Transparent Passenger Communication during Minimal Risk Maneuvers in Highly Automated Vehicles (L4)

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Abstract

Highly automated vehicles (HAVs, SAE 4) promise efficient, safe and inclusive transportation at an affordable price. Advanced concepts were developed without any fallback driver inside the vehicle. Though this is necessary to improve efficiency and affordability, it creates an unknown situation for future passengers. They no longer have a human driver present to reassure in uncertain situations, for example in minimal risk maneuvers (MRMs). MRMs are triggered when the vehicle automation encounters situations it cannot handle. In these situations, the HAV needs further assistance, which can be realized by the use of remote operation (RO). RO incorporates a human operator, who supports the HAV remotely (e.g. from distance) during MRMs and gives instructions to resolve these unknown situations. The combination of new situations, and the lack of a driver who could interact with passengers results in the need for new informational concepts inside the HAVs. The design and information richness of these concepts most likely influence passenger's experience and acceptance of HAVs. Additionally, a basic and more intuitive understanding of the automation and its functionalities might be beneficial for passengers' experience. Previous studies indicate that providing transparency by design might improve passengers understanding of the automation systems and increase trust. In theory, transparency improves when information about the actions and reasoning of a systems behavior is presented alongside its behavior. Yet, the specific design of informational interfaces in order to be transparent about the reasoning, especially in MRMs, is still unclear. Therefore, we investigated the impact of promising factors in an online study. Participants of the study evaluated different interfaces in multiple scenarios, where the HAV has to perform an MRM. The presented interfaces varied in displayed information richness to systematically manipulate transparency in the vehicle automation. The information varied concerning the vehicle´s behavior and reasoning. The design with the highest information richness also added expected consequences, like delay time, to the interface. The results of this study indicate that improvements of passenger's understanding in MRMs are linked with increased transparency of provided information. Understanding regarding those MRMs scored significantly higher in the information richest design compared to the design without MRM specific information.

Keywords: Human-Computer Interaction, Highly Automated Vehicles (HAVs, SAE L4), Remote Operation, Explainable AI (XAI)