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Increasing Acceptance of Advanced Driver Assistance Systems by Making Use of Driver Profiles

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Abstract. The acceptance of intelligent systems is a condition for achieving the aims of these systems as for example, increase of safety and efficiency. This requires that we take into consideration that each driver has his or her own needs and interests while driving. In particular, persuasive strategies that are intended to increase the acceptance may influence one type of driver, but may not work at all for another type of driver. This paper presents an exploration of the design potential for applications that aims to increase the acceptance of intelligent driver assistance systems for both careful and risky drivers.

Keywords: Advanced Driver Assistance Systems (ADAS), Intelligent Systems, Design Space, Driving Styles, Persuasive Technologies.

1 Introduction

Advanced Driver Assistance Systems (ADAS), such as Cooperative ACC, are developed with the aim to increase safety, efficiency, driver comfort and to reduce driver’s workload. Most of these systems interact with the driver with the purpose to advise or assist the driver or even to take over control altogether in certain driving situations [1]. Increased use of ADAS may reduce traffic accidents and improve the traffic flow, indicated by a higher average speed and a decrease of the number of shockwaves leading to congestions [2]. An increase in the number of drivers who adopt such systems may therefore enhance the impact of these systems on traffic safety and traffic flow.

Persuasive technologies may be applicable to influence drivers to adopt such systems. Since people differ in their needs and interests, strategies that are intended to influence one type of driver to use intelligent systems may have no or even a negative influence on other types of drivers [3, 4]. For example, when an angry driver receives an advice to slow down to create a gap for another vehicle s/he may just neglect this advice and speed up to close the gap, while a careful driver will likely comply with this advice. Identifying differences between drivers, in terms of their driver profiles and tailoring strategies according to those profiles may help to increase driver’s compliance with intelligent systems in vehicles. Our aim is to explore the design potential for in-car applications to enhance the overall acceptance of intelligent systems by different types of drivers through the use of persuasive technologies.
2 Related Work

2.1 Behavior Change

Multiple studies have been conducted with the aim to change the behavior of people in different contexts. A probe study conducted by Gärtner et al. [5] revealed that driving behavior may change due to specific experiences such as accidents, the availability of supporting technology and learning the consequences of certain behaviors. Also, negative changes of behavior were reported: experience built up over the years can result in loss of attention; and while vehicles become safer, technologies such as mobile services decrease safety. In order to achieve a positive change of behavior, persuasive technologies may be applied, either as a tool, media or social actor [6]. Furthermore, Kaptein [4] showed that personalized persuasion can be more effective in motivating behavior change by creating tailored persuasive messages to influence people’s behavior, making use of the strategies defined by Cialdini [7].

2.2 Driving Styles

One way to personalize persuasion is to look at people’s driving style. Hooft van Huysduynen et al. [8] looked into different questionnaires to determine someone’s driving style. Using the MDSI they could identify six driving styles: Angry, Risky, Anxious, Dissociative, Careful and Distress-Reduction driving style. Depending on the driving styles, specific approaches and strategies may be explored to influence driving behavior. This paper will focus on two driving styles, the Risky and Careful driving style.

3 Design Space

The main difference between a careful and a risky driving style is the driving speed, as risky drivers most of the time drive at or faster than the maximum speed and careful drivers more often drive below the maximum speed [8].

A second dimension, addressing to what extent the behavior of the driver is intentional or unintentional, can be placed perpendicular to the dimension of careful versus risky driving. We assume that someone may drive intentionally risky as a result of wanting to be in time at the end destination and believing that through higher speed and faster acceleration this goal can be achieved, or wanting to achieve a certain level of arousal when driving. Others may drive riskily unintentionally because driving more inattentively / dissociative can result in less awareness of their actual speed, creating more variations in their speed. We consider that an intentionally careful driver mostly tries to maintain control of the vehicle in more difficult situations or aims at more sustainable driving through lower speed and acceleration in order to reduce the fuel consumption. As other drivers drive more carefully as they experience higher speed and smaller gaps as more scary and drive mostly unintentionally at a lower speed.
The four different quadrants resulting from these two dimensions each have their own characteristics, needs and experiences. Selecting the most suitable persuasion strategy for each quadrant is important. Looking at the Captology concept [6] that conceives computers as tools, media or social actors, four different strategies can be defined to personalize the persuasion to the four different design spaces. Tools can provide support to people while driving; media can provide stimulating experiences and social actors can motivate people through correcting behavior or by providing feedback about the effect of their way of driving.

![Fig. 1. Framework of Risky and Careful Driving Styles](image)

Drivers who are categorized as unintentionally risky drivers are less aware of their driving by, for example, distraction created by secondary tasks such as the use of a mobile phone while driving. Persuasion through correcting risky behavior may support these drivers in maintaining a more safe and careful driving. Corrections by the system should be noticeable by the driver; this can for example be done through a change in feedback force of the steering wheel or gas pedal. Intentionally risky drivers are aware of their driving behavior and mainly focus on pursuing their goal. For example, trying to be at their destination as fast as possible or maintaining the preferred level of arousal. If intelligent systems in vehicles aim to induce a more careful driving style, it may create a mismatch with this type of driver. To support the compliance for this type of driver a system could be designed that creates an experience that substitutes the experience of risky driving. For example, creating a light beam in the vehicle through which light will move at a faster rate than the driven speed. This may produce a feeling of speed higher than the actual speed. Unintentionally careful drivers tend to be more anxious when driving, resulting in lower speed. In order for intelligent systems to effectively support them in their driving it is important that this type of drivers trust the system. To support the compliance of intelligent systems for this type of driver a system should support and create trust. For example, by creating an auto pilot that will take over the task initiated by the driver. As a last example, intentionally careful drivers tend to drive sustainably, for example, by focusing on the goal to reduce fuel consumption. Intelligent systems support the reduction of fuel consumption; in addition, we assume that these drivers also prefer keeping control / having high situation awareness. To support compliance with intelligent systems, for this type of driver extra information should be provided to keep the driver in the loop without the driver actually driving. For example, through sounds, visual or haptic
feedback in the car seat the driver is always informed about vehicles or other obstacles around the vehicle.

4 Conclusion & Future Work

In this paper we propose a framework defining four different design spaces that may be taken into consideration when designing persuasive technologies for vehicles as different driver differ in needs and interests. In this framework the driving styles Risky and Careful constitute one dimension. Perpendicular to the dimension of Risky and Careful driving a second dimension was created indicating intentional versus unintentional driving behavior. These two dimensions create four different design spaces around four different driver profiles which can support the exploration of the design potential for in-car applications.

The next step is to verify the assumptions of the different needs and interests within the four different design spaces. Next to that we want to design concepts according to the four different design spaces and evaluate the influence on the acceptance of intelligent systems in vehicles. Secondly, we aim to understand the effect of those concepts when they are not in line with the driver’s driving style.

References