



Safety Challenges in Transitioning Between Vehicles with Differing Technologies

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Introduction

The advent of technology in the automotive industry has led to a significant shift in how vehicles are equipped and operated. Advanced Driver Assistance Systems (ADAS) represent a cornerstone of this technological revolution, promising to enhance safety by supporting drivers with automated functions such as adaptive cruise control, lane keeping assistance, and automatic braking. Despite these advancements, the expected radical increase in road safety has not been universally realized, and the performance of these technologies under real-world conditions often falls short of expectations.

Today's drivers, particularly those who operate fleet vehicles or rent different cars, often have to adjust to different ADAS configurations within a short time—sometimes even within the same day. This frequent need to switch between various vehicle interfaces and control systems can overload drivers mentally. A major concern is when drivers mistakenly apply their understanding of one vehicle's controls to another, despite clear differences in technology. This can cause confusion and slow down their reaction times, leading to unsafe driving situations. This study seeks to investigate the safety implications associated with cognitive confusion arising from drivers transitioning between multiple vehicles equipped with varying Advanced Driver Assistance Systems (ADAS). Specifically, it examines how drivers manage these transitions and identifies the potential risks that such variability in vehicle technology can introduce.

Research Methodology

A questionnaire with close-ended and open-ended questions was designed to gather detailed insights into drivers' interactions with vehicle technologies, particularly focusing on the ease of adapting to different in-vehicle interfaces across diverse car models. This factor is vital as it can significantly affect driver safety, especially when drivers switch between multiple vehicles within the same day or week. Such frequent transitions can lead to confusion and increased risk due to varying layouts and functionalities of in-car systems. The survey also explored drivers' overall experiences with using these smart technologies. By investigating how individuals adapt to and manage the interfaces of different cars, the study aimed to identify common difficulties and safety issues that arise from this need to adjust frequently. Additionally, participants were asked to report any safety incidents directly attributed to these technological transitions.

A total of 502 drivers who drove multiple vehicles, including one vehicle that is fitted with at least two types of ADAS, e.g., adaptive cruise control and autonomous braking participated in the study. The study surveyed predominantly male drivers (92.8%, n=466), with females



representing 6.8% (n=34) and those identifying as other genders making up 0.4% (n=2). The age of participants ranged from 18 to 80 years, with an average age of 59.47 years and a median age of 63 years. On average, participants had held their driver's licenses for 42.14 years, indicating a highly experienced group of drivers. Regarding vehicle usage, participants typically drove an average of 2.18 different cars per week, with most driving 2 cars regularly. A substantial portion, approximately 81.8%, of respondents reported using more than one model of car, including their private vehicles.

Results

Regarding difficulties encountered with different smart technologies across these vehicles, only 17.3% of participants noted experiencing issues, whereas a vast majority, 82.7%, did not face any significant problems. Additionally, when asked about the functionality of smart technologies, 36.6% of respondents indicated that these technologies functioned differently from what they had anticipated, while 63.4% reported no unexpected functionality. These percentages reflect the varying levels of adaptability and challenges users experience with advanced vehicle technologies, pointing to opportunities for improvements in technology integration and user training.

Participants provided more clarification in open-ended responses, highlighting the frustration with ADAS inconsistencies. One particularly vivid example noted, "I find it difficult to become familiar with multiple different technologies and find some of them distracting. Different location of controls etc often causes me to use wipers instead of indicators when I'm approaching a turn." This quote underscores the challenges of adapting to different vehicle layouts and the potential safety hazards of such discrepancies. Furthermore, the negative experiences with ADAS often stem from a lack of standardization across vehicle brands, leading to confusion and potential danger. As one driver expressed, "Having a car suddenly pull to one side (lane assist) unexpectedly...Some technology does not work properly on all road surfaces (e.g., gravel) making it hard for a novice driver to keep control." These comments illustrate the critical need for intuitive design and greater consistency in ADAS implementations to enhance user experience and safety.

Discussion and Conclusion

This research highlights the complexities and risks associated with variations in Advanced Driver Assistance Systems (ADAS) across different vehicles. It shows that such variations can significantly confuse drivers and pose safety risks. A major issue is the unsafe use of ADAS by drivers unfamiliar with the differing systems in various vehicles. Many drivers view ADAS as distracting rather than helpful, undermining its safety benefits. The effectiveness of ADAS heavily relies on the driver's ability to adapt and properly use the technology. The necessity to switch between systems may worsen this issue, as drivers often lack the time or resources to acquaint themselves with each distinct setup, leading to reliance on inaccurate mental models of how these systems operate, which results in driving errors and unsafe practices. To reduce these risks, it is recommended that manufacturers and regulatory bodies standardize certain ADAS features to lessen the cognitive load on drivers. Improved training programs and educational resources on ADAS functionality and limitations could also enable drivers to make better-informed decisions about using these systems effectively. Moreover, creating more intuitive user interfaces could decrease confusion and increase safety.