Automated driving, secondary task performance and situation awareness

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Abstract

This paper describes a study which examined the effect of a demanding non-visual secondary task (Twenty Questions Task) on drivers' situational awareness during varying levels of vehicle automation. Using the University of Leeds Driving simulator, two groups of drivers (Total N = 50) participated in three separate simulated drives. The driving task was either (i) *manual*, with drivers in full command of all normal vehicle controls (ii) *semi automated*, where longitudinal (Group 1) or lateral (Group 2) handling of the vehicle was managed by an automated system or (iii) *highly automated*, where both lateral and longitudinal control of the vehicle were maintained by the system, which kept the vehicle in the lane centre and maintained a set speed and a safe distance from lead cars. Drivers' situation awareness was measured in terms of their response to a series of critical incidents in the road. Results showed that, overall, performance measures in the manual condition were different to those in the semi and highly automated drives, and that performance deteriorated in the presence of the higher workload imposed by the secondary task. Interesting differences were also observed between the two semi automated drives, linked to the driving performance measure under investigation.

Introduction

There has been a growing trend in recent years to implement more and more automated systems within vehicles, in order to increase driver comfort and improve safety. In most cases, one or more aspects of the driving task can be assigned to the vehicle by the driver, or are instigated by the vehicle/system itself, at appropriate moments in the drive. For example, drivers may use an Adaptive Cruise Control (ACC) on motorways to drive the vehicle at a certain speed and maintain a designated time headway from lead vehicles. The ACC can also be combined with a Forward Collision Warning to warn drivers of an impending collision. Whilst some such systems, such as those using radar for collision avoidance, are now more common place, others, such as Lane Keeping Systems (LKS) that continuously assist the driver by keeping the vehicles in a centred position in the lane, are yet to be implemented and are still very much at the research and development stage.