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Could Intelligent Speed Adaptation make overtaking unsafe?

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ABSTRACT

This driving simulator study investigated how mandatory and voluntary ISA might affect a driver's overtaking decisions on rural roads, by presenting drivers with a variety of overtaking scenarios designed to evaluate both the frequency and safety of the manoeuvres. In half the overtaking scenarios, ISA was active and in the remainder ISA was switched off. A rural road was modelled with a number of 2 + 1 road sections, thus allowing drivers a protected overtaking opportunity. The results indicate that drivers became less inclined to initiate an overtaking manoeuvre when the mandatory ISA was active and this was particularly so when the overtaking opportunity was short. In addition to this, when ISA was activated drivers were more likely to have to abandon an overtaking, presumably due to running out of road. They also spent more time in the critical hatched area—a potentially unsafe behaviour. The quality of the overtaking manoeuvre was also affected when mandatory ISA was active, with drivers pulling out and cutting back in more sharply. In contrast, when driving with a voluntary ISA, overtaking behaviour remained mostly unchanged: drivers disengaged the function in approximately 70% of overtaking scenarios. The results of this study suggest that mandatory ISA could affect the safety of overtaking manoeuvres unless coupled with an adaptation period or other driver support functions that support safe overtaking.

1. Introduction

An individual driver's choice of speed has been found to be relatively stable over time (Wasielewski, 1984; Haglund, 2000) but there are large differences between drivers. These differences can be due to the influence of relatively stable factors such as age (Parker et al., 1992), gender (Shinar et al., 2001) and personality (Dahlen et al., 2005) or transient factors such as impairment (Philip et al., 2005) and distraction (Patten et al., 2004). Aspects of the road environment such as the perceived level of enforcement (Keall et al., 2001), road width (Pau and Angius, 2001) and roadside furniture (Elliott et al., 2003), also impact on speed choice. However, whilst these factors can influence speed choice, ultimately the driver retains control of its modulation.

This freedom of speed choice can mean that drivers misjudge or intentionally exceed the speed appropriate for a given situation and this can expose them to risk. For example, Mosedale and Purdy (2004) report that erroneous speed choice is a contributory factor in 18% of UK rural road accidents, with overtaking being one of the most risky manoeuvres. Clarke et al. (1998) report that overtaking accidents accounted for almost 10% of fatal road accidents in their dataset and concluded that "the majority arose from a decision to start the overtake in unsuitable circumstances" (Clarke et al., 1999). The authors conclude that these errors are due to poor timing and speed choice, as opposed to poor vehicle handling skills.

Overtaking is a complex task, with the driver needing to monitor their interaction with a lead vehicle, estimate the time to collision of any oncoming vehicles and take into account the time required to complete the overtake based on their own speed and skill level. A task analysis undertaken by Hegeman et al. (2005), outlines five distinct phases of an overtaking manoeuvre, comprising almost twenty subtasks. With regard to speed, only some of these subtasks are of relevance to this paper, relating to a driver's desired speed (i.e. if the car in front impeding this) and their willingness to exceed this desired speed if necessary (i.e. in order to overtake).

When overtaking, a driver will want to minimise the time they spend in the opposing lane and this may lead them to increase their speed, even if that requires them to exceed the speed limit on approach to the lead vehicle and as they pass it. However, when drivers are estimating the safety of a potential overtake, high speed reduces the amount of time available to make the decision and then execute the manoeuvre. Studies have shown that drivers, whilst being sensitive to variations in distance to an oncoming vehicle, are much more prone to inaccuracy in their estimates of the speed (Farber and Silver, 1967; Berggrund and Rumar, 1973; Quenault et al., 1973). Farber and Silver (1967) report that drivers could not discriminate between vehicles travelling at 50 or 100 km/h. This implies that drivers not only reject safe passing opportunities but also engage in unsafe overtaking where the speed of the oncoming vehicle is faster than estimated.

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