

Drivers' attitudes toward imperfect distraction mitigation strategies

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Abstract

Studies were conducted to assess driver acceptance of and trust in distraction mitigation strategies. Previous studies have shown that in-vehicle tasks undermine driver safety, and that there is a need for strategies to reduce the effects of in-vehicle distractions. Trust and acceptance of such strategies strongly influence their effectiveness. Different strategies intended to reduce distraction were categorized in a taxonomy. Focus groups were conducted to help refine this taxonomy and explore driver acceptance issues related to these strategies. A driving simulator experiment was then conducted using two of the strategies: an *advising* strategy that warns drivers of potential dangers and a *locking* strategy that prevents the driver from continuing a distracting task. These strategies were presented to 16 middle-aged and 12 older drivers in two modes (auditory, visual) with two levels of adaptation (true, false). Older drivers accepted and trusted the strategies more than middle-aged drivers. Regardless of age, all drivers preferred strategies that provided alerts in a visual mode rather than an auditory mode. When the system falsely adapted to the road situation, trust in the strategies declined. The findings show that display modality has a strong effect on driver acceptance and trust, and that older drivers are more trusting and accepting of distraction mitigation technology even when it operates imperfectly.

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1. Introduction

Driver distraction can be defined as the diversion of driver attention away from the driving task and can be characterized in several ways. Both a driver's willingness to engage in a non-driving task and the attentional demands placed on the driver by that task contribute to the potential for distraction. Drivers do not always appropriately divide their attention between potentially conflicting activities, creating hazardous situations. The introduction of advanced technologies (e.g., navigational displays) to the driving domain raises additional

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concerns, because such systems may reduce driving safety by distracting the driver in critical situations and requiring too much driver attention (Verwey, 2000). It is, therefore, important to develop distraction mitigation strategies that will help reduce driver distraction.

Driver distraction mitigation strategies are diverse. Approaches to mitigating the effects of distraction may consider in-vehicle devices as conversational partners, and use concepts of communication theory to reduce distraction (Wiese & Lee, *in press*). According to this approach, distraction might be reduced if in-vehicle devices included some of the same conversational mechanisms that people use to coordinate their interactions. Another approach is to consider distraction mitigation strategies as a form of automation. Such automation adapts to the driver or to the roadway situation to encourage drivers to attend to the road and respond to critical roadway demands. Extensive research concerning automation in other domains can provide insights into how drivers may use or rely on distraction mitigation strategies that may or may not adapt appropriately (Sarter, Woods, & Billings, 1997; Sheridan, 2002).

Trust is a particularly important factor influencing the use of and the reliance on automation, and can also impact the effectiveness of different strategies. Miscalibrated trust and the potential for misuse and disuse of automation may result in a failure to provide expected benefits (Parasuraman & Riley, 1997). As distrust may lead to the disuse of the automation, mistrust can lead to a failure to monitor the system's behavior properly and to recognize its limitations, thereby leading to inappropriate reliance on the system (Lee & See, 2004). Over-reliance on the system might amplify risk-taking behavior as the driver places more trust in the automation. In situations of over-reliance, the failure of high levels of automation might lead to more severe safety problems than lower levels of automation. High levels of automation may also lead to lower situation awareness (Endsley, 1995) and greater dependence, thereby generating more opportunities to engage in risk-taking behavior. However, situations with time-critical elements (e.g., impending crash) do require higher levels of automation (Moray & Inagaki, 2003). If the system senses a near-fatal situation, the level of automation should be high enough to take control immediately. That is, if the driver is going to crash, the vehicle should take action.

Appropriate reliance on automation also depends on the performance of the automation and whether or not it is adapting appropriately to the driver state and situational demands. A system that falsely adapts takes action when there is no need, or takes inappropriate or no action when there is a need. False system adaptation undermines drivers' response to and acceptance of the system, which in turn influences overall system effectiveness (Parasuraman, Hancock, & Olofinboba, 1997). False adaptation includes both false positives (an alarm given when no impending collision is present) and false negatives (an alarm not given when an impending collision is present). In these scenarios, distrust and disuse can result from high false-alarm rates. Due to the low base rate of collision events, the probability of a collision when a warning is given can be quite low, while the false-positive alarm rate can be quite high, even if the warning system is highly advanced. High false alarm rates can also lead to driver frustration, which is itself a type of emotional distraction that can undermine traffic safety (Burns & Lansdown, 2000).

False adaptation and diminished trust can undermine driver acceptance. Driver acceptance depends on ease of system use, ease of learning, perceived value, advocacy of the system or willingness to endorse, and driving performance (Stearns, Najm, & Boyle, 2002). Each of these components presents complex behavioral phenomena which impact the joint performance of the driver and in-vehicle technology. Acceptance interacts with trust such that low levels of acceptance lead to disuse. Higher levels of trust, however, do not necessarily lead to greater acceptability of technology (Siegrist, 2000). Therefore, driver acceptance of a distraction mitigation strategy should be assessed before the strategy is implemented.

Driver acceptance can also be influenced by the presentation modality. If the strategy uses an alarm or a display that is perceived as demanding (i.e., ease of use), or non-intuitive (i.e., ease of learning), acceptance will be low. Some of the most common modalities employed in warning systems and displays are visual and auditory (Wickens & Hollands, 1999). Because visual warnings demand the same cognitive resource as the driving task, these strategies may be less effective (Wickens, Lee, Liu, & Gordon, 2003). However, even though auditory warnings are omni-directional, and hence may be more effective, some sounds may be annoying (Berglund, Harder, & Preis, 1994), particularly highly urgent warnings (Wiese & Lee, 2004).

Age is also a factor that affects attitudes towards technology. In general, older adults have less positive attitudes towards technology (Brickfield, 1984; Kantowitz, Hanowski, & Kantowitz, 1997). Other studies have

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