Using Driving Styles to Support Behaviour Change in Vehicles

Hanneke Hooft van Huysduynen

Technische Universiteit Eindhoven, Eindhoven, The Netherlands
H.Hooft.van.Huysduynen@tue.nl

Abstract. The transfer of control from the driver to the vehicle associated with autonomous driving results in a major change of driving experience. This change may have an adverse effect on the compliance of drivers to use intelligent systems in vehicles as the driving style induced by these systems does not always correspond with the needs and interests of each driver. Personalized persuasion may be used to increase the willingness of drivers to adopt intelligent systems, taking in account that different drivers maybe responsive to different persuasion strategies.

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

1 Introduction

Intelligent systems in vehicles allow drivers to delegate more tasks to the vehicle itself, resulting in a change of driving experience compared to manually driven vehicles. Besides the change in the experience of driving, the transfer of the control from the driver to the vehicle will also change the need for certain skills. Intelligent systems are starting to perform activities as steering, accelerating and braking, creating automated vehicles in which the driver's role changes from an actuator to an observer, and ultimately to a passenger [1]. This development will change the relation between the driver and the vehicle and therefore the driving experience. Experiences when driving a car manually could disappear or perhaps be partially replaced by new types of experiences when sitting in a fully automated vehicle [2]. These new experiences may not always be positive experiences, possibly resulting in drivers neglecting or putting off systems which are designed with the aim to support drivers and increase safety, efficiency and comfort.

The transfer of control from the driver to the vehicle already started with the introduction of navigations systems. With the introduction of these systems, the route to drive is now determined by a system instead of the driver or passengers. Other types of intelligent systems are, Cruise Control (CC), Adaptive Cruise Control (ACC), Blind Spot Warning, Lane Departure systems, etc. The increased use of, for example, ACC may have a positive contribution to the traffic flow conditions and the reduction traffic accidents that will be indicated by a higher average speed and a decrease of the

adfa, p. 1, 2011.

number of shockwaves leading to congestions [3]. The increase in the number of drivers accepting and using intelligent systems may therefore enhance the impact on safety and the traffic flow.

For several reasons drivers may decide to neglect the advice or assistance provided by intelligent systems reducing the overall benefits of these systems. The use of Persuasive Technologies in vehicles may be helpful in increasing acceptance of intelligent systems, increasing the overall benefits of these systems. Next to that it has to be taken in account that drivers can have different needs and interests which may result in a difference in sensibility for different persuasive technologies. By identifying differences between drivers, making use of personalized persuasion can enhance the overall acceptance of intelligent systems.

2 Behaviour Change

Gärtner et al. [4] conducted a probe study that revealed that driving behavior can change due to specific experiences such as accidents, the availability of supporting technology and learning the consequences of certain behaviors. The study also reported negative changes of behavior as experience built up over the years may result in loss of attention; and while vehicles itself become safer, technologies such as mobile services decrease safety.

Multiple studies about persuasive technologies focus on one strategy or design not aiming at specific user groups. It has been shown that tailored, more personalized persuasion is more effective in motivating behavior change [5]. As people differ in needs and interests, what might influence one person may not work at all for someone else [6]. To the extent that advice or assistance of intelligent systems in vehicles asks drivers to deviate from their own way of driving, the use of intelligent systems may be jeopardized. For example, if an advice is given to reduce the speed, a driver who normally drives at higher speeds will perhaps neglect this advice as it is not in line with his or her typical driving behavior.

Fogg mentioned that to positively influence behavior, persuasive technologies may either act as a tool, media or social actor [7]. The goal of a tool is support the user with their activity, making tasks easier to perform; media can provide stimulating experiences through information; and a social actor provides feedback and provides social support. Within each of the three different roles multiple ways can be defined to persuade people.

Kaptein [5] showed that personalized persuasion may 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 [8]. Cialdini identified six influence strategies; reciprocity, consistency and commitment, social proof, liking, authority and scarcity. These strategies are based on human preference for automatic, shortcut responses to messages.

3 Driving Styles

There are multiple ways to categorize drivers for personalizing persuasion. One option is to make use of driving styles. The study of Hooft van Huysduynen et al. [6] identified six different driving styles; Angry, Risky, Anxious, Dissociative, Careful and Distress-Reduction driving. (1) Angry drivers show angry and frustrated behavior when driving, indicated by swearing, signaling with light to other road users and making more frequent use of the horn. (2) Risky drivers show more risky and thrill seeking behavior indicated by higher speeds and more dangerous behaviors as skirting. The speed limit is often violated as drivers do not always perceive the risks of the road conditions and judge them lower, resulting in a higher speed than allowed [9]. (3) Anxious drivers show nervous and anxious driving behavior indicated by the feeling of distress and worrying while driving. Gwyther et al. [10] mentioned that drivers who are less confident will tend to over-regulate driving resulting in maladaptive responses. (4) Dissociative drivers show nonchalant, dissociated driving behavior indicated by inattentiveness followed by for example errors in gear shift or abrupt braking as the driver was unware of a more demanding situation in front of him [11]. (5) Careful drivers show careful and cautious behavior when driving indicated by attentive and responsive driving and safe speed. (6) Distress-reduction drivers show driving behavior supporting them relax more indicated by trying to relax through, for example, muscle relaxation techniques or meditation.

3.1 Personalized Persuasion

According to the different driving styles mentioned above, different persuasion strategies may be implemented by selecting the most suitable persuasion to influence the acceptance of intelligent systems.

Angry drivers may be persuaded by providing information about their driving and the difference in time when driving more carefully may help these types of driver to change their behavior and accept advice or assistance from intelligent systems. Risky drivers could be persuaded through a substitution of the experiences originated from with these types of behaviors. Anxious drivers may be persuaded through support creating more confidence in driving. Dissociative drivers may be persuaded through correcting their behavior and providing noticeable feedback when they are engaged in secondary tasks. Careful drivers may be persuaded to maintain their behaviors by informing them about the positive results of their behaviors. And at last Distress-reduction drivers may be supported in their driving by reducing the mental workload allowing them to become more relax.

4 Discussion

As intelligent systems in vehicles are developing and vehicles become more autonomous, the experience and use of vehicles is changing along. These changes may result in a deviation of driving behavior of intelligent systems from the way a driver wants

to drive. This may result in the possibility that the driver will neglect advice or assistances or even not use those systems at all. Persuasive technologies can be used to support acceptance of intelligent systems, enhancing the compliance. Creating personalized persuasion can affect the overall acceptance of intelligent systems as people differ in needs and interests and therefore will be sensitive to different persuasion strategies [5].

Distinguishing different drivers to personalize persuasion can be done in multiple ways. One approach is to distinguish drivers according to their driving style. However, personalized persuasion can also be based on human preference for automatic, shortcut respondings as used by Cialdini [8], who identified six different influence strategies. Another approach is to create personalized persuasion according to driver's goals when stepping into a vehicle. Someone's goals and motivations often determine someone's driving behavior as those goals and motivations determine the threshold of accepting certain behaviors [12]. During driving, these goals and motivations may change according to changed situations and environments. Dogan [13] revealed that in urban areas people prioritize safety when the traffic environment is perceived as more complex compared to highways where time is more often prioritized as driving goal. This makes that personalized persuasion may be adaptive not only according to the person driving the vehicle but also according to the situation and context which influencing the goals prioritized by the driver. This shows that there are multiple directions which can be taken with personalized persuasion within automotive. It is interesting to learn the differences in effectiveness of these different approaches to categorize drivers.

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