Perceptions of Risk & Control: Understanding Acceptance of Advanced Driver Assistance Systems

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Abstract: With a marked increase in advanced driver assistance systems (ADAS) being designed and deployed for cars, there is a logical emergence of studies that critically examine the influence these have on driver behavior and attitudes towards risk and safety. The research question addressed within this paper asks to what extent the level of perceived criticality or risk on the part of drivers influences their acceptance of advanced assistance.

1 Introduction

Presently, the technological feasibility of most ADAS is not the main issue for implementation anymore [1]. In fact, the first ADAS applications have already entered the market, such as adaptive cruise controls and collision warning systems. The focus in scientific research on ADAS in the past years has shifted from basic technology research and development towards the complexity and impacts of implementation of ADAS [2]. By focusing on the tools (both technological and conceptual) that mediate between our subject group of drivers and our augmented driving environment, this paper attempts to critically examine how diverse driver attitudes towards risk and control can be factored into the design of intelligent in-car systems.

2 Methodology & Experimental Design

This paper reports on the findings from two years of post-doctoral research that took place within the broader frame of a European network of excellence called HUMANIST[1]. Our methodology combined qualitative, interpretative analysis tools with simulator based study design, thereby allowing for a deeper, richer understanding of driver decision-making behaviour and subjective attitudes towards risk and safety, albeit within a controlled environment.

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[1] http://www.noehumanist.org/

A total of 20 subjects participated in our study, who were selected from a diverse background, cutting across gender, age, driving experience, and license history. With regard to the novice-elderly distribution, the subjects covered ages ranging from 24 to 66, their experience ranged from 1 to 48 years. In terms of mileage the subjects varied from below 3000 kms to 100000 kms. Finally, we had a mixture within the group of subjects that had points on their license and those that held a clean license history.

The simulator part of the experiment was divided into three main stages. These were: Orientation, Non-assistance and Assistance. This was further characterised by two series (1&2) where the driver experienced a range of critical and non-critical situations, but without any automation or assistance from the intelligent vehicle. Then in series (3&4) they once again experienced a range of critical driving condition, with assistance in the form of automatic breaking, steering control and speed reduction. Warning assistance was given by way of audio (beeps) and visual (flashing diode) signals. Finally the last section of series 4 ended with a near-collision scenario. After the simulator part, we again asked our subjects to fill in questionnaires and participate in semi-structured subjective interviews, where they had another opportunity to provide rich data on their perceptions of risk and control and their subsequent acceptance or need for ADAS.

3 Analysis

The environment that we refer to here concerns the physical features of the road (weather, geometry, signs and signals), the driver's own speed and direction, and the paths and speeds of other road users. As subject here we refer to the individual driver, while the instruments in question would be the ADAS and IVIS functions available within the experimental car. Our explicit goal here, or the object, would be to reduce accidents and injury on the road, thereby making the overall environment safer by endowing the subject with more informed decision-making powers. In Fig. 1 below we see this represented within the framework of the activity model.

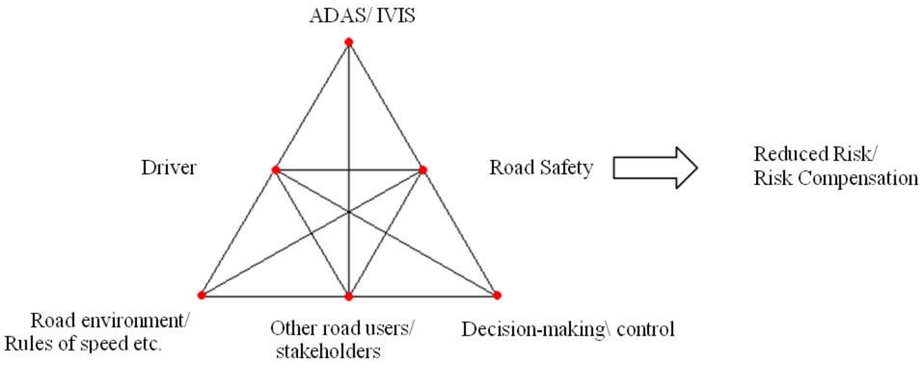

Fig. 1. ADAS Activity model

The outcome of the activity however is determined by the interactions between the various nodes. And given the subjective nature of risk it is not surprising that the final outcome of the activity could take form either in line with the desired object of activity or in tangent to it. For instance the perceived level of risk will be relatively low if the driver is confident about having the necessary coping skills, and higher in the case of those who doubt their abilities. This was precisely what was reported by one of our subjects during his self-assessment exercise:

“I consider myself a risk taker, however it is very important for me to be in control. Being in control for me means being aware of what is happening around me, to be at a speed that I can master and in general be in charge of the situation.”

Thus our subject was implying that risk taking was acceptable, in so far as the some of the variables were under his control. Taking this a step further, it is logical to argue that individuals differ not only in the accident risk they are willing to accept but also in their ability to *perceive* accident risk and in their decision-making and executive skills in the face of risk. Individuals differ in both willingness (i.e. acceptance) and ability (skill). However as situation awareness varies amongst drivers, so does their subject evaluation of the posed risk. Burger et al. [3], have found that those with a high desire for control exhibited a greater illusion of control (perceived control over chance events). The primary functionality of ADAS, as is understood at present, is to facilitate the task performance of drivers by providing real-time advice, instruction and warnings. This type of systems is usually also described by the term “co-driver systems” or “driver support systems”. Driver support systems may operate in advisory, semi-automatic or automatic mode [4], all of which may have different consequences for the driving task, and with that on traffic safety. Although the articulated object or goal of a driver support system is to have a positive effect on traffic safety, unintended effects have been shown on driver behaviour, indicative of negative effects on traffic safety [5]. Firstly, the provision of information potentially leads to a situation where the driver's attention is diverted from traffic. Secondly, taking over (part of) the driving task by a co-driver system may well produce behavioural adaptation. This behavioural adaptation, or compensation as it is called in a wider field, must be taken into account when investigating the conditions for introduction of ADAS [6]. When interviewed post simulation, one of our subjects outlined for us this very feature of compensation.

“When a system adds something that I don’t have, for instance in the case of fog, or night-time if a systems takes control, due to my inability to see well in poor conditions, I can accept that.”

The critical issue here is one of dependency on a technical artefact that could potentially lead to overlooking crucial variables and affecting the stakeholders in an adverse way. For instance there is now substantial evidence that the effect of risk compensation has been to shift part of the burden of risk from people in vehicles to vulnerable road users outside vehicles, leaving the total number killed in road accidents that could be attributed to seat belt legislation little changed [7].

4 Conclusion

Within this paper we've have seen how shifting perceptions on risk and control determine the efficacy and acceptance of ADAS systems. In terms of future directions for this research, we aim at continuing our analysis efforts both in terms of driver diversity in risk-taking, as well as in terms of user acceptance of ADAS. Parallel studies that were conducted using video tools and focusing on sensation-seekers and risk takers, will be integrated with the findings of this project at a wider level.

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