

Evaluating the influence of a head-up display on driver's behaviour

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I. Introduction

To facilitate driving a motor vehicle safely, various driver assistance systems are offered. To optimise their potential, such assistance systems need to ensure an appropriate interaction with the driver. However, to date only few studies investigating the influence of such systems on driver's behaviour under real world conditions are available. A naturalistic driving study was conducted to analyse the influence of a head-up display (HUD) on driving behaviour. It was hypothesized that the use of a HUD allows faster acquisition of the displayed information compared to the dashboard display. A safety benefit through faster recognition of the information could be assumed in that case. The system was evaluated with special emphasis on elderly drivers.

II. Methods

37 participants (control group: $n=9$, < 45 years of age; elderly group: $n=28$, > 65 years of age) were provided with a test car and drove on a predefined route through the city of Zurich, accompanied by a driving instructor on the passenger seat. The route was chosen such that it included parts with different speed limits as well as traffic situations of different complexity. The test car was equipped with a standard display (i.e. analogue tachometer) and a HUD. For the driving trials the vehicle was additionally instrumented with cameras and microphones (VBOX) in order to record the driver's behaviour. All participants performed two test drives: one with the HUD switched off and one with the HUD showing only the actual speed (Fig. 1). While driving, an acoustic signal was given at 16 pre-defined positions of the route and participants were instructed to readout the actual speed. The perception response time, i.e. the time between signal and answer, was determined based on the VBOX recording and compared between trials with and without HUD. Furthermore, the head- and eye movement was analysed.



Fig. 1: The speed is presented at the bottom of the visual field.

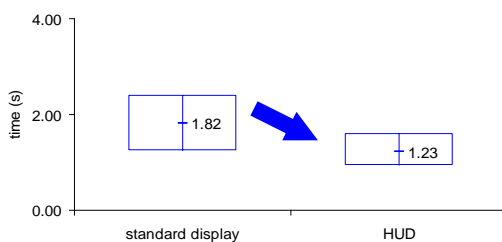


Fig. 2: Median perception response times of all participants using the standard display and a HUD.

III. Results

On average participants were able to determine the actual speed approx. 0.6 s earlier with the HUD compared to the standard display (Fig. 2). Also the frequency of head movements clearly decreased when using the HUD (no HUD: $n=257$; HUD: $n=118$). Moreover participants were able to focus their gaze better at the street when using the HUD, while they averted their eyes more often and longer from the street when using the standard display. However, no statistically significant difference was found between the two age groups.

IV. Discussion and Conclusions

Naturalistic driving trials were performed to assess the benefit of a HUD as an example for a driver assistance system. The rather small number of participants and the influence of an analogue vs. a digital speed display are methodological limitations of this study. Nonetheless the results clearly demonstrate that speed information presented in a HUD can be acquired faster compared to its presentation in the dashboard tachometer. Similar findings were reported by other studies (e.g. [1]). Hence this study indicates a safety benefit of HUDs since information can be perceived faster and drivers are enabled to focus better on the road.

V. Acknowledgements and References

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[1] Ablassmeier M et al, 9th World Multi-Conference on Systemics, Cybernetics and Informatics, 2005

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