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Effect of Training on the Utilization of In-car Touchscreens: A Driving Simulator Study on Visual Attention and Performance

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Introduction: The introduction of in-car touchscreen interfaces has revolutionized vehicle technology, offering a variety of functions aimed at enhancing driver convenience and comfort. In addition to fundamental features such as navigation and entertainment, touchscreens are also specifically designed for drivers to access advanced driver assistance systems (ADAS). Since in-car touchscreens affect the usability in operating these functions when compared to traditional tactile control systems (i.e., knobs and buttons), concerns persist regarding the potential negative effects of these interfaces on driver attention and performance, particularly in the context of distracted driving and usage of multiple touchscreen interfaces from different car brands.
Furthermore, nowadays car-sharing and renting services are becoming more prevalent, and therefore there is an increasing possibility that drivers may interact with unknown touchscreen interfaces for the first time more often than before. With this respect, the learning curve to interact with new touchscreen interfaces may have a significant influence on the driving experience and performance.
As a possible countermeasure towards these concerns, training in the use of touchscreen interfaces has been discussed as a possible solution. Therefore, there is the need for a comprehensive understanding of how much different forms of dedicated training in the use of these touchscreen interfaces could mitigate distraction and/or influence the driving performances. Therefore, the present study focuses on the impact of short instruction-based learning (also called rapid instructed task learning) on the use of in-car touchscreens for car drivers and how it influences driver visual attention and performance.

Method: This study employed a fixed-base driving simulator to investigate the effect of training/learning on touchscreen utilization, with a specific focus on visual attention distribution and task completion. A total of 60 Norwegian licenced drivers (36 males and 24 females) were recruited and equally assigned to trained and untrained group, with the trained group receiving instruction-based training just before the experimental drive aimed at familiarizing them with the functionality and operation of the in-car touchscreen interface. The duration of instruction-based training was limited to five minutes. During the training session, the instructor showcased the functionality and operation of a series of functions accessible through the in-car touchscreen interface. It's noteworthy that participants in the trained group observed the demonstration without directly engaging with the touchscreen.
Groups were established by considering the demographic characteristics of participants (i.e., age, gender, and driving experience), to maintain homogeneity between groups. Participants in both groups then underwent a simulated driving scenario designed to stimulate varying levels of performance demand and task complexity. To be specific, during each experimental driving session, participants were instructed to complete a total of eight touchscreen-based secondary tasks (i.e., change of radio channel, temperature control, activation of heating on the

windshields, navigation, and change of the fan direction). The secondary tasks were distributed along the specific segments of a 13 km long motorway section. The study also considered the driver self-learning of the use of touchscreen by providing a short selection of the previous secondary tasks repeated multiple times along the experimental motorway section. Visual attention allocation was assessed using eye-tracking glasses, capturing gaze patterns and fixations on the touchscreen interface and the surrounding driving environment.

Results: Despite the short duration of the instruction-based training provided, initial results revealed differences in touchscreen utilization between the trained and untrained groups. The trained participants demonstrated targeted interactions with the touchscreen interface. Specifically, participants in the trained group showed lower dwell times on the touchscreen, indicating better performance compared to the untrained group without prolonging the visual fixations. Moreover, a significant difference was observed with a higher secondary task completion rate among the group that received pre-training on the use of in-car touchscreens. A higher rate of secondary task completion might suggest that drivers were more efficient in handling the secondary task. However, the question remains whether their driving performance improved while carrying out this secondary task. This study is currently in the phase of data analysing, further investigation is required to gain a comprehensive understanding of how the 'instruction-based learning' affects visual attention and performance of drivers.

Discussion and Conclusions: The insights gained from this study may assist in recognising the influence of 'short instruction-based learning' on the utilization of in-car touchscreen and mitigating potential distractions while driving. The observed improvements in visual attention distribution among trained participants highlight the importance of structured short training protocols in optimizing the utilization of touchscreens. The present study focuses only on drivers' visual attention. However, it will be interesting to integrate additional driving performance measures such as longitudinal and lateral driving behaviour to gain further insights. It is important to point out that the scope of this study is confined to a simulated environment, future research in the real-world is necessary to have wider insights.

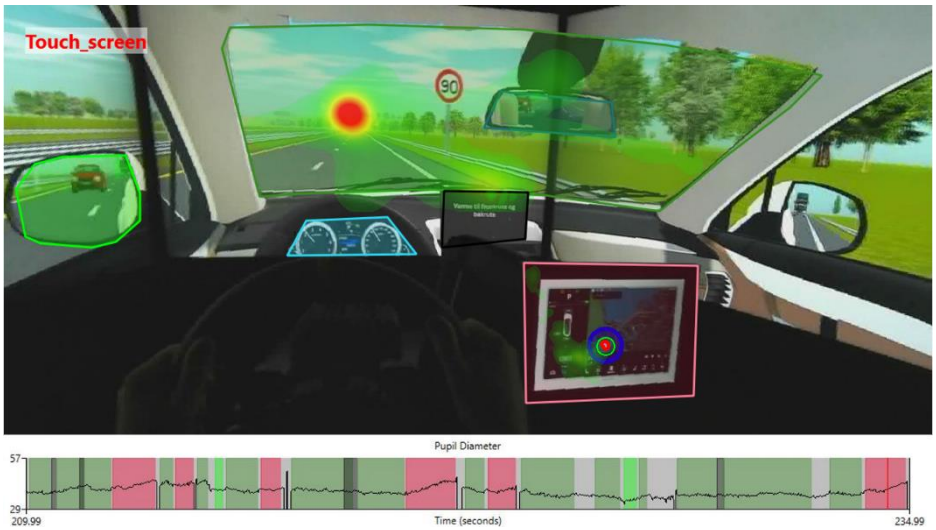

Figure 1 - An example of Area of Interest (AOI) of gaze data for Test driver number 5 (TD-5) performing a secondary task (change of radio channel) at the last frame and pupil diameter during the secondary task. The configuration of AOI is set with respect to all.