATL, Above the Line, which uses traditional media such as television, radio, print media, and posters.

only do they not research it, Hungarian police works with a different approach to categorization. In the response letter above, they answered our question as follows: ***"given that the direct cause of the accident is not the use of distracting devices*** *and any activity suitable for distraction (i.e. eating, drinking, smoking, talking to a fellow passengers). Therefore we do not research its use while driving and the use of distracting devices behind the wheel cannot be objectively proven after the accident has occurred. The cause of the accident in such cases is not the lack of attention but a consequence of some other violation of article No. 1/1975 on the rules of road traffic (II. 5.) of the rules of the KPM-BM joint regulation (hereinafter referred to as: traffic code) (e.g. failure to give way, failure to observe sign, traffic light, signalling device)."*

It is partly understandable that the police act on the basis of the traffic code and only deals with the consequences. In fact they leave it to the drivers to understand that being distracted on the road due to screen use can lead to one of the consequences listed above. In our view however, they are only scraping the surface which is an attitude less conducive to accident prevention and is only an arbitrary selection between the rules contained in the traffic code. This attitude places emphasis on violations that can be easily measured and sanctioned instead of meticulous preventive work.

We asked what preventive action do they carry out to avoid/decrease dangerous screen use in cars. Their response is as follows:

> ***"Due to its responsibilities and to the extent possible, the police carries out its accident prevention activities which, in addition to preventing road traffic accidents, are aimed at improving traffic morale and encouraging traffic behaviour that follows the rule.***

On the one hand, accident prevention activities are carried out by law enforcement ("classic" police road checks), on the other hand specific prevention and communication activities are done.

In connection with this issue, Section 3. (1) (c) stipulates that a person involved in road transport shall be obliged to travel in such a way as not to endanger the safety of other persons and property and not to prevent or disturb others unduly in their progress. This regulation sets a framework and limits all activities and circumstances that reduce the risk of any road traffic participant's (be it a driver, cyclist, pedestrian, etc.) ability (detection and response) necessary for safe traffic. Therefore, any activity that is dangerous by distracting the driver from the road or traffic or limiting him or her from taking appropriate action within the expected time is prohibited.

The police continuously monitor compliance with the legal requirements during their public presence and they also organize a series of specific targeted inspections. Every year, the network of European traffic police agencies (ROADPOL) announces a series of increased inspections under the name "Focus on the road" for a week and the Hungarian

police joins in. The announcement of the last inspection and the post-communication of the inspection can be found at the following link:

https://www.police.hu/hu/hirek-es-informaciok/legfrissebb-hireink/kozlekedesrendeszet/ focus-on-the-road-az-utat-figyeld-akcio

https://www.police.hu/hu/hirek-es-informaciok/legfrissebb-hireink/kozlekedesrendeszet/ roadpol-focus-on-the-road-2

During the inspections we primarily check the use of radiotelephones while driving but we also pay great attention to other activities threatening the safety of people and property by distracting attention, such as the operation of any electronic device by the driver of the vehicle while driving, the viewing of visual or texting data on such a device.

At the same time, in addition to sanctioning violations the police place special emphasis on prevention, on education about legislation, on the awareness of sanctions for violations and on the education of cultured transport. The activities of the ORFK's (National Police Headquarters) National Accident Prevention Committee (OBB) include creating publications and articles that draw attention to the characteristics of individual traffic groups.

Communication shall include the demonstration of the impact and dangers of violations (e.g. not using passive safety devices, use of mobile phones and other distractions while driving, speeding, driving under the influence) on road safety. You can find information about ORFK-OBB's activities, campaigns, current programs on the website: www.kreszvaltozas.hu."

In our opinion the work of the police is not very effective, the campaigns are boring, "invisible" and the "classic" police measures are not effective either. *(See our recommendations on page 60.)*

Although the volume of the Hungarian traffic code is very thick in international comparison, it is not specific enough on certain issues and it leaves the driver with a great freedom of interpretation which can easily lead to a big difference between real practice and the law. What we mean by that is that the driver has to realize in a series of steps what he should not do. For example, as Dr. Gábor Boros, Police colonel also referred to, the section in the traffic code that stipulates *"those who participate in road traffic are obliged to travel in such a way that they do not endanger the safety of other persons and property and do not unreasonably hinder or disturb others in their progress".* This also means that no one should engage in distracting activities while driving a vehicle. But the traffic code does not elaborate what is meant by this: *"the driver of the car cannot use a mobile radiotelephone held in hand while driving"*. We assume what that regulators meant was not only cell phones held to ears are banned but messaging and chatting is prohibited, too. However, it is easy to interpret the legislation (and you don't have to force yourself hard to do so) that by attaching the mobile to the dashboard or the air vent, one can type in long messages even if it is much less comfortable to do so or probably riskier than holding the device in hand.

It has been proven several times by many that holding a phone in hand while driving is a dangerous activity. The use of smartphone at the wheel has become one of the classic distractions today. According to calculations of Dipl.-Ing. Robatsch, traffic safety leader of the KFV (Kuratorium für Verkehrssicherheit, Traffic Safety Board) head-quartered in Vienna, Austria

> ***"using a smartphone without a handsfree set raises the risk of accident five times. Anyone occupied with texting messages behind the wheel must know that the risk of accident in that situation is 23 times higher".***

But let's go one step further: why is it safer to talk on a hands-free set while holding, for example an ice cream or a hamburger in one hand, waiting for the opportunity to take a lick or a bite? This is a reasonable suggestion, especially in view of the fact that there is already a number of studies showing that hands-free mobile telephony is also a serious distraction *(see brain channel capacity above and page 14)*. So the injustice of the current regulation is exposed. But in any case, the legislation is outdated—it does not follow current trends. (Again, when was the last time you called your smartphone or gadget a *radiotelephone*?)

Of course, in all such cases which we have listed here as an example, a quote from the traffic code comes into the picture: According to that—to put it simply—you have to be in a condition suitable for driving a car. We know that being inattentive or somewhat inattentive on the road is far from meeting this important criterion, but—and we would like to stress once again—

> ***such drivers will only be confronted with this fact in court when they realize that these sentences in the law can also mean this.***

There are arguments from specialists that it is not necessary to treat motorists as minors. In other words: you don't have to have a rule for every possible situation. We fully agree with this—our Association was founded precisely with the aim of eliminating rules that are difficult to follow and enforce. But the current situation shows that there is both over—and under-regulation, for example, in relation to the use of phones and other distracting devices while driving.

The infotainment touchscreens in cars replace traditional dials and buttons, thus posing ever greater risk to road safety. Hungary's vehicle fleet is aging so we have these risks too, but it will be a more serious problem in approximately a decade from now.

EUROPEAN UNION: FOCUSING ON DISTRACTION

Although there was no action in the European Union at the time we launched our research, in January 2024 the thematic report of the European Road Safety Observatory focused on this very topic[6]: driver distraction is a significant risk factor in traffic. Their research has shown that *"**drivers perform distraction activities for about half of their driving time.** Common sources of distraction for drivers include the use of mobile phones or other devices, setting up in-vehicle infotainment systems, interacting with passengers, and eating".*

Activities that require the driver to look away from the road, such as making a call or texting a message, are particularly dangerous. Distracted drivers are more likely to deviate from the predictable lines of their movements, have longer reaction times and often fail to notice information from traffic environment, including other road users.

> ***It is concluded that the most common source of distraction to drivers is the use of smartphones.***

Almost one in three European drivers admits to having used a mobile phone in their hand to talk, and almost one in four admits to having done so to view messages or social media while driving. Young people are more likely to use mobile phones while driving than older drivers.

> ***Overall, the use of a hand-held phone increases the risk of accidents by about 2.5 times, highlights a report published by the European Commission.***

DEFINITIONS

WHAT DO WE MEAN BY SCREENS?

The **screen** represents all the units that the driver has to look at while driving: most notably the mobile phone and the so-called infotainment system in the vehicle. As we have referred to, what **smartphoning means nowadays is far from just being on the phone held in hand, with or without handsfree set**. The infotainment system is, in a very simple way, a small or large touch display unit located on the center console, through which most car functions can be controlled like navigation, media players, radio, vehicle diagnostic tools, vehicle related information (e.g. hybrid system operation), car

[6] European Road Safety Observatory: New report from the European Road Safety Observatory: focus on distraction, Directorate-General for Mobility and Transport, 2024. https://road-safety.transport.ec.europa.eu/news-events/news/new-report-european-road-safety-observatory-focus-distraction-2024-01-11_en

safety and comfort settings, etc. Smaller displays can also distract drivers, not just larger ones. There are times when dedicated buttons[7] are paired with the touchscreen—that also belongs here. We also add the mirroring function of the smartphone, when through Apple CarPlay or Android Auto we can use some applications of the smartphone on the central display of the car.

DEFINITIONS OF DISTRACTION AND EXPLANATION OF THIS TERM

We thought a lot about the right term. Is it distraction? Being unattentive? Careless driving? Finally, we decided to use the word *distraction*, which is already established in the English language because this activity or phenomenon is both active and passive.

Let's look at the phrase in its broader context, as if it were a newspaper story: "the driver ran over the pedestrian on the zebra crossing because of a *distraction"*. A ***distraction***, assuming screen use is involved, in this sentence **may suggest that the driver is a victim of external circumstances** and is not responsible for being involved in screen use. Just as if he saw a naked person standing on the side of the road, and that sight distracts the driver, draws him in.

Partially, there is truth in this as nowadays it is no longer a secret how development teams, backed up by psychologists, work to make mobile and gadget use more and more addicting. Not to mention the content they offer, such as social media or video-sharing platforms and their aggressive self promotion. However, **the final, conscious decision is still with the user, in our case the driver (active)**, who seem to develop a thick armour when traffic safety professionals try to make them understand the dangers of using screens while driving.

One more argument in favour of the term *distracted*: The term distracted driving is often used in English speaking countries to express various driver activities while driving and sleepiness or daydreaming can be classified as being *unattentive*. The term *distraction* (also used in this study) refers specifically to a distraction that occurs when motorists shift their attention from driving to focus on another activity.

A 2013 report by the National Highway Traffic Safety Administration (NHTSA) to the United States Congress, titled Understanding the effects of distracted driving and developing strategies to reduce deaths and injuries, highlights that *"distractions can come from electronic devices such as navigation systems and cell phones or from more traditional sources such as eating or interaction with passengers"*. According to the report these distracting tasks affect drivers in different ways and can be classified into the following main types:

[7] Dedicated buttons and switches are assigned TO a single, separate function. Functions like this are typically the aircon switch, the stereo volume control.

- **Visual distraction**: activities when the driver has to turn their eyes away from the road to receive some other visual information;

- **Manual distraction**: activities when the driver has to take their hands off the steering wheel and handle an object or a device;

- **Cognitive distraction**: activities resulting in cognitive burdens when the driver has to focus on something else too while driving the vehicle.

Obviously, using a screen fits into the first two categories but it can sometimes be classified as being in the third category, too. You can think of having a phone call or listening to a media as an example.

FURTHER RESEARCH RESULTS

Since the beginning of the 2000s, serious studies have been made about the dangers of mobile phone use. Virginia Tech[8] sounded the alarm already in 2009. Researchers used cameras and instruments in the participants' cars to create a picture of drivers' distraction and mobile phone use in real driving conditions. Huge database were collected on driver activities continuously monitored over more than 9 million kilometres of driving. The Institute's statement highlights that *"catastrophic accidents and disturbing trends at the time have led to an alarming amount of misinformation and confusion about mobile phone use and texting behind the wheel of a vehicle. Our research results can help dispose of these misconceptions because they are based on real driving data"*. Phone calls and text messages were the problem at the time of this research. Since then, the elevated experience of online chatting and social media consumption have also joined in. Virginia Tech concluded that *"dialling a cell phone and texting significantly increased the risk of someone being involved in a safety-critical event such as an accident or an emergency situation"*.

> ***A normal conversation in the car or listening to a fellow traveller has increased the risk to a lesser degree***

in case of passenger cars and didn't increase the risk at all in case of a trucks.

> ***"Text messaging on a mobile phone had the highest risk of all mobile phone-related tasks"***

—concludes the American research.

[8] Official name: Virginia Polytechnic Institute and State University (VPI), a research university founded in 1872 with its main campus in Blacksburg, Virginia.

The specific numbers calculated by using risk estimates look like this in the Virginia Tech study:

In case of passenger cars and small vans:

1. **Dialling on a mobile phone increased the risk of an accident or near-accident by 2.8 times** compared to non-distracted driving**;**
2. **Talking or listening to a mobile phone was 1.3 times more likely to cause an accident** or near-accident than driving without distraction;
3. **When reaching for an object such as an electronic device, the risk of an accident or near-accident is 1.4 times higher** than that of non-distracting driving.

For trucks, the same risks were 5.9-, 1.0-, 6.7-fold respectively. **Texting increased the risk of an accident or near-accident by 23.2 times** compared to non distracted driving.

The researchers conducted eye tests to assess where drivers were actually looking when they were involved in a safety-critical event while performing mobile phone tasks. The greatest risks were those activities that distract the driver's line of sight from the road.

The study highlights that although recent (at that time) results from other researchers using driving simulators suggest that face-to-face conversation and listening to others in the vehicle are just as dangerous as visually distracting smartphone activities, Virginia Tech's results from real-world measurements clearly show that this is not the case.

Other studies and our own research and experience show that

> ***speaking on smartphones has a higher load on our brain channels than talking to someone next to us in the car. In a personal conversation, participants are present with their body language and gesticulation,***

"reception" of the information is clear, there are no problems with the signal. Radio presenters are specially trained to communicate what they have to say to their listeners by over-gesticulating (that is why it is often funny when former radio presenters over-gesticulate on TV where this is not necessary at all), possibly with a higher amplitude of intonation because between the narrower communicational frequencies of radio, the clarity (or the possibility thereof) is easily lost. In a car this is most often manifested in incomprehensible responses when using mobile phones. In response to this, the driver on the phone gives even more attention to the phone call by occupying and using new brain channels.

Also an important factor is that the **interlocutor who is not a driver but is in the car, to a certain extent vibrates according to the circumstances**; i.e. with the traffic, and thus with the driver. This is also the case if the passenger interlocutor is not a driver anyway.

So in a more risky situation, he or she also becomes silent (so "returns the channel" to the driver so that he can better focus on solving the problem) in a potential accident situation. The telephone interlocutor on the other hand, continues to speak or asks questions about what is happening at the wrong time, which—depending on the driver's temperament—keeps the driver even more busy, upsets him even more and possibly escalates an already existing problem such as an accident hazard.

In addition, a partner in the same vehicle, if feeling responsible (or scared) **warns the driver** to keep an eye on the road and/or draws the driver's attention to the problem in the event of an emergency. Clearly, this cannot be done from the "other end" of a smartphone conversation.

Similarly, it is important to **choose the time to make an emotional announcement** which is difficult to judge via mobile phone (no visual contact); extreme examples can be the announcement of a death or the announcement of a lottery prize. It depends on the listener's character but it may also entail major accident risks. The fellow traveller in the car is unlikely to report such news at a speed of 130 km/h on the highway but a phone call partner, not knowing about the circumstances and perhaps feeling that conversation is "OK now", can easily and inadvertently cause such problems. Emotional conversations can certainly occur in the car or in person (confessions of love, fallouts) and we can even listen to radio plays or audio-books which stir up our emotions—as the research by Virginia Tech says—"can have a measurable effect in the laboratory but the actual driving risks are much smaller compared to having a conversation on a smartphone".

The research also covered mobile phone use with a headset: they say it is *"not significantly safer than hand-held phone use"* as the primary risks for both activities are the same: dialling, listening and answering questions and other tasks that do not require the driver to look away from the road. In contrast, *"real handsfree telephone use (i.e. with a built-in speaker-phone) and voice control systems are less risky if they are designed well enough so that the driver does not have to take his eyes off the road often or for a longer period of time"*. Our recurring test experience aligns with the experience of the participants in the research is that the **operation of the voice control is not reliable, especially in Hungarian**. This is a particularly important conclusion in view of the fact that some car manufacturers prefer to answer questions about the accident hazards of increasingly widespread infotainment systems or mobile devices that are not fully integrated, that voice control is there. In short, it's not really there *(see details on page 15)*.

Our further experience is that touchscreen infotainment systems have not been covered in these studies for the time being and the hazards regarding their use are just beginning to be discovered. This is why it was important for us to include them in our research.

RESPONSIBILITY OF CAR MAKERS

The latest generation automobiles are almost all equipped with touchscreen infotainment systems.

These are basically large tablets that control most of the functions in a car. Everyone is happy except for the professionals who are concerned about traffic safety. Consumers get a more modern, cooler solution while car manufacturers charge more for less expensive (we repeat: less expensive) technology. But the danger of distraction lurks behind this spectacular and cost efficient new technology.

TOUCHSCREEN HMI SYSTEMS IN TODAY'S CARS: GOOD AND BAD SOLUTIONS[9]

In case of the models on the European car market from the 1950s to the beginning of the 2000s there were no big ergonomic differences in the design of the dashboard and control functions of cars that significantly influenced the driver's attention and concentration. The air conditioning and audio system interfaces were organized into well-separated units and the controls, dials and buttons of the most frequently used functions were easily accessible without looking at them. The most important buttons and consoles were illuminated at night and the most important controls were accessible without letting go of the steering wheel.

Dashboard of Mercedes-Benz E Class (W124), 1990

Minor modernization steps were also taken during this period. The climate control lever was replaced by the rotary dial and analogue systems were replaced by digital car radios and climate controls. In only a few years' time, on-board computers displaying road and consumption data have trickled down into less expensive cars. A few manufacturers have tried something extreme from time to time; the digital instrument units (Fiat Tipo, Renault Twingo)—resulting in exciting and hard fought disputes over them—have appeared more and more often, but even in these cars the desire for clarity and minimal distraction remained a steady effort on manufacturers' side. Typically for this era, car magazines two decades ago considered it to be a notable error if the dial of the speedometer covered some of the dial numbers or if the emergency light switch was not placed in the center of

9 Tamás Rácz, the author of this chapter titled *"Touchscreen HMI systems in today's cars: good and bad solutions"* is an automotive and transportation journalist with more than two decades of experience and the president of the *Association for More Reasonable Road Traffic*.

Citroën CX 2400 Super Break (1978–82)

Subaru XT (1985–87)

the dashboard to be easily accessible by both the driver and the passenger (so in case of a sudden braking force on the highway even the passenger can immediately turn on the yellow hazard lights while the driver is still busy steering and decelerating).

The first touch-screen interface was offered in a car in as early as 1986 (Buick Riviera), but largely due to the feedback from customers complaining about the distraction from driving, the manufacturer ceased to offer this monochrome novelty with green lights and it did not return to the automotive industry for about two decades.

The developing electronics industry, and especially the rapid spread of mobile communications brought about a spectacular expansion of equipment in cars by the 1990s. Replacing the simple car radios and outdated cassette tape players, CD-players (sometimes with 6 disc units), radios with DAB (Digital Audio Broadcasting) reception, MP3-players and combined head units appeared. Car radios were already capable of Bluetooth hands-free and music playback and GPS-based navigation systems were offered. From the 2000s the classic, standard-size (DIN) infotainment devices began transforming into systems integrated into dashboards and into the car's electronics network system. The resolution and image quality of the navigation screen have been improved and infotainment has been added by the premium brands with a tuner capable of receiving TV broadcasts. An increasingly large part of the dashboard was dominated by a colourful and bright surface which captured more and more of the driver's attention.

Then the mobile telephony created the technological background to mass produce low-cost and high-quality **capacitive touchscreens** and time proved that these devices can **withstand temperature fluctuations and are quite durable—even better than previous liquid crystal displays**—, so approximately from the late 2000s (1st iPhone: 2007) car manufacturers could no longer resist the double temptation of using this new technology in their cars.

On the one hand, the touchscreen looks very good. The beautiful and colourful images and animations on it make the passenger compartment of the car interesting and exciting, evoking a television in the center of a living room in an apartment, thus making it an extra attractive for the customer. On the other hand and more importantly, the **touchscreen is not expensive**. The myriads of small buttons, separate displays and the design, manufacturing and assembly costs of the wiring connecting these subsystems of a conventional dashboard are significantly higher than that of a single interface with a single touchscreen and especially if only this one and only module must be placed on top of the empty dashboard.

Tesla Model S, 2013

> ***The disruptive start-up, Tesla splashing huge waves in the automotive industry has created a new trend with their portrait style touchscreen.***

Similar interfaces appeared in a range of new models and BYD took the game even further by incorporating a touchscreen that could be rotated by a motor and set horizontally or vertically in its cars. **So what are the disadvantages of the Human-Machine Interface (HMI)?** The constantly changing visual information keeps distracting drivers even if they don't use the HMI. Touchscreen management while driving always requires the motorist to look away from the road—contrary to using buttons, rotary dials or toggle switches. **Mistakes are frequently made; it is difficult to touch just the right area on the screen with the tip of your finger** in a car moving down the road while a series of buttons can even be felt all the way until your finger reaches the corresponding button. In addition to this **the permanent location of buttons gives you muscle memory so you can learn faster** how to handle a physical panel.

BYD Atto3, 2022

In contrast to a fixed physical console with buttons and dials the menu structure of a touchscreen system has layers and overlapping screens. An active navigation system covers the audio settings, some of the climate control functions disappear into the background while we are on the phone. **Scrolling through the pages and changing the menu requires a lot of attention and time** while we are on the road and should be in full control of a moving vehicle. The double pressure of marketing (trendy design) and profit making (cheaper manufacturing) for car manufacturers have increasingly sidelined a safe on-board driving environment. Paradoxically, the development of automotive safety technologies has started to promote the spread of touchscreens and the increase in their complexity. Complicated menu settings of more and more prevalent safety systems in cars can occasionally distract or even malfunction and can create extremely dangerous situations (i.e. a lane keeping assist system that prevents you from returning to the right lane after overtaking). Motorists have to use the HMI systems via the touchscreen to switch off these functions if necessary.

Another boost to keeping touchscreens in the car was the belief that **the era of self-driving was fast approaching**. Even up to these days the automotive industry and the car-buying public join together believing that driver assistance systems will soon take full control of driving and the drivers can become passengers in their own cars on long journeys on the motorway or in traffic jams in cities. And what else would 21st century passengers do in a car with time on their hands? Stare at a large screen to pass the time during the boring miles.

Mercedes-Benz EQS, MY 2025

BMW iX, 2022

As the experience of test projects from developing self-driving cars accumulates, it seems ever more likely that this era is not so close. Self-driving taxis cause traffic jams in America. Electronic lane keeping assists and cruise control systems sometimes "hallucinate" and cause accidents with unjustified emergency braking or they "put the driver to sleep" then unexpectedly give a faulty reaction to a situation. While a decade ago the automotive industry expected the era of widespread self driving automobiles for the middle of this decade, we often hear today that we have to wait another 10 or so years for it happen.

However, interior designers who are used to model cycles of 6-7 years, expected that the car they recently designed would become self-driving before the next generation model would arrive. Anyone who was sat in the armchair of a BMW iX or behind the huge Hyperscreen of a new electric Mercedes cannot help but think that these cars are not designed to be driven, but to travel in them—including the driver.

Mazda 6, 2018

Dashboard of Volkswagen ID.3 from 2024

Of course, car makers also see that the future does not want to come as quickly as they expected (or they promised to us). They also hear complaints from journalists testing new cars and customers who prefer previous "old-school" generation models to the new generation of cars with "clean designs" because they find them difficult to operate. **Some reordering has begun;** Skoda has already started to bring back the physical climate console in its new models and dedicates buttons and dials for the most frequently used functions that need no swift attention shift to operate. Volkswagen has also realised that the ID electric models' clean interface was too complicated for users, these controls are not good and safe and the new models are already undergoing major changes.

Japanese and Korean brands have demonstrated exemplary restraint in touch-screen design. Mazda is specially careful: they even kept the rotary dial between the front seats which is independent from the touchscreen on the dashboard. Mazda made sure that rarely used functions are unavailable while the car is on the move. It is a common phenomenon for European premium brands that their conventional models have the transparent, easy-to- read consoles but HMI system operability largely deteriorates on their new electric cars due to excessive focus on screens.

It is plain to see the good intention in many new cars to separate the important function controls from the infotainment part of the screen but even today a return from the paradigm shift is not yet entirely common in the automotive industry. According to the latest information we received, the trendsetter for the touchscreen, Tesla is not even considering a retreat in this field.

DESIGN TRENDS

We sent our questions to several car manufacturers (BYD, Mercedes-Benz, Peugeot, Renault) who have distributors in Hungary: what priority is given to the hardware and software design of the on-board screen systems and what is the direction of design in the future. Citing various reasons—or none at all—none of them responded, except for Peugeot.

Peugeot's headquarters in France responded saying the manufacturer *"conducts so-called approval tests for all development projects"* during which the new design is tested in real life conditions and involves drivers of other brands as well. *"One of the most important cornerstones of these developments is safety in use"*—they said.

Peugeot 508 i-Cockpit, MY 2023

We also inquired about what are the solutions that help the safe usage of these systems apart from the exclusion of manufacturer's liability. Peugeot said their i-Cockpit system was launched in the first generation of the 208 and had a central touchscreen unit that has been continuously improved since then. According to Peugeot it "became more and more ergonomic and smartphone connectivity also improved'. **Buttons with quick access to the most important functions are available on the display.** *"The latest generation of the system in the new E-3008 and E-5008 now includes* ***a separate customizable panel*** *helping drivers to program and save their 10 most frequently used functions. In addition, we decided to keep a few important physical buttons for functions on the center console (e.g. air recirculation) and there are physical (non touch sensitive) buttons on the steering wheel as well."*

According to Peugeot, *"the use of touchscreens has become a part of our daily lives as we want to access more and more data and functions"*. They add that *"if we were to assign separate buttons to each and every function currently available, safety would be even more compromised"*.

They also highlight voice control as a usable solution which *"has improved a lot"*, but *"unfortunately, it does not speak Hungarian yet, but it is not a problem to change climate settings, give navigation instructions or change the media source in English"*. Peugeot also highlights that some functions are not available on the fly through the central touchscreen of the infotainment system. We asked if using touchscreens was less expensive for them they avoided to give a straightforward answer: *"the choice of technology applied in our products is dominated by market needs and we always treat safety as a priority"*.

We contacted design engineers born in Hungary, too. One of them is currently employed by a big German manufacturer. He wished to remain anonymous. He said:

"What I can tell you is that I don't see a radical change in the ongoing trend in the short term. I think the direction we're heading is a lot of screens and sophisticated UI[10]. On road safety: we may be—or we actually are in—a period when more and more screens and their functions will distract drivers in cars;

> ***I don't expect a "return to buttons and dials" happening by itself.***

I find it more likely that after this difficult transition period, self-driving cars will drive on the road and we will have a lot of screens and internet in cars but it will no longer be a problem if we are distracted. It is also clear to me, although I have no specific calculations in this regard, that since there is an increasing demand for these displays it is less expensive to include them in cars and connect them to the system with a cable.

Let me finish with my private opinion. Personally, I can't stand the fact that regularly used, vital functions can only be accessed from the screen and from all kinds of menus. I drive a [undisclosed brand]. All important functions of my car are accessible with buttons, yet the dash not overcrowded with controls. If I'm just going to be a passenger in the car, then obviously I'm going to be looking for the ability to watch my favourite movies on a long journey."

A few months later, this expert made another remark: "We, at the company I work for, are trying to achieve self–driving that's why HMI systems with screens are a priority—it may be different with other manufacturers. **However, Euro NCAP may be able to force a change as it verifies these systems***."*

We also asked for the opinion of vehicle designer Zsolt Tarnok who is the founder of TMCARS studio. In the past he designed a sports car for the Italian company Mazzanti Automobili and has been involved in various automotive design projects ever since.

"Road safety in my opinion should be a definite priority in a design process, but in many cases it is not so clear. Regarding infotainment systems in particular, we can see a tendency that they negatively affect traffic safety by distracting drivers and their attention.

> ***Over-designed and badly designed systems can also be seen as an example for this: a system "too good" can offer functions that are not at all essential when driving, but they are fun so the driver (along with the passenger) interacts with them while driving. A bad system can distract the driver because it is lagging or the complexity of its software. A bad menu structure can also give drivers a headache if they have to dig deep into the system to reach a certain function.***

[10] Abbreviation for User Interface

We can see two main trends in the design of these systems: on the one hand more and more screens and bigger systems are used so the entire dashboard becomes one large display and a screen is placed in front of the passenger as well. In many cases various functions and systems are separated for the driver and the front passenger—almost assuming that the infotainment system will be watched during the journey. On the other hand ***we can see a move towards simplicity, clarity and integration: some manufacturers try to compress their entire system into the central display often resulting in a complicated menu system with hard-to-find functions****. In several systems this is complemented by a small display behind the steering wheel (as in old school dashboards) for displaying basic car and navigation data (the head-up-display sometimes replaces this feature). The objectives of manufacturers are also quite similar; when their goal is a clean and simple interior they prefer to use systems integrated into one unit (i.e. Tesla) but when they want to offer users as much as possible there is a chance for several screens covering a lot of area with a lot of information and services.*

It is likely that these two directions will prevail in the future. *In one of the latest concept cars augmented reality has already appeared as an infotainment system feature: user entertainment goes beyond the screens. Moreover, non-functional elements like communicating panels and customizable functions are slowly being added to the exterior of the cars—although legislation will be able to set strict limits to this.*

As the self-driving functions will be gradually developed and improved in the future there may come an age when cars will not require a driver to control them and legislation will make it possible for an automobile to navigate the traffic without human supervision. When this happens the system that "entertains" passengers during the trip will be appreciated even more. So I think that

> ***we will see more and more functions in our cars, mainly to entertain us and less for functional use.***

I hope that manufacturers aiming for clean interior design will find solutions to maintain clarity and can create the desired functions with as few screens and displays as possible. *An example for this can be seen in concept cars where the steering wheel can retract into the dashboard in self-driving mode. The presence of a series of entertainment devices will probably also be present in these cars, albeit with a more restrained appearance.*

It is quite certain that cost-effectiveness is the main reason for the rise of touchscreen systems: it is a lot less expensive to program a graphical interface or update the menu system and the 'icons' in it than to do the physical redesign of an interior or a center console. Fortunately, most manufacturers have recognized this problem and have brought physical buttons back to infotainment systems for basic functions so it has become typical to use a hybrid system. I think this is a pretty good solution because it requires minimal distraction to adjust basic functions (e.g. ventilation) with physical buttons. It is an important to know that a person learns his environment in a vehicle so he can operate the physical buttons

by muscle memory without looking at the buttons themselves. This can not be done on a touchscreen or it can be a lot more difficult and slower.

> ***I am confident that hybrid system of physical buttons and a screen is the best available compromise,***

but only if the whole system is well programmed and unified and the most basic functions have dedicated physical buttons/dials (e.g. the user can set the temperature as well as the direction of airflow).

Voice and/or gesture control could be the ideal development direction for the future. That means the user doesn't have to take his eyes from the road and look at the setting of individual functions."

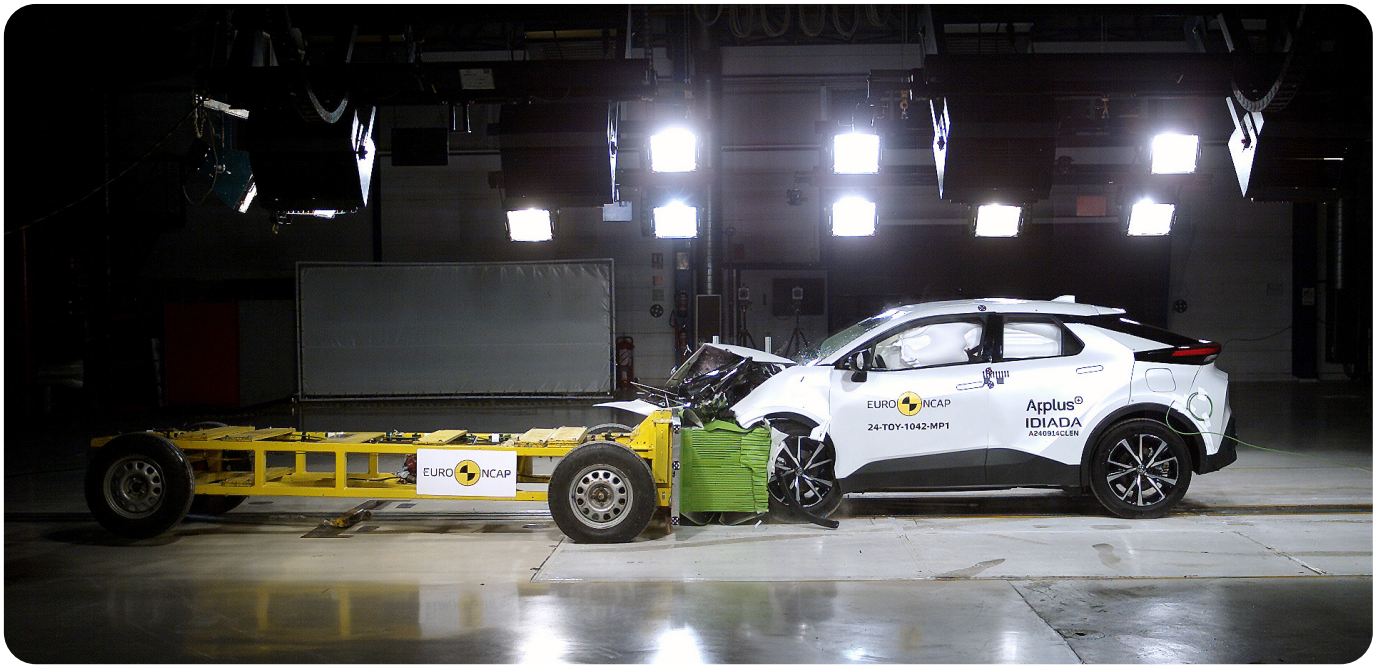
VOICE CONTROL IS THE "SOLUTION"

Some automakers try to ease the concerns of those who are worried about huge displays by recommending their voice control systems. According to our experience—which is identical to the experience of those participating in our anonymous research—the systems developed by the OEM manufacturers are predominantly bad—and on top of that they rarely understand Hungarian. These systems tend to respond with questions if BBC English is not used for instructions like turning down the music volume or raising the temperature in the passenger compartment. When experiencing this, users, now probably upset, are forced to tap the touchscreen four or five times—due to the system's poor comprehension of voice commands. Amazon Alexa, Google Assistant or Siri for iOS are a little better but they also have limited native language capabilities and for most users it is quite awkward to say "Hey, Google, I'm hot" while driving.

The extension of voice control to many functions is hindered by safety considerations. A command accidentally issued or "misunderstood" by the machine must not be allowed to operate security systems or equipment affecting other road users (i.e. headlights). It is almost certain that voice control will not be connected to that car's most vital computerized systems except for comfort and entertainment systems. We can conclude: voice control is also not the right solution to driver distraction.

OTHER FORM OF FEEDBACK: EURO NCAP

The pressure on the manufacturers began to rise gently. The European New Car Assessment Programme (Euro NCAP) is an independent organisation based in Leuven (Belgium) that deals with the safety of cars sold in Europe and has got under the skin of manufacturers repeatedly in the past. Feedback from the non-profit organization awarding star ratings to car models and most renowned for its crash tests, has led to the disappearance of the spectacular pop-up headlights—like the ones in the first generation of the Mazda MX5 roadster.



The Euro NCAP has not taken a strong stand against the difficult-to-use touchscreen infotainment systems. Though Richard Schram, technical director of the organization replied that "Euro NCAP already includes driver monitoring[11] in its vehicle ratings, which include assessments on both distraction and fatigue/sleepiness". In addition, a first protocol was developed "to evaluate general controls that provide control for the most commonly used and important vehicle functions". At the same time we were informed that they were studying measurement methods to be introduced as of 2026 "to identify internal distractions caused by the infotainment system. In other words: how much attention is distracted by the use of various functions of infotainment".

It also turned out that Euro NCAP does not necessarily see the solution in going back in time i.e. the "rebuttonization" of the dashboard but—generally accepts that drivers' attention is diverted—in improving and developing Driver Monitoring and ADAS12 systems. This is partly supported by us because driver distraction is not only caused by using screens while driving but also by global lifestyle changes.

[11] Warning system for driver attentiveness/alertness/freshness. There are different levels of solutions. The more serious ones take into account a number of parameters (up to 70-80), from monitoring steering movements, vehicle movements using camera sensors built into the interior rear-view mirror housing, to checking pupil dilation. While the simpler ones, for example, only monitor one steering movement.

[12] ADAS or Advanced Driver Assistance Systems, is a set of technologies that assist the driver while driving. ADAS uses automated technology, such as sensors and cameras to detect a nearby obstacle or a mistake by the driver and responds accordingly. ADAS have been proven to reduce the number of fatal road accidents by minimizing human error. (Abdul Hamid, Umar Zakir; Ahmad Zakuan, Fakhrul Razi; Zulkepli, Khairul; Azmi, Muhammad Zulfaqar; Zamzuri, Hairi; Abdul Rahman, Mohd Azizi; Zakaria, Muhammad (2017-12-01). "Autonomous emergency braking system with potential field risk assessment for frontal collision mitigation". 2017 IEEE Conference on systems, processes and control (ICSPC), page 71- 76.

CONSEQUENCES OF "FRAGMENTED" AND "STICKY" USE OF SMARTPHONES: DISTRACTION

As we referred to an international research in the introduction of this document: *"the duration and frequency of smartphone use alone do not necessarily cause distraction and delay for the driver but specific smartphone usage patterns can be decisive"*. Highlights:

> ***"distraction is mainly experienced when smartphone use is highly fragmented, i.e. interactions with the smartphone happen frequently but randomly in time".***

Fragmented use of smartphone can cause distraction because it leads to attention shift(s).

> ***When smartphone use is fragmented users keep shifting their attention between smartphone use and offline activities. Every single attention shift requires cognitive input because it takes time and effort to reconfigure attention to the new task.[13]***

Attention shifts due to fragmented smartphone use are caused2 by the habit of receiving notifications or checking them.[14] Several studies have shown that distracting notifications from smartphones cause serious damage to the ability to focus attention. In addition, research has shown that

> ***habits of checking incoming messages/notifications are the main motives behind smartphone distraction[15],***

and makes it difficult for people to control their phone use.

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[13] Verschooren S., Schindler S., De Raedt R., Pourtois G. (2019). Switching attention from internal to external information processing: A review of the literature and empirical support of the resource sharing account. Psychonomic Bulletin & Review, 26(2), pages 468–490. https://doi.org/10.3758/s13423-019-01568-y

[14] Kushlev K., Leitao M. R. (2020). The effects of smartphones on well-being: Theoretical integration and research agenda. Current Opinion in Psychology, 36(1), 77–82. https://doi.org/10.1016/j.copsyc.2020.05.001; Oulasvirta A., Rattenbury T., Ma L., Raita E. (2012). Habits make smartphone use more pervasive. Personal and Ubiquitous Computing, 16(1), 105–114. https://doi.org/10.1007/s00779-011-0412-2

[15] Heitmayer M., Lahlou S. (2021). Why are smartphones disruptive? An empirical study of smartphone use in real-life contexts. Computers in Human Behavior, 116(1), 1–12. https://doi.org/10.1016/j.chb.2020.106637

The more fragmented smartphone use is—i.e. someone looks at his/her phone 10 times per minute instead of only 3 times—the bigger the distraction will be.

> ***If smartphone use is sticky—"users are immersed in their smartphones for a longer period"—delay to do other tasks is mainly experienced. This immersion creates a so called flow-state in the user***

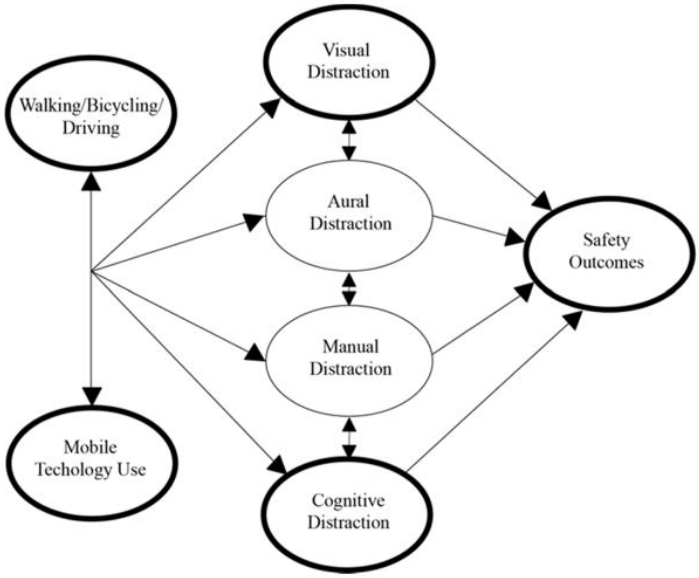
When users get into this flow-state they concentrate so intensely on their device that **they have hardly any attention left to do anything else**[16]. Though smartphone multitasking is prevalent,

> ***humans can only concentrate on one thing in a single moment in time.***

(These important statements about influenced attention should definitely be put in the context of driving. Previous studies have done this and we have done likewise in this study.)

In addition, these factors will not cause distraction in a given situation/moment of time. **Effects are long lasting**; if anyone who is distracted gets behind the wheel of a car will remain distracted in the vehicle, too even if he or she leaves their phone at home or the car does not even have a touchscreen. However, if he/she takes the smartphone into the car or the car has an infotainment system, the effect is enhanced. The same effect is further enhanced if the user has been active in mostly continuous smartphone/device use during hours prior to driving.

A 2017 study[17] focusing specifically on young drivers also concluded that the use of digital technology affects accident risk in two ways. Firstly, the technology distracting their attention draws resources from four areas: **visual** (eyes taken off the road), **cognitive** (less awareness of the road and traffic), **manual** (letting go of the steering wheel), and **auditory** (listening less to noises from the road and traffic,



[16] Hoffman D. L., Novak T. P. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. Journal of Marketing, 60(3), 50–68. https://doi.org/10.1177/002224299606000304

[17] Stavrinos D, Pope CN, Shen J, Schwebel DC. Distracted Walking, Bicycling, and Driving: Systematic Review and Meta-Analysis of Mobile Technology and Youth Crash Risk. Child Dev. 2018 Jan;89(1):118–128. doi: 10.1111/cdev.12827. Epub 2017 May 15. PMID: 28504303; PMCID: PMC5685949.

especially when walking or cycling). Tasks/activities carried out with digital/smartphone technology may involve one or more of these four areas. Secondly, the frequency of multitasking work is related to safety. Thus, even a low-stress task can be a significant safety problem if performed frequently.

This 2017 study summarizes relevant experiences from several (35 in total) previous works, highlighting the following findings:

1. Both novice and experienced drivers were affected by the use of smartphone/digital technology. Interaction with the phone resulted in significantly more lane departures and wandering amongst teenage drivers compared to older, more experienced drivers, as did phone calls.
2. According to the studies, visually demanding tasks (texting) distracted drivers from the road ahead.
3. Reacting to incoming messages had a mixed effect on reaction time, with several studies showing a significant slowdown in the driver's response, and one showing no effect.
4. Overall, driving speed was found to vary greatly. It was significantly slower when dealing with visually demanding tasks on smartphone while driving and the speed increased again after the call ended. Other research suggests that visual smartphone interactions are associated with speed increases for short periods.
5. Cognitively demanding but visually undemanding tasks of phone calls did not affect visual attention in natural or simulated environments, either. However, cognitively distracting tasks such as these made drivers to turn at the wrong junction, miss a turn or forget to look in the mirrors, pause excessively at stop signs and drive through flashing yellow light signals. Talking on the phone slowed down the reaction time of drivers in three of the studies, but not in a fourth. Phone calls also resulted in slower (to a more variable degree) speed while driving. These safer behaviours may represent compensatory strategies from the drivers' part.
6. In studies comparing visual distraction to cognitive distraction, texting resulted in greater variability (lane departure or wandering between the lanes) in the car's position on the road than phone calls.
7. Drivers tend to make more intense movements on the brake pedal when distracted by a phone call.
8. Young people often recognize the dangers of distracting activities in traffic situations, yet they choose to participate in them. (Note: this does not mean that older/more experienced drivers do not behave this way, but this particular study focused on young drivers.)

To broaden the age group, we cite another study which found that *"compared to older drivers, younger drivers are more likely to use their phones behind the wheel. Among drivers aged 16 to 24, 3.7 percent held their phones in their hands while driving in 2021, compared to 2.5 percent for ages 25 to 69, and 0.7 percent for age 70 and over".*[18]

[18] Bieber, C., Sember, B. (2023) Distracted Driving Statistics & Facts In 2024. Forbes Advisor. www.forbes.com/advisor/legal/auto-accident/distracted-driving-statistics

HYPOTHESIS OF OUR RESEARCH

When compiling our **anonymous research** we started from the hypotheses developed on the basis of our previous research and our experience as road users. We also used domestic and international statistical data, research and studies which we incorporated into the questions both directly and indirectly.

These hypotheses are as follows:

H1. Using a touchscreen increases distraction and the risk of an accident.

Drivers
H2a. do not recognize and/or underestimate the serious risk of using touchscreens while driving;
H2b. are more critical of other drivers if they see them using touchscreens while driving.
H2c. We assume that with this approach without self-criticism they may not deal with this issue anymore.

H3. Using digital technology outside the vehicle is linked with the tendency to use a touchscreen in the car.

H4. Drivers have confidence in the counteracting effect of automotive technology—active and passive safety systems—in other words, they have a false sense of safety. Some studies say that this confidence in driver assisting technologies can cause safety compensation: the effect meant to increase road safety makes a U turn as drivers show risky behaviour patterns behind the wheel because of this false sense of safety[19].

Since we have no preliminary data regarding the next question we have introduced this technical hypothesis solely on our own road experience and with the need to be as scientific as possible:
H5a. The majority of drivers would like to have dedicated physical buttons/dials because they think these are easier to handle, they can learn to operate them faster, so they are safer to use overall. So the presence of such controls is important for their next purchase;
H5b. at the same time we also assume that touchscreen infortainment systems are more and more popular and participants in our research will ask for this when they buy their next car.

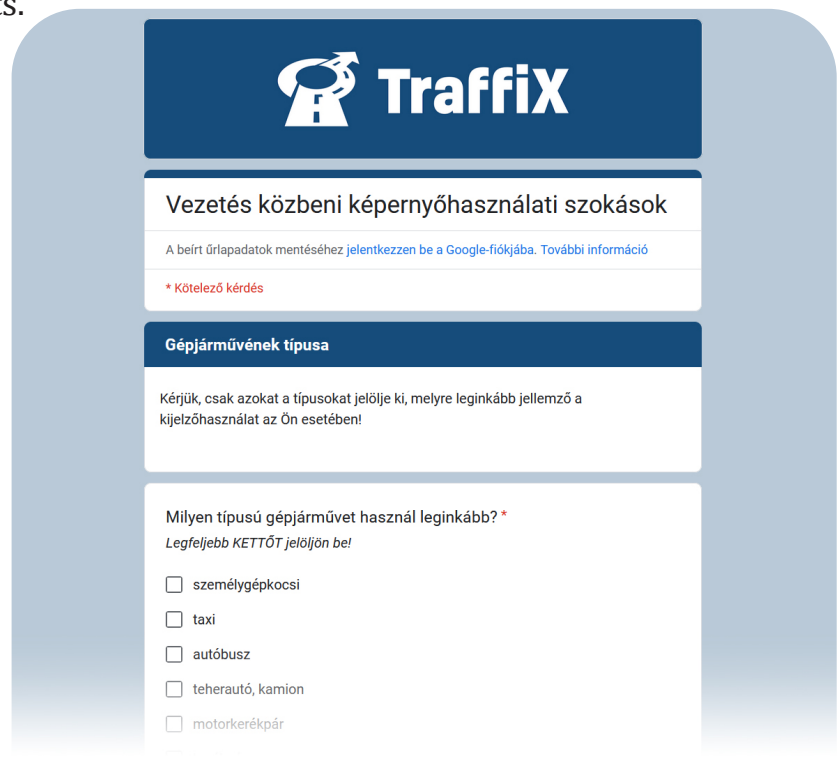
[19] Österreichische Verkehrssicherheits strategie 2021–2030, Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie, Wien, 2021., p. 46.

THE METHODOLOGY OF OUR RESEARCH

The questionnaire for our 2024 research was launched on 1 February and closed on 7 April. We asked for the assistance of Hungarian automotive websites and professional magazines to promote our survey so that we could work with the biggest possible sample. So in addition to our own website, vezess.hu, a totalcar.hu, origo.hu and autonavigator.hu also announced the invitation to participate in our research.

Most studies rely on self-declared data from participants that *"can be too general in determining and measuring special smartphone use patterns such as fragmented or sticky. Besides this effect, self-declaring data for smartphone use in cars are distorted*[20] *by remembering/oblivion and social acceptability"*. This is the very reason why we to **developed a very detailed questionnaire** and we included clarifying questions. Furthermore, we included "control" questions which can expose if the respondent changes his/her answers and steer them to give more sincere answers. In addition, we emphasized several times that this research is anonymous. We did not ask for names, email addresses but we needed demographic information (e.g. gender, age, place of residence in general).

The research questionnaire was edited and published with Google Forms. The questionnaire consisted of radio buttons, check boxes, multiple choice questions and multiple choice grids (with ratings from 1 to 5, 1 being the least, 5 being the most relevant/true for the respondent). We also included open questions to invite written answers. Completion of our questionnaire took 9-16 minutes depending on the length of answers and thoroughness of our respondents.



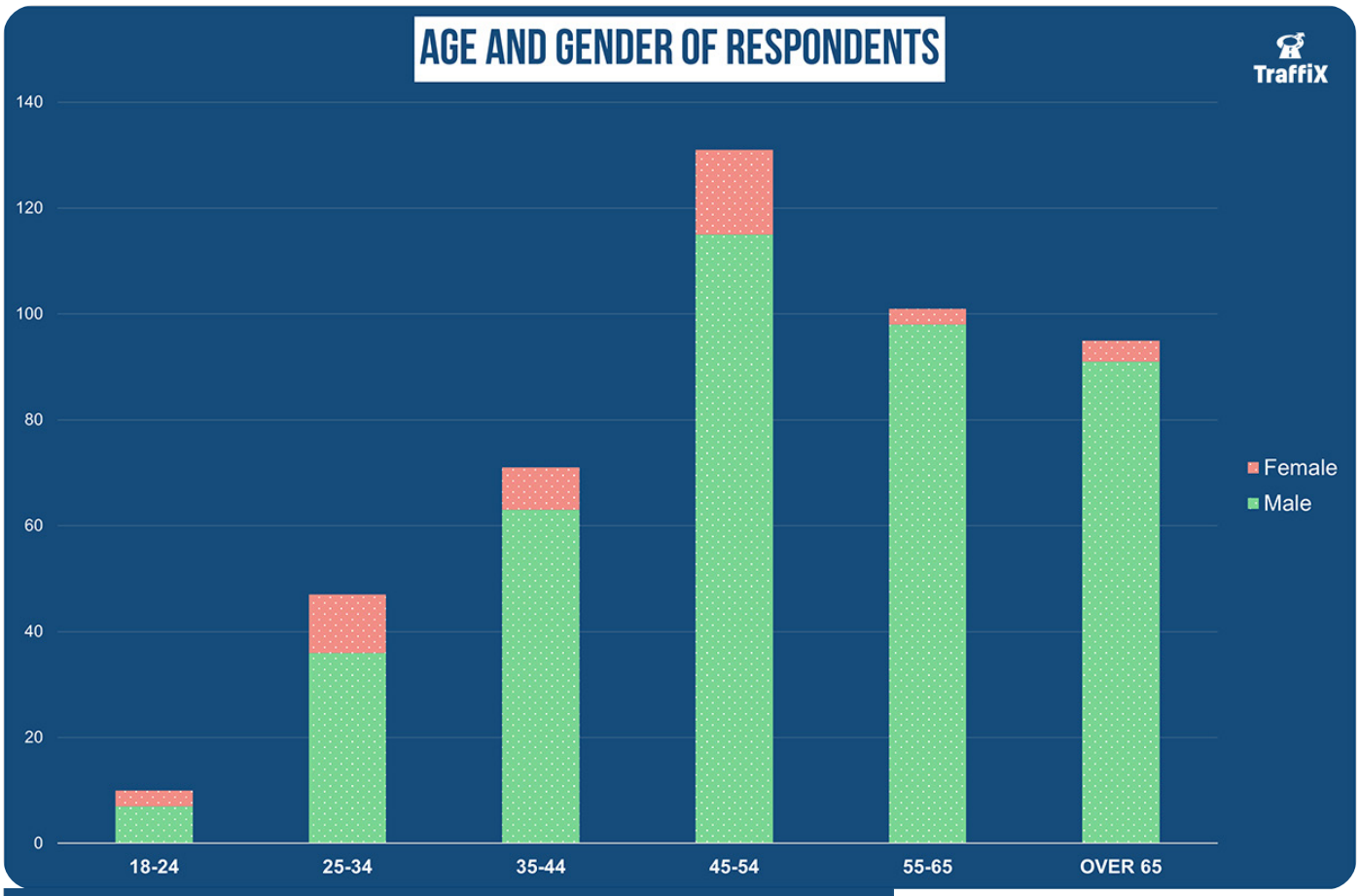
[20] Parry D. A., Davidson B. I., Sewall C. J. R., Fisher J. T., Mieczkowski H., Quintana D. S. (2021). A systematic review and meta-analysis of discrepancies between logged and self-reported digital media use. Nature Human Behaviour, 5(11), 1535–1547. https://doi.org/10.1038/s41562-021-01117-5

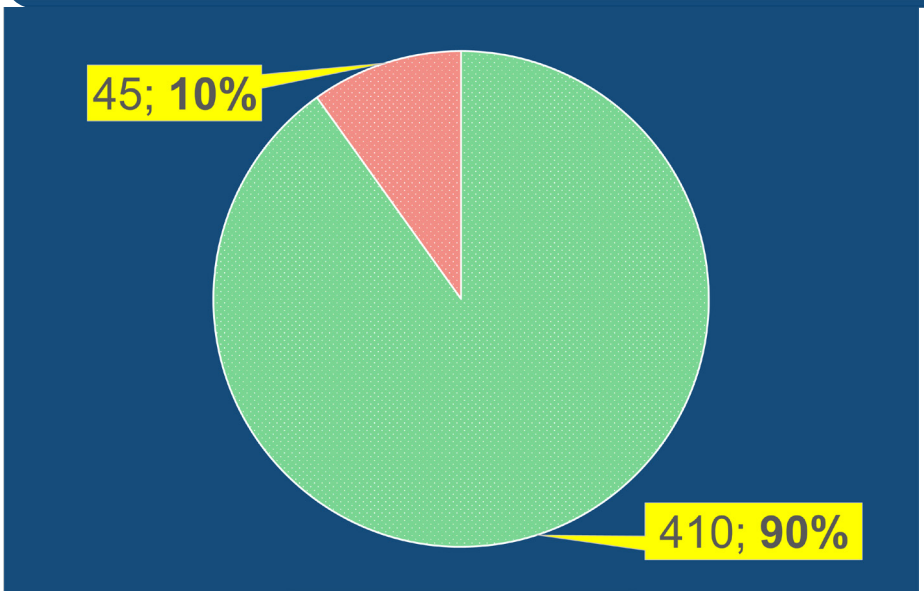
PROCESSING OUR RESEARCH

DEMOGRAPHICS AND BASIC DATA

Online questionnaire for the research was filled in by 459 people.

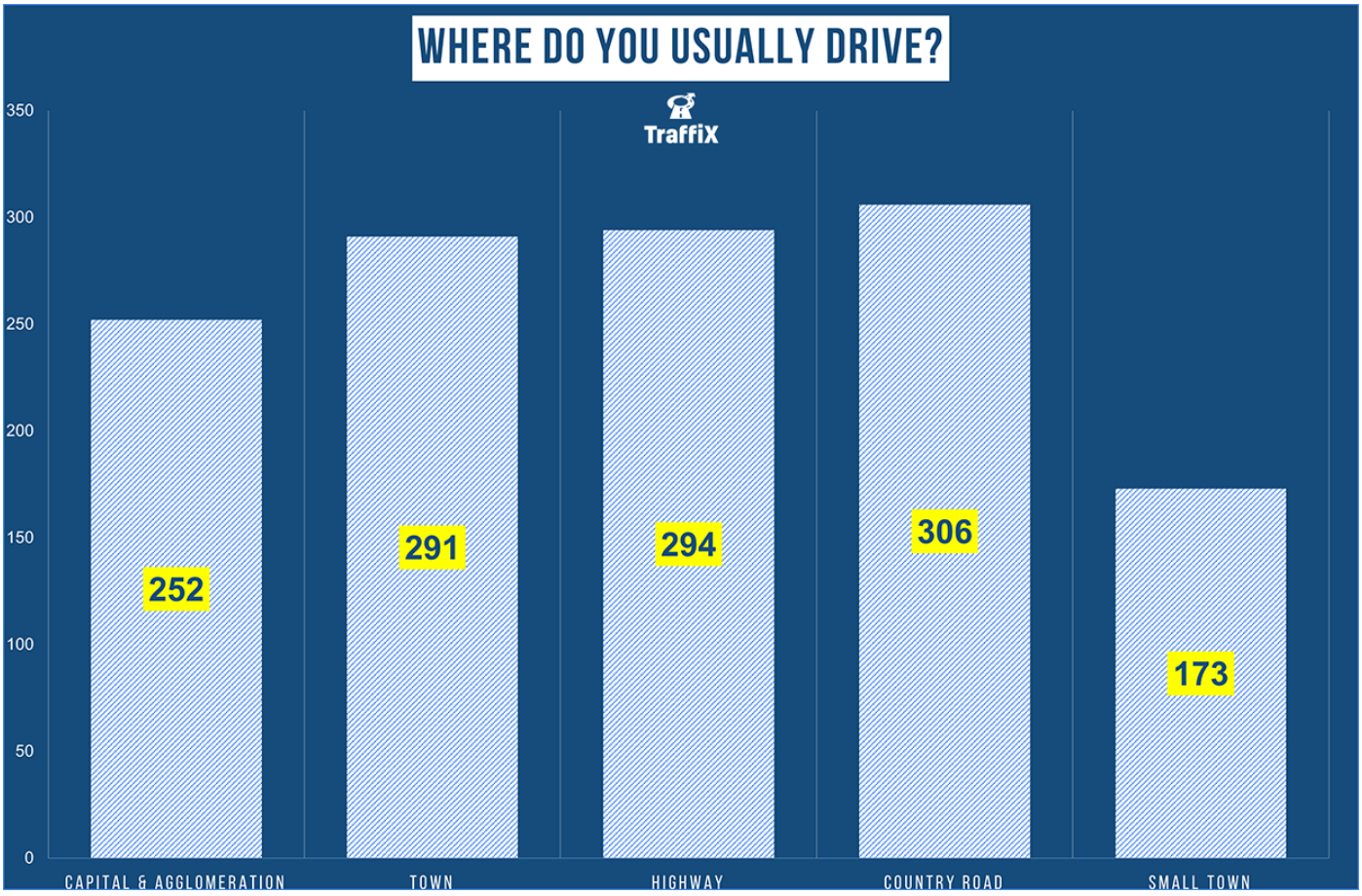
Apart from 4 (0.9%) all respondents declared their gender and year of birth in our anonymous questionnaire: 90.1% of participants are male, aged mostly between 45 and 54. Our female respondents were mainly in the age group between 45 and 54 and between 25 and 34. Average age of all our respondents is 51.7 years.





Great majority of our respondents drives a car so **our questionnaire is specifically relevant on screen use while driving.**

Two-thirds of our respondents drive **mostly on country roads** (66.6%).



Respondents' driving mix includes highways (64.1%), city streets (63.4%), capital and agglomerations (54.9%), small settlements (37.7%) (multiple answers could be given for this question). Regarding the question about domestic and international driving *"Which country do you drive the most?"* the vast majority of our respondents cited Hungary (94.3%; abroad: 5.7%.

HABITS OF SCREEN USE

Answering the questions *"What device or service requiring visual attention do you use frequently or on a daily basis while driving for longer periods that 1-2 seconds with active focus of your attention?"* and *"What do you use these devices for?"*—**our respondents said that using smartphone included mostly a phone call (67.3%), using apps for navigation like Google Maps, Waze, Apple Maps etc. (51%), music streaming (27%) but responding to messages and notifications is also relevant (10.2%). Similarly, the use of on-board infotainment systems is quite high, too (34.7%) which was surprising for us**. We also found out that infotainment systems were mostly used for relatively simple functions like on-board navigation (22.2%), climate control (15.3%) while using more complex functions for on-board systems was less typical (8.1%).

There is also a high rate of smartphone use without a hands-free set (5%). Many people also take advantage of Waze's social reporting capabilities (37.3%) for accidents, traffic jams, potholes, police presence, speed cams or fog spots. This has been simplified a lot

lately (press and swipe can be used to access certain functions) but it is still a distraction. Using social media and checking e-mail accounts while driving is at a rate of 2.4 percent.

15.7 percent of respondents said that they did not use any devices in the car but their answers to open questions at the end of the questionnaire showed us that some of them interpreted this question quite loosely and in a forgiving manner for themselves *(see details later)*.

> ***57.7% of our responders claim they regularly use some kind of digital device(s) while driving.***

31.4% of them responded that they do it rarely, while 10.9% said they never used a device while driving. This is contradictory to the answers (15.7%) given earlier to a previous question asking about the same. This 10.9% is even reduced even further after eliminating those who contradicted their own answers in their answers to open questions.

> ***Respondents on average claimed that they do distracting activities at a rate of 5.89% while driving.***

The biggest group—**one quarter (26.8%) of respondents—wrote that they do distracting activities while driving for a mere 1%**. When we specified the question they answered: rare smartphone use was slightly less than half (46.2%), regular smartphone use was almost one quarter (22.9%) and no use at all stood at 30.9%. Regarding the on-board infotainment system 36.8% of respondents use it regularly, 23.2% use it rarely and 9.2% never does it despite the fact that their car is equipped with such a system. 30.7% of respondents don't have an infotainment system in their cars.

Our hypothesis (H3) based on international studies claim that habits for smartphone use are not only fixed in cars (in fact, mostly not) but in other situation in our lives and then we carry on with our habits while driving. For this very reason we thought it was important to ask about the regularity of smartphone or digital **device use outside cars**, like at home, at workplace, public transport or a restaurant. 82.1% of respondents use it regularly, 17.2% uses it rarely and 0.7% never uses it.

36.6 percent of participants in general (outside their cars) use their devices not only for the most necessary functions so playing games or watching movies is included in their use, too. A slightly smaller group (34.2%) use their device more often, even to chase away boredom and a quarter of them (25.7%) uses mobile devices only for the most necessary functions like phone calls and work. 2.2% of respondents said they were addicted.

We asked respondents on a multiple choice grid to characterize their **typical habits** and actions on a scale of 1 to 5. According to this, the majority of respondents (answer 1-2: 46.4%) do not use their devices or prefer not to use them only when their vehicle

is stationary (including stampeded traffic). In this question a middle ground is represented by 15.4 percent of respondents (answer 3) and 38.3 percent prefer or prefer to only touch the screen when the vehicle is stationary (answer 4-5).

We had a question related to the above: how typical is it for you to **immediately reach for your smartphone/device** because of boredom or out of habit when stopping in a traffic jam or at a red light? A significant percentage of respondents wrote that this was not typical at all (82.9%) or only slightly (11.1%). 4.4 percent of them admitted that they preferred to do so (2%) or always do so (2.4%). The answers to open questions partly contradict this.

Many people refrain from using the screen because it distracts their attention from the road due to its complexity (*"using the device is complicated for me, so it distracts me"*, answer 4-5: 18.7%). Those who use their devices confidently (answer 1-2: 69.7%) also use them regularly (60%). What is even more shocking is that **every other insecure user (44.6%) uses devices regularly and the same proportion (44.6%) rarely use devices while driving**. Only 12 percent of respondents who found the use of the devices difficult said in another question that they never used them.

"I don't think it's a problem for me to use them",—the majority of volunteers (66.3%) disagree or slightly disagree with this statement, yet 50.9% of them regularly use their devices on the fly. According to those who don't expect to have problems at all using these devices (21.1%) use their screens at a higher rate (67.4%).

Texting while driving is not a popular activity for our respondents: (*"I like texting while driving"*, answer 1, meaning No: 92.5%, answer 4-5, meaning Yes: 2.2%). But if we compare this to their answers to open questions in our questionnaire there is a contradiction because those answers show that one in ten (10.2%) drivers use their devices to send messages. This suggests

> ***a that frequent, sticky texting is not typical but swift checking and/or sending of messages/ notifications is.***

It is not typical that people use screens or consume media to pass the time in the **"calm" of the highway** (*"I use my smartphone or push the screen in the car on highway"*, answers 1-2: 93.6%, answers 4-5: 3.1%). Answers to the open questions had a lot of referring remarks to this:

> *"If I drive on a longer journey I prepare with music (which I usually start only on highways because when in heavy traffic I want to be able to hear everything: my car, noise of the traffic."*
> (This respondent gave answer No. 1 i.e. disagree strongly with this statement: *"I use my smartphone or push the screen in the car on highway"*!)

"Yes, it can distract my attention but I do it only when it doesn't seem to be dangerous [...] I never do it in front of a zebra crossing but I tend to use screens in light traffic on wider roads or on a highway)." (Again, answer No. 1 to the above statement.)

"When traffic is free flowing or I am on a highway the only thing I control is navigation" (Responded with 1 to the above statement.)

"When it is possible I use voice control to have my messages read out for me. When it is not possible I check the message myself to see if it is urgent or not but only on a highway, country road when the road is straight and traffic is light". (Responded with 3 on a scale from 1 to 5.) "When driving on a highway I open the chat app on the fly and I read messages but I do not respond to them. I change my Spotify settings integrated into Waze while driving." (Responded with 1.)

So the contradiction in answers to open questions suggest that **more people use screens frequently on highways**. Ate the same time there are a lot of people who think driving on a highway is a dangerous "job":

"I use my phone to talk only with a hands free set and under 50km/h. Outside the city when I am on a highway I do not make or accept calls."

Increased distraction due to "sticky" and "fragmented" device use can have the serious consequence that certain road sections are **completely missing from the driver's attention**. According to the respondents this is **not typical for the vast majority of them at all or only slightly typical** (*"sometimes road sections are lost [out of my attention], I am so busy with the device"*, answer 1-2: 93.8%, answer 4-5: 3.3%). 42.8% of respondents gave a 1-2 (rather non-typical or slightly typical) answer to the question: ***"I can divide my attention** between the road and the device"*, yet 44.5% of them use a device on a regular basis. Furthermore, it is not very common for drivers to use the devices only or mostly only when **they are alone in the car** (answer 1-2: 71.1%, answer 3: 10.4%), although this distorted sense of responsibility manifests itself in a large proportion (answer 4-5: 18.5%).

The majority of respondents (60.8%) fully or almost fully agree that **using an infotainment system is no less dangerous than pressing a mobile phone**, but a relatively high number—almost a quarter of respondents (23.6%)—do not think so. Those who disagree with the statement (*"I think using the car's infotainment system is less dangerous than using a smartphone"*) say that using the infotainment is just as dangerous as using a phone, yet 24.2 percent of them regularly use the infotainment in the vehicle they drive.

A lot of research, as we quoted, has already found that hands-free conversation can also be a distraction. More than half of the respondents disagree or rather disagree with this (*"hands-free telephone conversations also distract me"*, answer 1-2: 53.6%), but a little more than a quarter (25.5%) agree or rather agree with this. Yet 63.4% have hands-free conversations while driving and 46.4% of them regularly do it.

What's more surprising is that **7 percent use the phone without a handsfree set** (if they get distracted anyway, why bother using it?).

Drivers are less likely to think that the **vehicle safety systems compensate** for their distraction. A large majority of them totally (64.9%) or rather disagree (18.7%) with the statement: *"the safety systems of the car compensate if I do not pay attention to the road for a while"*. Only 8.6 percent agree with it completely or mostly.

We also inquired to what extent a potential **over-regulation** makes drivers use their screens. It turned out to be untypical. Our statement said *"If I can drive slower than expected (e.g. 80 km/h on the highway due to road maintenance or an unnecessarily strict speed limit or in a 30 zone), I will touch the screen sooner"*. The majority (85.9%) responded with 1 (not true at all) or 2 (6.4%, hardly true), and far fewer (4.8%) said that it was rather or totally true for them.

Due to **weather conditions**, the differences slightly decrease as 14.1 percent of respondents are fully or rather influenced by weather conditions when using their device but a larger proportion (81.4%) are not or rather not affected by it. It is also noteworthy that among those who responded with no or rather no (1-2), the proportion of people who regularly use devices while driving is 55.2, the proportion of those who rarely use them is 32.2, while those who never use them are 12.6 percent.

Almost half (49.2%) of respondents, regardless of device use, **do not or prefer to hold the steering wheel with both hands** anyway, and almost one third (31.8%) say they hold it or mostly hold it with two hands. Our next question was whether drivers do some other activity (i.e. eating, searching in their bag or plugging the charging cable) in the car while driving. A little more than three quarters of respondents (67.4%) said they didn't do it at all (answer 1: 42.5%) or very rarely (answer 2: 24.9%). 13.8 percent answered 3 (meaning sometimes), while 18.7 percent answered yes (answer 5: 7.8%) or many times (answer 4: 10.9%).

ANSWERS TO OPEN QUESTIONS ON DEVICE USE

338 people (73.6% of all respondents) gave a written answer to our open question on device use in the car. We have drawn the following conclusions after evaluating the answers.

Many regular users control the device while the car is stationary before setting off (most notably navigation and/or music streaming). Some people use the device to adjust functions or make phone calls when they idle in traffic because of a red light or standstill traffic. Many of them do everything before departure so they "only" have to monitor the navigation.

> *"I never use my phone while driving, I pull the car over if I have to make a call. I use navigation and I pull over if I have to adjust it."*

"I only make calls in the car when stationary, so I can safely and comfortably pick who I want to talk to."

"I look at the navigation map on the screen of the phone when I drive in an unfamiliar place. If I need to study it I'd rather pull over in a parking space."

"When I get in the car I adjust everything I need to, then I start driving. While on the fly I only accept calls (1-2 seconds) but nothing else. If I need to do more I pull over."

"Usually I control map and music settings before I start driving. I only control these if there is a problem with reception or data transfer. If I can't overcome the problem with one or two pushes I pull over or ask my passenger."

It is obvious from the above responses that

> ***only a few people are aware of the real dangers of screen use in the car.***

This conclusion is confirmed when a lot of them say they are "forced to" use their devices:

"I set the navigation system before I start driving. But in the city when I don't have a chance to pull over I am forced to control the system on the go if necessary."

"I link my smartphone to the car's system via Bluetooth when I am already in the car but before I start driving. I only touch the screen when I am parked or at a red light or after I pulled over. I only touch it while actually driving if I don't have any other options."

"During slow traffic (mostly at 30 or 50 according to current regulation) I get bored and I tend to look around. I already had a few scary moments because of this."

"When I am alone in the car I drive faster (speeding), my pulse is higher and all my attention is focused on the road and other cars and because of this I didn't have dangerous situations for the last three decades."

"Unfortunately, sometimes I have to read a message related to my job."

"When I see something that I want to share with the family or friends, I make a photo of it while driving and share it on Messenger and sometimes I read the incoming answers, too. This is typical only on roads or main roads with no or little traffic, but in built up areas, in heavy traffic or in limited visibility conditions I do not touch my phone. Sometimes I turn on the radio or I start a video on YouTube for my son and I touch the screen to skip commercials or reach for his toys when he drops them. Sometimes I give him his water bottle or snacks and these activities may distract me for longer periods than using my phone."

Many of respondents **simply underestimate the hazards of distracting activities during driving** as it turns out from the answers given to multiple choice questions for statistical reasons:

"I only look at the device when it shows something important."

"I use my device for mostly navigation, phone calls and reading messages.
I use my device constantly but only according to needs.
When I have to do something more complicated like sending an email, I pull over."

"I almost never use my device when driving (higher speeds, complicated traffic situation), but when I am at a traffic light or in slow traffic or in a traffic jam I use it regularly."

"I am in trouble when I have to adjust the GPS because of an unexpected thing in an unknown area. I have two options in this case: I pull over to find a new route or I do click by click settings on the device as the traffic situation allows me to find my new route."

"I am aware of surrounding traffic, I watch out for oncoming traffic. I pull over if he wants to go around an obstacle. When I get bored listening to music or a podcast I touch the screen in the car but only when I am alone. Very rarely when I have to send a short message, I do it with voice command. If I have to send a longer message, I pull over to do so. Sometimes I eat and drink in the car but I always keep my eyes on the road."

(It is true for a lot of respondents that they use their device "only" when they travel alone as it is explained in the answer above.)

"When driving, I sometimes skip the songs on the radio but I rarely hold my phone in my hand."

"I use the screen of my phone to show the GPS route and I use a phone holder but this is only valid for around 10% of my drives."

"When I drive alone I set everything I wish to use. I do the necessary simple adjustments on the go within two seconds and keeping a safe distance."

"In cities, because of the slower (average) speed, there is more time to check the GPS."

"When I drive alone I set everything I wish to use. I do the necessary simple adjustments on the go within two seconds and keeping a safe distance."

"If I think that the message may be important because of the first few words or the sender then I swipe down and read it without holding the phone in my hand. While reading the message I keep looking back to the road every few seconds and I increase my following distance to the car in front."

"When I have to use my phone I use a handsfree set and I touch the phone only to make the call."

There are people who are aware of the hazards of screen use **but still do it**:

> *"I use phone only with a hands free set and I set the destination in the GPS usually after I start driving—I know it is not good."*

> *"I ordered a handsfree set for all my cars but it is still a distraction for me. When I am on the phone I'd rather stop talking while I have to do a manoeuvre or when I am in a more complicated traffic situation and then I start talking again when I am not so busy."*

> *"I do music settings for my daughter and perhaps this is the most dangerous thing. We have disputes because she has to wait until we reach a red light but that is OK for me. When I am at a red light I read the Messenger from my partner and my boss. But I do not reply in writing, I only send OK to confirm reception. If it is important I'd rather make a call. My job is about accidents so I think I am more careful than others."*

> *"I regularly use traffic feedback in Waze. When making a call, receiving a message or answering an incoming call I do not have to interact physically with the phone but it is still a distraction for me."*

We have respondents who underestimate the hazards of their own activities but they **criticize other drivers** for using screens while driving:

> *"I can follow the GPS and playlist on the dashboard so I use the screen of the infotainment system to monitor the state of the hybrid system. So when I am in traffic I am free to marvel at people sitting in 20+ million HUF (€50.000) SUVs who talk with phones held in front of their faces."*

> "It is horrible to watch people in cars worth over 40 million HUF (€100.000) doing 44 in the left lane in cities while it is plain to set that they use the touchscreens of their smartphones."

> *"It is especially irritating to see people holding their phones in their hand in cars worth 50-60 million (€120.000-150.000). I think that a handsfree set is available in all cars. I think that earphones are not a good solution in a car but a single earphone is still OK. We don't need stricter rules, we have to keep the existing ones."*

The majority of respondents use more functions of these systems than simply making calls or using the GPS. As we have already concluded the hazards do not only come from making calls but the screens overwhelm the drivers—even those who try to be responsible in their use. They only want to look at it for a few seconds then who knows for how long they get occupied with it. Texting is the most popular distracting activity; about two third of respondents "only" read their messages but do not respond to them.

> *"I use it depending on the changing conditions and randomly. If there is a bottle neck in traffic: I use Waze/Google Maps to find me a new route. If the radio show*

is boring or I have bad reception: let's listen to a CD. Changing road conditions: I adjust the air suspension settings. I'll be late from the business meeting because of unexpected stampede in traffic: I make a call to say I am late. I have just run over a big pothole and the right front wheel got a heavy hit: let's look at the tyre pressure monitoring system if I have a puncture or a loss of pressure… or not."

"I use it too many times but I am trying to decrease it."

"Very rarely, when it is really important I text back."

"Obviously I start the GPS and "keep an eye" on it. I make calls and answer them with a hands free set but sometimes sound quality is bad and I switch to holding the phone in my hand. I receive messages, sometimes I send some and I give short responses too. I listen to music and radio during driving. I do not visit social media sites."

(We received a lot answers that are hard to categorize or are unclear. As you can see it in the last one, the respondent is not aware of the hazards—this is evident in a lot of answers that we included elsewhere in the document. Driving safety for this respondent is solved by stating he/or she never visits social media sites.)

"I put my phone into the holder on the windshield and it links to the system of the car automatically. I positioned it to the left of the steering wheel so it doesn't interfere with my view. I set the GPS the first time I have to stop in traffic, I don't use voice command, and sometimes I do it when I am already driving. I use the on-board system of the car for making calls. I try to respond to messages when I am at a red light but sometimes I do it while driving."

"I rarely text but when I think of something I look it up on Google or on social media while driving. I use the GPS regularly and I type in the destination while driving. When I arrive I kill the engine, put my phone in my pocket and that's all."

(*"That's all"* is a recurring sentence in similar answers. The respondent makes a list of activities during driving then trivializes them with this remark.)

"All the functions are available on the center screen so I use that for everything (Tesla driver). I try not to touch it unnecessarily and a lot of the functions are automatic (i.e. aircon) and they are easy to hit because the icons are big but it is still distracting."

"My habits of use are totally random, sometimes it is up to my mood. I try to focus while I am driving and not to be distracted by a lot of things."

"If there is an incoming call, I answer it with tapping my smart-watch."

It turned out from the answers to open question that those who clicked on the box *"Never use a smartphone while driving"* two thirds of them still do. Usually

they set navigation or music streaming before setting off and they only use their screens for seconds while driving instead of "never".

> *"After I get behind the wheel I do my necessary settings on the screen and only then I start driving. When I am on the road, all I do is accept an incoming call (1-2 seconds at most). If more time is required I choose to pull over."*
>
> *"When there is an incoming call I answer it because the phone is there beside me."*
>
> *"I use my phone only with a hands free set, I have no internet on my phone."*
>
> *"Before I start driving I set the data if necessary. If there is an incoming call, I don't answer. If I'm expecting an important call I hook up my device to the car's speakers before setting off, it's at eye level, it doesn't distract me. But this happens very rarely."*
>
> *"My cell phone is in my bag on the back seat. I always say that I'm not the president, so I'm sure anyone can survive without talking to me until I arrive. If I need to use the GPS, I clip my phone on the dash directly beyond the steering wheel so I don't have to look away from the road. I adjust the volume of the GPS according to where I am (louder in the city, quieter in the outskirts)."*
>
> *"Before driving I set up the necessary things (e.g. navigation). If there is a need for any changes on the way, I prefer to park somewhere."*

Consistent responses, on the other hand, reveal that there are those who **really never** use a device in the vehicle:

> *"I prefer not to use my smartphone, I keep it in my pocket while driving. I feel that if it was on the dashboard and I had an accident, the phone would fall down and maybe I wouldn't be able to reach it and call for help. If I have an incoming call, I never answer it. Some people don't like it, but that's me, get used to it".*
>
> *"When I get in my car I put my phone away and I am unavailable while driving. […] Music is playing, the landscape changes, engine is revving and I enjoy driving: this is the reason why I got in a car."*
>
> *"I use my car as a quick way of transport. I don't even switch on the radio because it would distract me. I drove 1 300 000 km in my life and never caused an accident. I would be happy if I could write this down in another ten years too."*

According to the answers most people are content because they **do not hold their phones in their hands** but it is clear from their answers to open questions that most of them read the incoming messages. So they do not consider it to be dangerous to read (or respond to) messages on their device.

In addition to this it is worrying to see the respondents' claims that they look at the screen for one or two seconds only.

At a highway speed of 130 km/h a car covers 36,1 meters in a single second. It takes time to unlock the screen on the fly and it can be complicated (entering PIN code or swipe pattern, password or fingerprint) and is also dependant on where the device is positioned so it is surely distracting for the driver. A good solution is to link the device to the car's on-board audio system through Bluetooth if possible, because the linked device is usable without the unlocking procedure.

It is also typical that they "only" answer calls but they do not make them.

Regarding traffic safety it is a meaningful factor that making a call is a more complicated process because the caller must search the called party from the contacts menu. On the other hand if an incoming call results in an unexpected piece of news or situation, it can surprise the driver. Similarly when messages are "only" read by the driver but not responded to:

> *"My phone gets linked to my car via Bluetooth and typically, I don't make calls only answer them. I use Waze on my phone but I don't hold my phone in my hand. I change radio stations on the in-built screen of the car."* (This is another example for a multi-category answer with *"not in my hand"* suggesting the respondent is content with his traffic safety this way.)

> *"If I get a call while driving, I answer it. If it is a message and I am free, I look at it but I do not respond."*

> *"I often answer calls on the handsfree set because of my job but I prefer not to make a call from the car."*

Some people **who trust the vehicle's ADAS systems are more frequent screens users but all in all people tend not to trust these systems**—as we learned from answers to the multiple choice grid questions:

> *"In stop and go city traffic the most useful function is the active cruise control which starts and stops so I don't need to concentrate so hard and slowly moving traffic doesn't make me go mad."*

(This is not the only answer that described driving as a boring activity.)

> *"Active cruise control and lane keep assist are very useful on a highway when I want to set a function or look for some music."*

Users of modern cars like to use the up and down buttons **on the steering wheel** for phone use which makes operations (answering a call) safer.

"I can also control the radio with a switch right next to the steering wheel so it is less distracting than if I have to set it on the center console."

"I can control almost everything (navigation and media) from the steering wheel with physical buttons so I rarely have to look at the screen."

"I try not to touch this goddamn panel! The multi-function steering wheel makes it a little better. […] It is also slightly distracting but much less than the center screen or the touchpad between the seats."

Opinions are divided on the **infotainment** system, as was revealed in the statistics section:

"I love these systems although I had to get used to them first."

"Phone is a taboo. I put it in the cubby hole under the armrest and use it with mirroring function via Android Auto. […] It really bothers me when I am distracted and have to drive blindly."

"A factory fitted screen is a lot safer than using smartphone screens on the go. Physical buttons are important because touching the screens is very distracting. Also, it is very useful if the system includes a head-up display because I can keep my eyes on the road all the time."

"The factory-installed screen is a lot safer than smartphones in a holder attached to the windshield and linked to the system with a wire that is in the driver's line of sight. As usual the presence of the screen is not a problem in itself. The source of the problem are the people who think they can divide their attention between driving and using a device."

"New cars freak me out that every single time I start driving and I am already on my way I have to push OK on the screen to agree not to touch the screen while driving."

"I regularly look at it (and many times I do it for longer than one or two seconds until I can see what the message on the screen is about), if the car itself warns with a signal. For me that is the most distracting thing while driving."

"I have an information screen in the middle of the dash with controls. I learned how to use it while not keeping my eyes on it. I can control the climate settings without looking away from the road."

"Using a screen is dangerous without a doubt and because we are almost attached to it we don't even realize how many times we push or touch it."

"I would literally go crazy in a car that focuses on the touchscreen."

"I set the controls like temperature and ventilation before I start driving because I don't like the icons on the screen, it is difficult to control them without looking."

Most of the respondents—consistently with previous answers—are in favour of **dedicated, physical buttons**:

> *"I can hardly stand cars in which I can only control climate functions on the screen. If there is a button or a dial and I know where it is then I can control it without looking at it. It is not a good trend to group all functions on the screen, I think."*

> *"Luckily my car has a dedicated physical button for every function and it is a very important aspect when choosing my next car that it will be like this even if I give up some of the infotainment functions."*

> *"I don't have to use a touchscreen because the volume and climate controls are easy to reach and I don't even have to look when using them."*

> *"I use devices only with easy to touch and feel (shape and size) buttons and I can use it without looking at it while driving in heavy traffic. We drive in Hungary, driving requires constant attention. In Austria for example, one calms down while driving; everybody adjusts to the speed of traffic there and keeps a normal distance from the car in front."*

> *"Luckily, my car has a contemporary touchscreen system and the most important functions like air-conditioning, seat heating, volume control and skipping can be controlled with physical buttons and I have 9 additional hotkeys that I can program more functions to. This is very useful."*

> *"The whole thing is totally unreasonable. According to the Traffic Code it is illegal to touch the GPS screen on a smartphone attached to the windshield but if the GPS screen is on the onboard screen, then you are free to touch it while driving. I'd like to ask why you have to access a sub-menu of the aircon to change the temperature setting? The touchscreen system is completely unnecessary, I want the buttons back, they were a good solution."*

But we have the usual counter-opinions here, too:

> *"Physical buttons will not help a lot with dividing focus. Japanese cars have so many buttons and you have to search for the right one when you want to adjust something."*

THE "BENEFIT" OF VOICE CONTROL

According to car manufacturers, a voice control system can be used without distraction and it is a good alternative for the central display which does not even have to be touched to use voice control. A third of respondents' cars (37.7%) have some form of voice control; the majority (59.5%) does not have it and a small number (2.8%) said they didn't know. The most common is the system built in the factory (54.8%), but many have Google Assistant (17.7%) and Apple Siri (11.8%), too. About one third (35.8%) of

drivers with such systems use it exclusively and only 11.4% use it for most of the functions. **A higher percentage (65%) of those with "factory-fitted" systems do not use voice control.** The majority of those who use it, do so in a foreign language that they understand well (59.1%) and only a minority of them use/can use voice control in Hungarian (21.2%) or in a foreign language that they do not or only slightly understand (19.7%). **Using voice control in Hungarian is limited because Hungarian language is not available in factory-fitted solutions of several manufacturers.**

The majority of respondents (60.5%) think that voice control is not or only slightly useful for them,

approximately one in every four say that it is useful or rather useful for them (26.9%). Almost half of the drivers (42.9%) doesn't think or rarely think to use voice control even if their car is equipped with such a system. Only a slightly bigger number of drivers use it or mostly use it (48.6%).

Although it's been published in various tests that these systems often—sometimes annoyingly—ask back because they don't understand the instruction, the majority of respondents do not or rarely experience this (63.6%), and only 17.1% say they do or sometimes do. Users of built-in, "factory fitted" systems are more affected by this problem (52.9%): one in four users (25%) is annoyed by the system. Half of the respondents (50.6%) disagree or slightly disagree with the claim that the voice control system distracts attention, too. However, 31.4 percent rather agree or fully agree. Roughly the same proportion of them believe that the system is easy to manage (34.4%) and difficult to manage (37.6%).

In answers to open question about voice control systems we received almost only negative comments. Here are the most relevant ones:

"I have voice control too, but it works in English or German only. It asks me if it cannot identify a name and then calls someone else. Many times it is not the person I wanted to talk to."

"Voice control is faulty. Noise and language interpretation makes it unusable. Just a trendy thing."

"Text messages are read out by the car but I respond to them on voice basis or after pulling over."

"Voice control: I tried to use it several times but I was very rarely successful. Practically bordering on being useless."

QUESTIONS ABOUT POSSIBLE ACCIDENTS

In the segment of our questionnaire titled "Question on a possible accident" **15.7% of respondents answered that they were involved in a traffic accident in the last three years as passengers, drivers, pedestrians or cyclists**. Two thirds of them (66.7%) said the other party was responsible for the accident. Only one in five (19.4%) blamed themselves while only 6.7% said the responsibility was shared.

> ***According to our respondents almost one in five accidents (19.2%) was influenced by screen use, i.e. smartphone (15.3%) or infotainment (4.2%).***

> ***Whether the respondent or the other party used the device was not uncovered by the authorities in most of the cases (88.9%). In only one in every twenty accidents (5.6%) it was determined by the authority that a device was used.***

The most common forms of distracted driving in these **rear-ending accidents** are as follows:

"I had three rear ending accidents as an innocent party in the last 18 months. No personal injury happened but my car spent four months in total in the workshop. In all three cases the other party acknowledged that he/she was distracted by screen use. Because there was no action from the police on site in any of these accidents the reason causing the accidents was never revealed officially."

"I gave the way for a pedestrian to cross at a zebra crossing. And then I got bumped from behind."

"Traffic light turned to green on the access section of the M5 but there was a line of cars waiting so I had to stop behind them. The next car behind me was about 70 meters away and the driver didn't see that I slowed down and stopped so he rear ended me. He acknowledged responsibility at the scene. According to what he told me, he was looking at the GPS screen and saw the green light in the distance. I thought he felt safe at that moment but in a few seconds he ran out of that 70 meters …"

"I was riding a scooter when the good man ran me over."

"Rear ending accident with four cars involved, built up area, I was the second car in the line. We were about to drive off when the fourth car ran into the third one without braking. The cars rolled into each other like a line of dominoes. There was a light injury in the car behind us, we had no injury at all. Police have determined the sole responsibility of the driver in the fourth car."

"I could see in the rear view mirror what was about to happen because I saw him using his touchscreen with his head looking down."

"While on the phone the driver in the car behind me rear ended me. When he realized this he jumped out of his car with his phone still at his ears and reported the accident to whoever he was talking to then said "I call you back". This was the moment he mentally returned to the present."

"The driver in the car in front of me was fiddling with a charging cable, his car drifted to the left and collided head on with an oncoming car. The oncoming car spun around and hit my car at the front wheel."

"I rode my bicycle in a straight line at a junction. The motorist arriving from the front turned left and failed to give me the right of way and ran me over."

"The yellow tram drove down a boulevard in a major town parallel to car traffic on a straight line with legal speed. It was a Sunday. A black car was driving in the same direction in very light traffic. The tram stopped to pick up passengers then carried on because it had green lights. The black car overtook it then changed lanes to turn left and stopped. The tram was approaching on its rails that turned slightly right and slowed down because there was a dangerous crossing ahead and then another tram stop. So there was no reason for the tram to hurry and it was a Sunday anyway. At this moment the black car started, drove on to the tram-rails right in front of the oncoming tram. The accident happened. The driver acknowledged responsibility and admitted that he was checking the GPS when he drove on to the rails. His wife and two children were there with him. Luckily, there was no injury to anyone but the damage was significant."

"The police never asked a question about it."

Just over three-quarters (78.2%) of the participants in our study first thought that they had not been in a **traffic emergency without an accident** because of screen use. For those who answered no (21.8%), we went on to ask them to lower the bar on this issue: *"Let us be a little more specific here! Here we also meant if, for instance, while using a screen you veered off the road a little or ran out of your lane, or you "just" didn't remember a short stretch of the road or you had to brake harder, as opposed to when you were completely focused on the road."* After this more specific request **17,8 percent of our respondents changed their mind**, so it finally turned out that

> ***more than a third of our respondents was involved in a dangerous traffic situation with no accidents because of using a screen (35.9%)!***

> ***This rate repeatedly highlights the fact that motorists significantly underestimate the dangers of device use even in specific situations and emergency situations.***

Distracted driving mainly results in lane departure (57.9%). There a lot of times when the ADAS systems save the situation.

"Highway, Waze, slight lane departure because typing in the destination address."

"The driver in the other car was fiddling with his screen while driving and didn't even realize that he crossed into the oncoming lane on a country road in a very short time."

"The oncoming driver veered into my lane and was obviously not looking at the road. The motorist in front of me zigzagged on the road. I overtook him and, while passing, I saw his phone in his hand."

"Lot of drivers veer into my lane, I also change lanes accidentally but trouble rarely happens. You can see that they use their smartphones while driving."

"Browsing the infotainment menu on the motorway, dancing from lane to lane."

"I was still unexperienced (but with a false sense of safety) I fiddled long enough with the Spotify playlist on the empty highway only to realize that I was heading straight into a barrier of a departure lane with a speed of 120 km/h (I felt it was only a couple of seconds but obviously it must have been a lot longer than that). This has been a precious experience for me and it always comes back to me every time I have to touch my phone (because I only do it now when it is absolutely necessary)."

"Veering off the lane to the right but the lane keep assist corrected it."

"My relative was driving and he had to go around a stationary car because the driver glued a billboard. My relative reported the stationary car in Waze on his screen and in the meantime we accidentally changed one lane to the left."

"I failed to hold the steering wheel straight because I was using my phone, I was looking for a destination in Waze. If it is possible I only do this at a red light ever since."

In events like these **pedestrian on a crossing, scooter riders and cyclists** were in danger at a rate of 8,5 percent. Heavy breaking in the last moment in front of a crossing is the most common in events like this. We have a few more detailed answers on this:

"The motorist didn't slow down at a zebra crossing because he used his phone, I had to jump to save myself."

"I failed to see the pedestrian on a crossing for a while bit luckily I did in the last moment."

"I was a pedestrian and was crossing the road at a green light while the motorist who had a red light used his phone and almost ran me over."

"I cycle to work and it happens frequently that motorists using their phones accidentally drive onto my bike-lane, don't give me the way, pull over to my lane without looking up."

The nearly rear ending accidents are also typical (29.9%) so

> ***the cause of emergency looks like not keeping a safe distance or not giving the right of way***

as it turned out from the detailed answers. Here are a few:

"I almost rear ended the car in front while searching my route in the GPS."

"Emergency braking not to bump into the car in front."

"Sudden braking in steady speed traffic because the car in front didn't use the indicator before turning. I was just setting up my GPS."

"I had to break heavily because I got too close to the car in front."

"I missed to give the right of way but I managed to stop in time so I didn't have a collision."

"I had to break more heavily because I got too close to the car in front, and once I started to drift outside my lane and I had make an emergency steering manoeuvre because of oncoming traffic."

"While I was adjusting my radio settings I fail to see an object on the road and almost hit it. I managed to stop with emergency braking. (Older radios could be adjusted without looking at them—rotary dial.)"

Indirect traffic violation—when the innocent driver must do something to avoid the accident (i.e. evasion with a lane change/crossing the white line, pull over to the side of the road, break suddenly and giving up the right of way) are also frequent. These examples are also included in out statistical summary:

"I had to give up my right of way because of the other motorist's carelessness."

"It happens frequently, several times a day that I have to honk my horn, change direction, emergency break or do something else to avoid an accident or emergency because of another driver using his phone, lighting a cigarette or discipline their children."

"I have to break or evade regularly because of someone using his phone while driving."

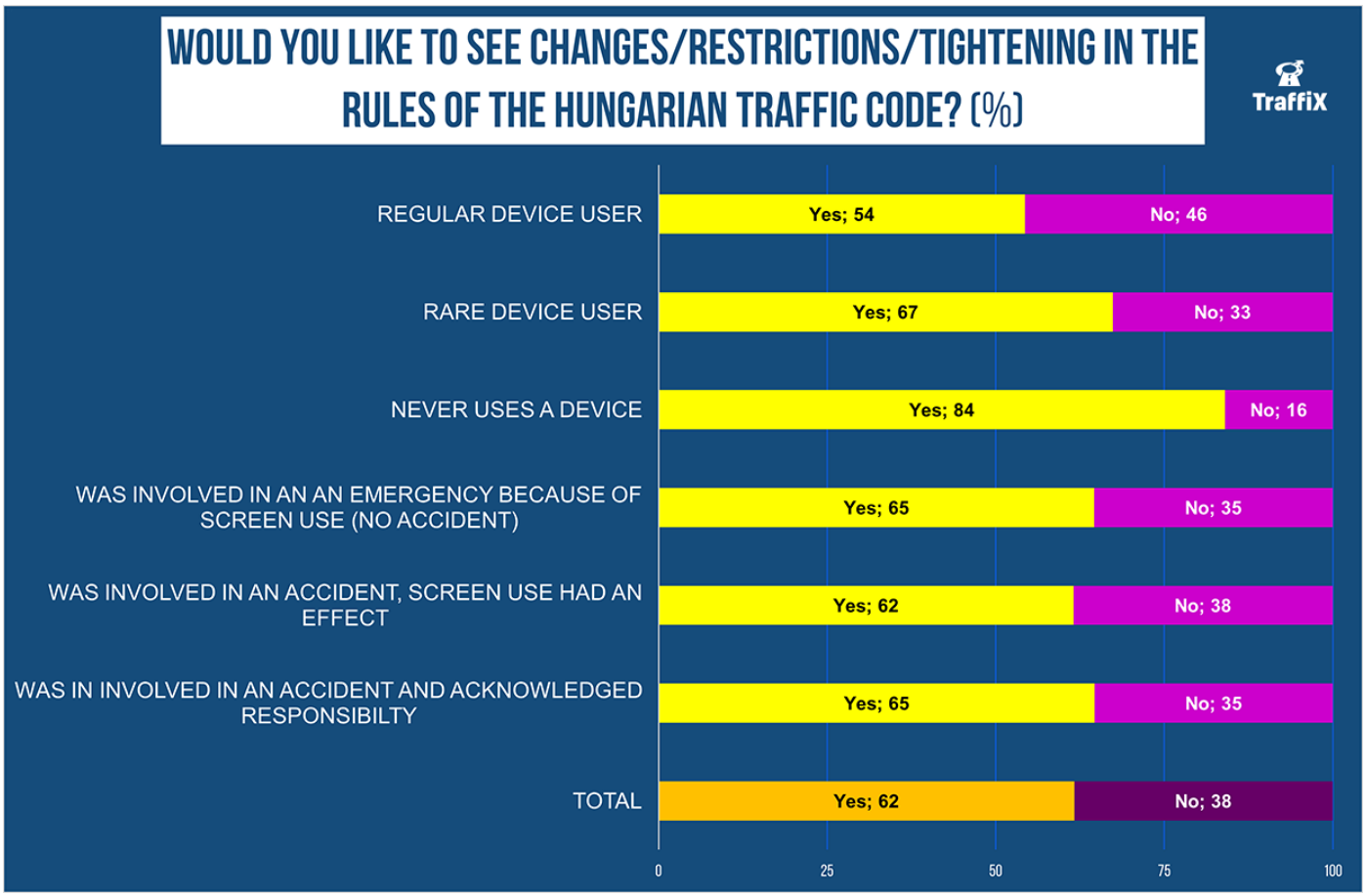
RECOMMENDATIONS FOR CHANGING THE LEGISLATION

The majority of our respondents (61.7%) said yes to our question: *"Would you like to see a change/restriction/tightening of rules regarding screen use in the Hungarian Traffic Code?"* The majority who said yes would **want stricter rules** including not only in the Traffic Code but in compliance with the rules and the enforcement of rules as well. Stricter enforcement was a favourite for those who answered with a No to this question.

> *"The Traffic Code doesn't need to be stricter. We have to follow the rules and have the law must be enforced. If I recorded with a camera what percentage of motorist drive with their phones in their hands I would put it at around 40 percent. I would also ask serious questions why people cross the white line in the middle of the road or why people tailgate another car on the highway. Same about drivers who do only 60 or 70 outside built up areas and create a dangerous situation with driving too slowly."*

> *"The legislation is broadly adequate, but control and fines should be increased."*

Half (50.9%) of those who answered in the affirmative—i.e. those who would like to see changes in the Traffic Code—, are regular device users while driving. This suggests that the social acceptance of introducing a package of stricter legal measures may not be strong when regular device users realize that they will also be subject to these stricter rules. People who rarely use their device made up for 34.3 percent and those who never used a device were at14.8%. Those who opted against stricter rules were regular users (68.8%) rare users 26.7% and those who never used a device 4.5%.



Among the supporters of stricter rules the most typical proposal is to increase the fines and—as in previous answers—have extensive police controls. Many support our suggestion that the current legislation on mobile phones ("radiotelephones") is outdated:

"Detection of cases—road controls like cameras built into speed-cams—then a heavy penalty. Not necessarily a fine but revoking the driving license or a prison sentence."

"I would brutally penalize using any device while driving."

"Stricter rules please: fines but not only for holding a phone in the hand."

"We have to set it in the rules that in the event of an accident the use of a device is an aggravating factor."

"Use of device should be banned even at a red light."

"If a motorist is caught using a device in hand for any reason while driving I would sentence him to a mandatory driving training at his own cost and revoke his license for a month. Obviously we would need more controls to do that."

"A legal ban of phone use applies only to phones held next to ears but I think hand-held phones should be included."

"I also consider it necessary to amend the rules of the Civil Code on total property compensation (depreciation, use of a rental car, lost profit/ income, etc.); and to introduce mandatory accident scene investigation (using either the public land Inspectorate, the Civil Guard, etc.; and to properly educate the relevant authorities (detection of the real causes)."

"Using a device while driving should be considered as speeding. For example, if you drive at 50 km/h (no matter where), you would be fined as if you had exceeded the speed limit by 50 km/h. The current fines of 10-20 thousand HUFs are ridiculously low."

"In more severe cases a heftier fine is necessary or even revoking the driving license for 2-3 years."

"Phone use of pedestrians and cyclists should also be monitored, at least near crossings."

"In the event of an accident, all parties in the accident may be subjected to a lie detector test to find out who is responsible for the accident. The driving license of a distracted motorist who fails to look at the road and the traffic should be revoked for a period of 1-5 years. If the motorist causes injury that heals longer than in 8 days his license should be revoked for a period of 8-12 years and in case of causing a fatal accident he should be banned from driving forever."

"We need bigger fines for phone use and more penalty points on the traffic record. Then a driving ban. Later, the temporary withdrawal of the vehicle from traffic"

"The change is not about the rules of the Traffic Code but stricter sanctioning, heavier fines to give some deterring effect to the existing rules. If you're using your phone while driving, don't drive, so I'd take your driver's license away. First violation: only for 1 month, after the second one I would impose a ban for 3 months, then 6... and so on!"

"Registering sccoters and bicycles with a number plate and impose some of the rules for them just like for car drivers."

We clearly see that the above draconian measures are merely an exaggeration on the part of the respondents. We do not support a Robespierre-like massacre regarding the use of devices and infotainment but we wanted to show that strong emotions are evoked in connection with this type of driver behaviour that so many people see as dangerous and unsanctioned.

Education, sensitization and campaigns are mentioned by only a few people:

"It is difficult to have an effect in this with new rules in the Traffic Code. But more time should be devoted to dealing with this problem already during the driving courses for would be motorists."

"Mandatory education films in the driving schools/courses."

We also received quite a few recommendations on the attitude of car makers and the relevant legislation. The majority of these suggested to limit the use of infotainment systems and the return of dedicated physical buttons:

"The main controls should be physical buttons (aircon, audio, cruise control). If we already use AI, the system should be able to recognize the setting that can be done very fast on the infotainment screen. It should be linked to the car's systems (i.e. radar, camera) to detect the traffic situation and the flow rate of traffic so the system should be able to decide whether the setting will be allowed or not in that moment."

> ***This remark from our respondent is a very important one: linking certain functions of the infotainment to an active cruise control, ADAS system and lane keep assist is brilliant and an undiscovered idea in the automotive industry. We intend to work on this proposal and pass it on to the organizing bodies defining European vehicle standards.***

"Over a certain speed on the highway the system would not allow or limit the use of the screen."

"New compliance regulations for cars are necessary in connection with the connectivity of devices and system usability and a ban should be imposed on models that only have touchscreens."

"Apart from the GPS function the screen should go black for other functions while driving."

"Phone use could be a means of monitoring speed."

"The number of available functions on the infotainment screen should be limited in a moving car."

"Voice control in the native language of the country should be mandatory."

"Regulation and control of motorists is difficult but functions of smartphones could be limited somehow while driving."

"The car should monitor the driver's eyes, especially to the right side."

"If the device detects that the speed of movement is faster than walking, it should lock. In such a case the device should automatically answer an incoming call."

And a few more remarks on the "good old" buttons:

"I would remove certain functions from the infotainment screen so they couldn't be adjusted there because the rotary dials can be adjusted without looking at them.'

"It should be mandatory for manufacturers to provide physical buttons for basic functions like air conditioning at least."

"My recommendation is to return to the real physical buttons and dials because after two days people would develop muscle memory to use them and learn where is what. The car should be a car, the computer should be a computer."

"I am a transportation engineer, I studied vehicle ergonomics. Pity that Tesla designer didn't."

"I have worked in customer service in an authorized dealership for almost 20 years. I can clearly see from the feedback of our customers that they do not know these modern user interfaces designed in the spirit of our times."

We have a few other interesting recommendations that would elevate the threshold for driver eligibility criteria:

"It would be beneficial to have a test about every five years to check the reflexes (like in an exam for professional drivers) for every driver. This could also monitor their ability to divide their focus."

"I have a professional driver's license ("PAV" in Hungarian) that I use for driving buses and special emergency vehicles so it is not a problem for me to multitask. I think it is important to have a PAV-exam (test for professionals) to define phone use, speed limit and fines. In addition, this kind of exam would be useful for all motorists."

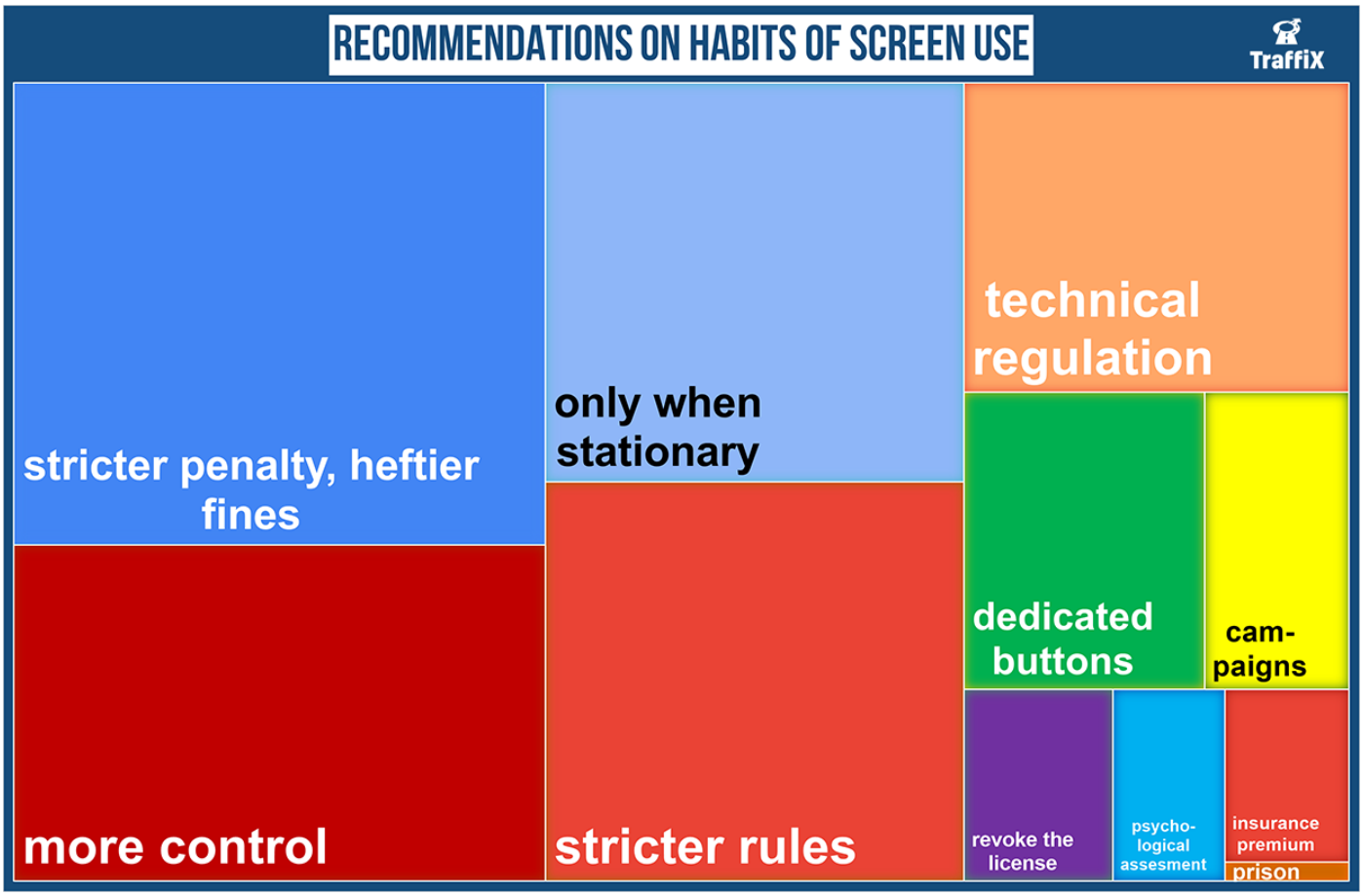
Here are some more ideas from our respondents:

"I would ban roadside billboards."

"The phenomenon of screen use while driving is a real and growing problem, but I see no other effective solution other than self-control because it wouldn't go against the technology that is making everyday tasks more and more convenient and efficient."

"People do not recognize that if they start only two seconds later at a traffic light because they use their phones, then that traffic light loses about 25% of its flow rate capacity with that little delay."

"I don't think that screen use should be sanctioned. When you set functions with big icons on a 15 inch Tesla screen it is worlds apart compared to digging deep in the menu system to find something on a 6,5 inch smartphone screen. The first one takes very little time, the other is a lot slower. You can't drop the screen of the infotainment system, it will be always be there in the same place. The smart phone on the other hand…., don't let me start on this. Totally different piece of cake."



MY NEXT CAR

At the end of the questionnaire we wanted to collect information on preferences for the next car purchase. For more than half of the respondents (52.9%) it is not at all important (45.1%) or not really important (7.8%) **to have an infotainment system with a screen in their next car**. 29.4% of respondents claim it is really important (19.6%) or rather important (9.8%) to have a system like that. This will be interesting and a sobering experience for the manufacturers but an improvement can only be made with new legislation.

Three quarters of respondents (75.4%) mostly agreed (12.1%) or fully agreed (63.+%) with the statement *"I would prefer to have physical buttons to access the main functions, even instead of the touchscreen"*—as can be seen from previous answers to open questions. The proportion of those who totally disagree with this (4.2%) or mostly disagree (9.7%) is surprisingly high (13.9%) for us.

The **commitment to buttons** is only slightly weakened if those buttons are not really nicely designed or trendy looking (*"No problem if the physical buttons are not so nice and trendy"*). More than two thirds of the respondents (68.4%) fully (52.1%) or mostly agreed (16.3%) with this statement. A relatively high number of them is afraid of this solution (18.8%).

Although manufacturers usually install infotainment systems at higher trim levels and/or for extra price, they usually have a higher price on the equipment list despite their lower cost for the car maker. Despite all this, **ordering an infotainment system is not a price issue** among respondents, as only 7.6 percent would not or would rather not ask for infotainment in their next car because it is expensive. In contrast to this, for nearly three quarters of them (73.2%) this is not the main reason, but safety concerns are not, either. We claimed (*"you don't need infotainment because it's not safe"*) and more than half of the respondents rejected this completely (49.4%) or mostly (9.9%)—a total of 59.3%. A little less than a quarter (24%) of respondents fully agreed with the statement (15.7%) or mostly agreed (8.3%).

Motorists are not interested in **voice control**. Evaluating the responses in this questionnaire and based on our own experience this is totally fair to say. More than half of our respondents choose answer 1 (totally disagree: 45.3%) or 2 (mostly disagree: 9.9%) to this statement: Voice control must absolutely be mandatory in my next car. We have a high proportion of uncertain people (answer 3: 22.4%) and we have a relatively low number (20.3%) who will surely order it (11.8%) or likely order it (8.5%).

CLOSING REMARKS IN THE QUESTIONNAIRE

At the end of the questionnaire we asked a few open questions, too. The answers confirm the importance of legislation and real enforcement of the rules. In addition to this we also had some people who trivialized and underestimated the dangers of device use.

> *"If you drove 100-200 thousand kilometres or even more then you are experienced enough to use a screen while driving for a few moments or a couple of seconds when*

you really need to and you will not be a hazard for other motorists in traffic. OK, I get it.. if you look away from the road you are actually driving blindly. But in real life we only tap or touch the screens when the road ahead is clear and we are in a neutral situation. The road can collapse under you or a wild animal can run across the road in front of you but the reality of everyday life and the statistical likelihood of events like this actually allows reasonable screen use because it doesn't take longer than what they teach in driving school to wander your eyes over the gauges, mirrors and then through the windows."

"The rate of accidents caused by foreign drivers for different reasons should be included in accident statistics and Hungarian drivers shouldn't be limited or penalized because of them."

"The devices built in cars are underdeveloped and they give a false sense of safety."

"Devices are part of most modern vehicles. Their use shouldn't be limited and regulated. Education on how to use them is the safest possible way."

"I think that the government should launch a national campaign to decrease smartphone use because I see no other solution."

"It should be explained to people and make them understand that this is not a rational decision: because it doesn't matter how smart a driver is or thinks he is, his brain can deceive him and he doesn't even realize it."

"I've been telling to my friends when I see the reports of accidents on TV, that: look, he must have used his phone while he drove."

"I've been a fire-fighter for 27 years and I saw a lot of accidents related to smartphone use."

"I don't think this topic should be under the powers of the Traffic Code, just like using winter tyres, driving schools, using the safety belt or to keep right in traffic. People need to be shown in different, clearer ways how they kill each other on the roads when they think they are above the laws of physics and human neurology."

"We're slowly starting to scale everything down to the level of idiots, and the whole driving thing is losing its main function, which is exactly what it was invented for: getting from A to B as fast as possible."

"I think this study is useful but I don't see a chance for a meaningful change in attitude from car makers and drivers. What is achievable though is to make a shift in attitude and I hope that by doing that we can avoid a few accidents."

"You need to learn to focus and there are no excuses."

SUMMARY: THE USE OF SMARTPHONES AND INFOTAINMENT SCREENS AS A HIDDEN CAUSE OF TRAFFIC ACCIDENTS

Our first hypothesis (H1) was that interacting with screens increases distraction and accident hazard. Answers to both multiple-choice and open questions clearly show that this is confirmed by the experience of drivers. 14.9 percent of our respondents who were involved in accidents in the last 3 years said that smartphone had a role in the accident. A little more than third of all participants (34.2%) have had a traffic accident due to interacting with a screen in the last 3 years or have been in a traffic emergency (without accident).

Our second hypothesis is that drivers do not recognize the severity of this risk (H2a). This was a recurring motif in a large proportion of the responses to open questions. In addition, respondents to the questionnaire considered that they were themselves engaged in only 5.89% of distracting activities, averaging all responses. This is significantly below the previously cited thematic report of the European Road Safety Observatory, which concludes that

> ***"drivers perform distracting activities in around half of the driving time", which means that participants in our study are likely to significantly underestimate the risk and hazard of screen use.***

The majority (26.8%) reported that they were engaged in distracting activities for about 1% of driving time. From responses to another claim, we found that almost every second user who finds it difficult to use the devices still uses them regularly (44.6%) while driving. Their responses to another claim also showed that the majority (66.3%) believe that the use of devices could be a problem for them, yet 50.9% of them are regular device users while driving. So we find this hypothesis of ours to be verified, too, with the addition that many people use their device even if they are aware of the risks.

Related to this is that many people are more critical of other drivers in terms of screen use (H2b) and we assumed that with this non–self-critical attitude they might even close this issue in themselves; meaning, they do not evolve, they do not progress (H2c). We found support for this in the answers to open questions, either in the descriptions of accident situations and in their proposals for legislative and enforcement routines, or in the final comments. This is supported by the large number of proposals from regular device users (50.9%) to tighten traffic rules and controls.

Our third hypothesis predicted that out-of-vehicle device use was related to screen use tendency inside the vehicle (H3). We found partially convincing support for this hypothesis in our own research. 27.2 percent of respondents who use their smartphone

regularly outside the vehicle, use it regularly in their cars too. 45 percent rarely use it and 28.3 percent never does. But screen use—beyond smartphones—is more sticky, as they are used regularly by 61.9 percent and rarely by only 29.6 percent. People who use their device regularly outside the car, use it only at a rate of 9.0% inside the car. 70 percent of addicts—who described themselves as addicted in the previously analysed responses—do regularly use a screen in the vehicle, too.

Our fourth hypothesis is that drivers have confidence in the counteracting effect of safety technology built in cars—active and passive safety systems—i.e. they have a false or at least unreasonable sense of safety (H4). We found no support for this hypothesis in the questionnaire because almost three quarters of respondents totally disagreed (64.9%) or mostly disagreed (18.7%) with the statement. This contradicts their responses to open questions where several people mentioned how ADAS systems helped them in an emergency situation. Similarly, it was not confirmed by the responses that trust in the vehicle's safety systems would cause risk compensation: this is the effect which should serve to increase road safety but is reversed as drivers feel protected and engage in more risky behaviour. This requires further research, we think.

In our fifth hypothesis we assumed—mostly based on our own experience—that the majority of drivers wants physical, dedicated buttons because they consider them easier to adjust, faster to learn, thus safer overall, so these physical controls will be an important factor for them at their next purchase (H5a). At the same time we assumed that infotainment systems would also become more and more popular and will be ordered in their next car (H5b). The first part of the hypothesis (H5a) was clearly demonstrated by both multiple choice and answers to open questions but the second assumption (H5b) was denied.

OUR RECOMMENDATIONS FOR SOLUTION

Distracted driving should be a priority in all road safety related work.

We recommend that **the updated/modernised/new version of the traffic code should include more detailed, specific definitions and rules in order to reduce screen usage that cause distracted driving**. We know that adapting the legislation to the rapid development of smartphone technology and devices with screens in the car is a major challenge—especially for applications that require different levels of interaction—, but it is essential. In our view, we should not underestimate the importance of monitoring screen use (it is increasingly easy to monitor it by the way), but it is very important that the regulation should be realistic, rules will have to be followed easily and thus they will ultimately be a useful part of efforts for better road safety. So we think that reading or sending messages, and watching visual content (videos, browsing social media, e-mailing) on the fly should be prohibited. We propose to ban all smartphone use for novice drivers and teenage drivers.

It is also important to include passages in the traffic code that **support the implementation of monitoring distracted driving**, so that the police—according to these new laws—are obliged to investigate distracted driving (i.e. screen use), not only its consequences.

But we are not advocates for over-legislation, either because there is a risk that the whole regulation will be adapted to less capable drivers. The updated rules should **reflect the abilities of average motorists**.

We have a relevant question here: why change the regulations at all, since the frameworks are already included in the Traffic Code? We think that the **framework should be made clearer and more specific and should reflect the real situation on our roads**. Let's say a new driver learned in his/her driving school that he was obliged *"to drive in such a way as not to endanger the safety of persons and property, or to prevent or disturb others in their progress without reason"*[21]. He/she will not (necessarily) think this means that no messages should be sent from the car—because he/she can do so under the current rules if his/her phone, tablet is docked/linked to the onboard infotainment system of the vehicle. Similarly, he/she would not think that this sentence also means that if he/she deals with messages at a red light and because of this "sticky" smart device use, he/she gets into a "task delay" and he/she drives off a few seconds later after the light turns green, he/she breaks the rules.

Yet, we think that a ban should not be imposed on screen use if the vehicle stops because of a stampede in traffic, but it should be made absolutely clear that the driver is responsible to keep the flexibility of traffic and to contribute to the flow rate of the road section even if he used a device for a few moments. This is significantly easier to translate into reality; from this point on, it is a matter of individual ability—and consequently—,

[21] Traffic Code ("KRESZ") I.3. § c.

individual responsible decision as to how much, for example a 30 second screen use at a red light or in a congestion will draw in user ("sticky" use). In connection with this we plan to conduct research to accurately determine the extent to which the use of devices while driving causes a deceleration in average speed and flow rate of road sections.

OUR RECOMMENDATIONS FOR THE POLICE

Even before the new legislation is put in place, it would be worthwhile to establish official action and research groups to investigate distracted activities that affect the safety of driving. The trained staff of the task force would even monitor screen use from civilian cars—while focusing on other violations as well—and possibly sanction it. (Logically, until the rules are changed, this should include the manual use of mobile phones, i.e. phone calls, messages, content consumption, and the effects of mobile/infotainment use on traffic, hindering and endangering other road users.) Continued police presence could be a major deterrent in this area as well.

The *research team* would visit those involved in an accident possibly related to device use—either the driver(s) or the passenger(s) in the vehicle(s)—by conducting anonymous interviews with them for the purpose of collecting statistical data. It would beneficial if the professional who conducts the interview would be proficient in psychology to have a better chance of filtering out if the subject of the interview is not honest. This is why we think, this task would better be outsourced, because there will be more trust about the guarantee of anonymity on the part of the prospective interviewee if he is not approached directly by the police. The more realistic data collected can be extremely useful for developing truly effective road safety strategies.

Authorities in Austria already dig deeper and look beyond the consequences of accidents when they follow the guidelines of the Austrian Road Safety Strategy 2021-2030. Florian Ammer, director of Transport Service/Strategic Accident Analysis at the General Directorate of Public Safety of the Austrian Federal Ministry of the Interior (Bundesministerium für Inneres) highlighted in his response to our questions that "*the statistical causes of road accidents are determined by written answers or interviews of drivers and witnesses who were involved in the accident and on the basis of these, by the first on-site evaluation of the accident investigation bodies of the Federal Police.*

> ***Statistical definition of accident causes is independent from technical professional reports and from tests commissioned by the criminal justice system and from the verdict on the responsibility for the accident.***

In road accident statistics in Austria, the accident cause 'inattention' is statistically defined as: lack of concentration, visual and mental distraction, all non-driving activities (eating, drinking, reading, smoking, telephoning, searching for objects...)."

From the letter of an employee in the Federal Ministry of the Interior of Austria we would like to highlight that police work **serves solely the collection of statistical data and is separate from the procedure/investigation**!

The need for the police to investigate distracted driving is not only important for the sake of clarifying statistics, but by seeing this, road users can identify the use of the device directly and more clearly as the cause of the accident.

It would also be beneficial to have **effective systems to monitor screen use**; there are more and more such systems/devices that are able to do this task efficiently. Smart cameras should be installed near accident hotspots to enhance the success of post-detection.

TECHNICAL REGULATIONS

We also consider the issue of technical regulations to be important. Although the decision-makers of the European Union have also begun to act in connection with the distraction caused primarily by the use of screens, it is worth taking action sooner in Hungary, perhaps showing the way to the community and/or taking advantage of Hungary's 2024 EU presidency, to consider the possibility of introducing some measures:

1. In Hungary, vehicles—with or without an infotainment system—could be marketed only if they have **dedicated buttons for some of the main functions**. The main functions are: the control of the music player/radio (skip, volume control), the control of the heating/cooling/ventilation system in the passenger compartment (temperature, air flow rate, circulation), the driving mode selector and the "home" button in the main menu of the infotainment system.

2. It requires special research—we do not consider it reasonable to introduce new rules before the research—whether **disabling certain functions** of infotainment on the fly is useful. On the one hand, this can lead to more dangerous device use, because the driver then would choose to use the smartphone while driving to access the function disabled on the central display i.e. sending messages. On the other hand, this can also cause traffic to slow down, as the driver would like to perform the operation(s) available only when the car stopped for traffic reasons. This may cause him to start with a delay of a few seconds, perhaps in a more nervously. However, it is recommended that a **voluntary activation solution should be mandatory** in onboard factory systems; voluntary activation presupposes a more responsible attitude by the driver so that he does not look for loopholes in screen use.

3. Similarly, there should be a **voluntary system for mobile phones**, too. While the mirroring functions in Android Auto and Google CarPlay are quite ergonomical and give limited use to phone features, there are none or only paying apps

available for users who cannot connect to the car's system. In this case it is worth considering to mandate for smartphone manufacturers to install an application offering limited availability of distracting functions and to show only the most necessary, route-related notifications with larger, easy-to-use icons, which the driver can turn on before departure.

4. It is important that the **onboard factory-fitted systems** (infotainment, voice control) are mandatory to work in the official languages of the member states of the European Union. It is logical too, because if the legal disclaimer to be accepted appear in different languages, most of the emergency warning messages should also be delivered in the user's native language. The efficiency of the voice control systems would also be greatly improved with this solution. This measure can bring about a decrease in distraction.

5. **Maximizing the number of notifications of driver assist systems** and eliminating their distracting nature is also important because they can often act as distractions.

6. It is worth **making certain ADAS systems mandatory** for new vehicles to be road legal in Hungary or putting pressure on the European Union in this matter. More and more manufacturers now have a driver monitoring system that monitors possible distractions, for example by monitoring and evaluating eye movements. They can be made mandatory from a date when they are expected to be safe and secure for the majority of car manufacturers.

We agree with the Euro NCAP response which claims that drivers' attention is *"distracted while driving and that a secure system approach should be ensured by directly monitoring the driver and linking the driver's condition to the ADAS settings. Therefore, if the vehicle knows that the driver is distracted, the sensitivity of the ADAS systems should be increased to compensate for the state of distraction and/or sleepiness."* For this, *"we cooperate with OEM manufacturers in order to reduce the risk of distraction/drowsiness as much as possible"*. So the work of Euro NCAP can bring results although they will be statistically delayed in time in Hungarian transport due to the country's aging vehicle fleet. So the problem here could come up in a decade and so could the solution. Euro NCAP plans to introduce their new protocol in 2026; therefore, it is worth putting it at the regulatory level before that date.

RAISING PUBLIC AWARENESS

> ***An important result of our research is that respondents significantly underestimate the risk and danger of screen use.***

This raises the need for **effective education**. This could help to convince drivers who are "forced" to use their screen while driving by striking or shocking ads, campaigns

(roadside) on billboards, social media, video sharing, radio, television and workshops. These would also serve to influence those drivers those who are (more or less) aware of the dangers of screen use but do not refrain from doing so. It is useful to evaluate the different persuasion strategies to see what has worked and what didn't; although there is no exact measurement for these, it is possible to find the connection between the campaign and the result, i.e. the measurable drop in the device use. One of our plans is to conduct this international research.

Education should also take place in elementary schools, where education for responsible and conscious behaviour in transport should begin. Mostly among pedestrians and cyclists—and especially for younger people—, smartphone use is an issue that needs even more attention. **Driving schools** should also focus on effective education based on a centrally developed curriculum, and on the further education of their trainers.

Our proposal which goes beyond distracted driving, is to **tie the issue of the driver's license to a day spent in a driving center**. This requires the creation of at least one driving center track per county—as opposed to the current situation, when all of these are located in or near Budapest (Hungaroring/Mogyoród, Tök, Zsámbék, Autoklub headquarters). Specialist trainers would educate drivers on the basis of a **standardized national curriculum** in these centres, including the illustration of the consequences of distracted driving.

We also plan to carry out a research in the future aided by instrument measurements with sensors and cameras. After evaluating our data we can get an even more accurate picture of the use of device and its effects on driving.

One can raise the issue here: why ask these question "on the eve" of self-driving cars and autonomous driving?

> ***Although several manufacturers are working hard on developments, the introduction of self-driving cars seems to be further away in time than we thought about a decade ago.***

According to the predictions of that time we should already see a lot of cars with autonomous driving capabilities all around the world. Obviously, this is not so and we wouldn't bet that it will be like that in 10 years.

At the same time, this also highlights the fact that **legislation should catch up with the pace of rapid development** because we expect a transitional period when old Lada cars will share the roads with the self-driving cars of drivers/passengers who will probably be staring at their screen. It is also possible that our streets will always have a "mixed fleet"; still offering the experience of driving to society—we can't know for sure just now. But in the meantime, we need to work out the rules of the traffic code that will put things in order in the current situation in preparation to accepting new rules and definitions that will soon be necessary.

CONCLUSION

Reducing screen usage while driving is a complex challenge that requires a comprehensive approach.

> ***We are convinced that a combination of efficient methods can be used to change the social perception of distracted driving.***

On the one hand, legislators, car manufacturers (and their suppliers who do development), the police, road safety organisations, civil society organisations, national and urban transport operators and of course motorists—therefore the whole society in general—must work together to create the culture of road safety and responsible traffic behaviour. Sanctioning is an important tool on the way there but education and awareness are equally essential to ensuring safer roads for all.

> ***The vision of our Association is that road users can find their own regulatory systems at different levels from the Traffic Code to the strictest fines.***

Those who follow rules should be able to enjoy the benefits of the country's flexible transport system. Those who "need" to be warned by the police from time to time, let's give it to them. And for those who "need" to be ejected from the system for a shorter or longer period of time, let them face the consequences.

> ***The vision of our Association is to achieve a final state of affairs in which road users, out of their own volition, adhere to reasonable road traffic rules and for example, they may not even think to irresponsibly use a screen while driving a vehicle. A significant majority will do this in order to be part of a road transport community that returns to the basic goal of individual transport: to get from A to B as quickly and safely as possible. We concluded that making road transport efficient, reasonable and likeable is a social interest which will have a significantly wide-ranging impact on the everyday life and well-being of road users in the country.***