Introducing Advanced Driver Assistance Systems (ADAS) into drivers' training and testing: the young learner driver's perspective

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Novice drivers attract a lot of the attention in terms of their involvement in traffic accidents, especially during the first period of driving. This stems from errors of attention, visual search, speed selection and adaptation, hazard identification as well as control during emergency manoeuvres. In the Netherlands, the crash rate for young novice drivers between 18 and 24 years old proves to be five times higher than the rate of experienced drivers.

Following the traffic safety facts, safety has become a vital asset for the automotive industry over the past decades. The radical development of Advanced Driver Assistance systems (ADAS) has shown potential to compensate for the inabilities of drivers to properly react to risky situations. Thus, they could especially contribute to mitigating novice drivers' crash involvement by assisting them in performing difficult driving tasks, like hazard detection and speed adaptation. Despite these technological advancements in the vehicle industry, drivers' training and testing procedures did not yet incorporate these technological developments.

The main objective of the presented study is to describe the perception of learner drivers towards the Adaptive Cruise Control (ACC) and Blind Spot Detection (BSD) system. These two systems were chosen after taking into consideration the main difficulties young drivers face which include speed selection and adaptation, as well as, hazard and risk detection. Taking these issues into consideration the main research question is formulated as following: "What is the learner drivers' perspective on the Blind Spot Detection (BSD) and Adaptive Cruise Control (ACC) systems and their introduction to drivers' training and testing?"

The research methodology was designed carefully in order to collect the necessary information so as to answer this question and allow a thorough data analysis. The first part of the methodology was *literature review* in order to imbibe knowledge on previous work in the fields of drivers' behaviour, ADAS systems and widely applied training and testing methods. The identification of gaps in these areas of study has been used as input for the development of an *online multi-content questionnaire*. The first part of the questionnaire consisted of two existing behavioural inventories, the Driver Self-Image Inventory and the Driver Stress Inventory (DSI). They helped in gaining information on the driver profiles of the participants (confident, courteous, and impulsive) and their driving stress causes (Dislike of driving, Hazard monitoring, Thrill seeking). The second part was video-based and has been especially

developed for this study. It included a short video for each system, where a brief description of the system was made, and a set of questions about the perception of the respondents towards the BSD and ACC systems. The questionnaire responses to both Likert scale items and open-ended questions have aided in the organisation of follow-up *in depth personal interviews*, which only focused on the introduction of the systems in drivers' training and testing.

For the data analysis, two groups of participants, 40 learner and 48 experienced drivers, were recruited. The data has been analysed both quantitatively (statistical analysis and tests) and qualitatively, reaching conclusions on the relation between the profile of drivers, the causes of their driving stress and their perception towards the systems. In the end, a suggestion for the introduction of the systems in drivers' training and testing has been made based on the findings of the analysis.

The research results:

Knowledge of the two systems: The BSD system was found to be relatively known to 45% of the learner drivers, whereas the areas of application of the system seem to be quite unclear to them (33%). In contrast, the ACC system has been confused by more than half of the learner drivers with the Cruise Control system, thus creating a wrong impression of its capabilities and areas of application. Learner drivers' understanding of the systems, after the use of videos as a teaching tool, increased by approximately 30% for both systems

Usefulness of the two systems: Learner drivers' perception of usefulness of the BSD and ACC systems is highly dependent on the type of driving tasks and safety aspects the systems are used for. The BSD system is considered to be statistically significantly more useful in enhancing traffic safety of drivers as well as in helping them in several driving tasks, such as collision avoidance and lane-changing rather than in improving their driving performance. Concerning the ACC system, its usefulness in properly adjusting to the traffic conditions by maintaining the learner drivers' speed and distance headway from the vehicle in front is statistically significantly higher compared to its usefulness in enhancing their driving performance and safety. Although both systems mainly aim at increasing the safety levels of drivers, the ACC system has been considered more as providing comfort to drivers rather than safety. This is partly explained by the type of driving tasks drivers find most difficult. The ACC system, from the point of view of drivers, is attractive but not essential to the drivers in terms of traffic safety enhancement.

Expected ease of use: It is relatively high for both systems, with 31-33 out of 40 learner drivers reporting that they agree or strongly agree with the following statements: 1. "My interaction with the system will be clear and understandable", 2. "It will be easy for me to become skilful at understanding and using the system".

Willingness to use: Learner drivers are statistically significantly more willing to use both systems in highway environments and rural roads than in urban environments. Also, a distinction is made between highways and rural roads, with the learner drivers being considerably more willing to use the ACC system in the former.

Correlations between learner drivers' *self-images, causes of* their *stress* during driving, and *ADAS need in training and testing*: It was found that the need for the BSD system is unaffected by learner drivers' self-images. This means that although all drivers who expressed their need of the system have different driving behaviour, they equally recognise the necessity of the introduction of the system in training and testing. However, the more learner drivers feel confident, the less they need the ACC system (r=-0.318[**]) and the more they argue against its introduction into drivers' education.

The answer to the main research question is given through the analysis of the above mentioned components. Relieving the young driver from the stress caused by multitasking, as well as, increasing traffic safety levels lead to ranking the BSD system first in their preferences for driving assistance. The BSD system is considered as an ADAS increasing traffic safety, whereas the ACC system is believed to be luxurious system assisting in harmonising the traffic flow. For these reasons, learner drivers ranked the BSD system at a higher priority over ACC when they were asked about sequence of the systems' introduction in the drivers' education.

Concerning the *systems' integration in training and testing procedures,* their integration should ensure that drivers learn to react safely to all input interfaces and properly perceive all the systems' indications. The training should also teach drivers about handling systems' possible failures. Thus, after determining the sequence of the systems' introduction, theoretical behavioural tests should be made to the trainers before the practical lessons and specific elements need to be included in both training and testing, depending on each system's specifications and demands. In this way, elements for all levels of drivers' training, from tactical to strategic, are incorporated.

Recommendations for future research: First of all, it is suggested to increase the reliability of the results by increasing the sample size and improving the videos used for increasing awareness. Moreover, it is proposed to assign weights to the used measures (usefulness, ease of use, etc.) and to identify other measures influencing drivers' perception towards ADAS, such as their familiarity and occupation with technological advances or sociodemographic characteristics. Finally, it is recommended to conduct a driver simulator study and field studies and examine driving behaviour and drivers' performances in relation with ADAS.