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Driver-training and emergency brake performance in cars with antilock braking systems

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Abstract

The purpose of this study was to assess the effects of a two-day post-license driver-training program on brake performance in cars with antilock braking systems (ABS). A trainee group ($n = 26$) and a control group ($n = 13$) participated in the experiment. The trainee group were enrolled in a two-day training course that included instruction in a braking technique that may be used in cars with and without ABS. All participants performed emergency brake tests from 80 and 100 km h^{-1} in an instrumented car before and after the training period. Results indicated the post-training group used a smoother braking profile, were less reliant on ABS activation, had enhanced postural stability, but took about one car length longer to stop from 100 km h^{-1} compared with the control group. Implications of these results for braking in cars with and without ABS, and for driver education programs in general are discussed.

Keywords: Driver-training; Road safety; Emergency braking; Postural stability; Driving skill

1. Introduction

Driver-training and education programs are available in most jurisdictions, and offer the attractive possibility of improved road safety (Mayhew et al., 1998). However, conclusions

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based on randomised controlled studies of the effect of post-license driver education on road injuries and crash statistics tend not to support this view (Ker et al., 2005). It has even been reported that driver education (DE) can have a negative effect of road safety through the development of overconfidence or underestimation of risk amongst trained drivers (Gregersen, 1996). As a consequence, some researchers have questioned the value of DE as an effective road safety intervention strategy (Williams and Ferguson, 2004).

In contrast, others have argued that instead of evaluating old forms of driver education, attention should be given to the development and evaluation of new driver education programs (Hirsch, 2003; Robinson, 2002). This development and evaluation process is essential because newer programs are more likely to reflect recent advances in understanding of crash risk factors. Indeed, recent studies report significant benefits of driver-training in terms of reduced crash statistics (Carstensen, 2002) and enhanced simulated driving performance (Dorn and Barker, 2005). Since it is generally acknowledged that basic driving skill is an important requirement for safe driving, the question therefore arises as to what skills should be taught and practiced in DE.

An important skill taught within most driver-training programs is correct brake technique. Of primary importance is to avoid wheel lock due to rapid brake pedal depression in order to prevent loss of steering control associated with skidding (Gardner, 1998). The importance of controlling car balance (forward shift of car weight), thereby improving stopping power is also emphasised. In cars without antilock braking systems (ABS), this is achieved by brake pressure regulation, which can include the well-known skid countermeasure of pumping the brakes when the driver first feels the wheels lock. In cars fitted with ABS, firm brake pedal pressure activates the ABS, which in turn prevents skids by mechanical regulation of brake pressure. ABS has been widely reported to enhance braking and steering, especially on slippery surfaces (Broughton and Baughan, 2002; Mollenhauer et al., 1997). However, there is evidence that drivers of cars fitted with ABS adapt their behaviour in ways that offset the intended benefits of the ABS (Sagberg et al., 1997). Crash statistics also suggest that cars fitted with ABS are at greater risk of certain types of accidents such as crashes fatal to their occupants, rear end impacts, single vehicle crashes and run-off-the-road accidents (Delaney and Newstead, 2004; Evans and Gerrish, 1996; Farmer et al., 1997). It has also been reported that while ABS has the potential to reduce accidents, this may not have been achieved because of limited knowledge and/or improper operation of ABS (Broughton and Baughan, 2002; Harless and Hoffer, 2002). From a DE perspective, this raises the question of how drivers should be trained in the use of ABS, and to what extent braking technique is transferable between vehicles with and without ABS.

In addition to teaching braking technique, some driver-training programs emphasise the importance of maintaining postural stability during critical situations. For example, during an emergency brake task, individuals can increase their stability during rapid car deceleration by the use of brace forces applied by the legs against the car (Treffner et al., 2002). The rationale for this technique is that a driver who is posturally stabilised via the lower body does not need to stabilise themselves by tightening the grip on the steering wheel, and is therefore able to keep the hands more relaxed and steer more effectively. This transition from a posture where the upper and lower limbs operate as a single, stiffened degree of freedom to one where the upper and lower body can work independently (through a freeing of the relevant degrees of freedom), is seen as an essential component in development of skilled motor performance (Kelso et al., 1979; Ko et al., 2003; Newell, 1986; Newell and McDonald, 1994). The result of this coordination strategy is that the lower limb functions