Distracted Drivers and Autonomous Vehicles

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Abstract
In autonomous vehicles, machines take over driving tasks from the human driver. This can potentially reduce the driver's workload and reduce the number of accidents that result from human error. However, with partial automation, drivers are occasionally required to take over driving. The psychological and driving literature suggests that in these hand-over situations, response times are relatively long when compared to non-automated driving. In our work we try to further the understanding of such situations. For example, by investigating what causes this slow-down, and under what conditions humans respond faster and more accurate. This can inform the design of safer (semi-) autonomous vehicles.

Author Keywords
autonomous driving; distraction; multitasking; automation; attention.

ACM Classification Keywords
H.1.2 [User/Machine Systems]: Human information processing; H.5.2 [User Interfaces]: Theory and methods; I.2.9 [Robotics]: Autonomous vehicles

Introduction
Traffic accidents are a leading cause of death among young adults worldwide [12]. One promise of

autonomous vehicles is that they can provide a safer driving experience when taking over driving from humans. When programmed well, a machine cannot be drunk and drive, will obey traffic laws, and - more generally - will not make human errors.

However, there are many forms of (semi-) autonomous driving and in all forms except full automation, the driver can or has to take over some driving tasks [10]. This still leaves the potential for human error and potential accidents.

One aspect that we and others (e.g., [9]) are concerned with in particular in this context is the distracted or multitasking driver, as we have also motivated recently at the automotive-UI conference workshop on autonomous driving [4]. Even in non-autonomous vehicles, drivers frequently distract themselves with a variety of (non-driving related) tasks such as eating, smoking, conversations, and looking up and entering information on their phones [8]. These distractions increase the risk of a crash, especially for novice drivers [8]. The frequency of in-car multitasking and distraction is likely to increase with an increase of autonomy of the car, as the driver has fewer and fewer driving tasks to take part in. Moreover, it would continue to trend of frequent multitasking that is observed in driving and other domains (for a recent special issue on the various domains in which multitasking occurs, see [6]).

The danger of such increased distraction is that the driver might not be prepared for a sudden handover. Their mind is processing other tasks when in-car alerts try to get them to pay attention to driving. Indeed, a recent meta-review suggest that distraction increases in higher level autonomous cars (e.g., SAE level 3), and that reaction times to unexpected events decrease with increased automation [2].

In our work we try to understand what contributes to these slow reaction times. At the moment we are running empirical studies with a simulated driving set-up to investigate how well participants respond to signals in general in distracted and undistracted driving. We analyze behavioral measures (e.g., reaction times) and physiological measures (e.g., EEG). The results can then inform the design of safer (semi-) autonomous vehicles, road design, and in-car technology.

About the authors

Christian Janssen is an assistant professor of experimental psychology at Utrecht University. His background is in artificial intelligence, cognitive modeling, human-computer interaction, and psychology. His research focuses on understanding human multitasking in general (e.g., [3,6]) and in driver distraction settings in particular (e.g., [1,5,7]). He has worked with partners in industry and in government to study these domains.

Remo van der Heiden just started as a PhD student at Utrecht University. His PhD research will investigate how well people detect and react to events in (semi-) autonomous vehicles, together with partners in government. His background is in computer science, artificial intelligence and applied psychology. His Masters thesis research investigated how quickly drivers change lanes after they receive visual in-car alerts that lanes are closed [11].

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