
Automated vehicles' safety and the human perspective

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Automated vehicles (AVs) are undoubtedly the “next big thing” in transportation. Road crash statistics highlight that in the vast majority of crashes (around 95%) human error is among the main causes; “human” either being a driver, pedestrian, cyclist, rider, etc. Aiming to maximise road safety, this would lead to the idea that human intervention should be eliminated (or at least minimized). Automated driving comes as a possible solution to reduce at least part of those crashes that are related to the car driver: driving tasks are taken over by the vehicle itself which, based on high-end technology and computing, is able to perceive the environment and perform the driving manoeuvres.

This solution has of course a series of issues to overcome in order to be viable, effective and, finally, able to solve the problem which generated it. Some of these issues would still have to do with the humans and their interaction with the vehicle. This occurs in different ways:

- *In the vehicle:* The vehicle should effectively interact with the persons it transports, i.e. its passengers. It is important to establish effective communication before, during and after the trip. Also, at low levels of automation, the driver still has some of the driving tasks to perform or twist turns with the vehicle on the control. Thus, there should be appropriate cooperation between the human and the vehicle. Moreover, it is important that the “driving style” of the AV is, apart from legal and safe, also accounting the needs and preferences of the different passenger groups, thus increasing their levels of comfort and trust.
- *Between vehicles:* At initial deployment, AVs are participating in the traffic mix in low penetration rates. This means that they should interact with a variety of human-operated vehicles, in the same road environment and under diverse conditions and circumstances
- *With other traffic participants:* The co-existence of AVs with non-motorized traffic participants, e.g. pedestrians, is also crucial from both sides; on one side for the vehicles to safely interact with pedestrians and, on the other, for pedestrians to recognize an AV and get accustomed to the fact that there is no human behind the wheel, thus the interaction is different than usual. Additionally, it is important for humans to be able to understand whether the AV is in autonomous mode or not, as well as whether it has acknowledged their existence in the road environment.
- *With the operators:* The AV or the operator at the Traffic Management Centre (TMC) needs an appropriate interface with the vehicle to either monitor its optimal performance (and intervene if necessary) or to manage and oversee the traffic (incl. AVs) at network level.

Among several research initiatives in this area, the Drive2theFuture^{1,2} Horizon 2020 project aimed at investigating the ways, tools and technologies to raise acceptance of AVs among different actors in the transport chain, for all transport modes, and guiding the AV industry in keeping the user in the centre of design and development. Behavioural models, HMI strategies, user surveys, training

¹ <https://cordis.europa.eu/project/id/815001>

² <https://www.drive2thefuture.eu/>

curricula, material and tools were only some of the methods and products of the project, which were piloted throughout Europe.

According to the evaluation and impact results, user acceptance seems to be positively impacted, mainly when users experience AV systems, get accustomed to them or receive training on them, as in their vast majority they exclaimed higher acceptance of the systems upon testing them. Moreover, affective, persuasive and personalised HMI along with external HMI were highly accepted by the users and considered as highly contributing factors for enhancing their acceptance of the systems. In terms of safety, training and HMI addressed to drivers, AV and TMC operators, passengers and other road users were considered as the factors that would have the most significant impact on its enhancement. In particular, the dimensions of affectivity, persuasion and personalization in HMI allow its adaptation to the users, thus enabling them to behave in a safer and considerate manner when using AV. Additionally, the external HMI is highly contributing to the safety of other road users, and especially non-motorized road users, by making the AV status and intentions clear and thus minimising the risks of reduced safety due to misunderstanding on the interaction of the AV with other users.

Research in the field is of course ongoing and further initiatives should not overlook considerations of the human dimension in AVs development and deployment, as their success – at all levels, safety, efficiency, market, etc. – shall always rely on the users, their acceptance, willingness to use and trust on AV operations.

This column is written in a personal capacity and reflects only the views of the author.