Can drivers modulate the effect of a motor priming assistance device during lane departure?

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Abstract

Traditional Lane Departure Warning Systems are designed to improve the driver's assessment of vehicle position. Motor priming (MP) devices, consisting of fast directional oscillations on the steering wheel, are also hypothesized to directly trigger the corrective motor response. The efficacy of MP has been proven (Navarro et al., 2007, 2010). It remains to determine whether drivers would be able to modulate or inhibit the effects of MP effects when necessary (e.g., weak risk, system failure). In two simulator studies, the effect of two levels of MP strength was studied in lane departure situations. First, we addressed the question of how the effect of MP could be modulated by expected risk. Second, we determined whether an erroneous directional cue could be inhibited and countered. Results showed that MP reduced lane excursion duration, to a greater degree with strong MP than light MP. The lower the expected risk, the higher was the duration of excursion, whatever the strength of the motor cue. Drivers inhibited their steering response and countered MP when its direction was erroneous. In some cases, due to shorter reaction times, the duration of lateral excursions was reduced even with the invalid cue. Thus, MP improved recovery manoeuvres, whilst drivers remained in full control of steering. This suggests a modulation of the effect of MP by higher levels of cognitive control.

Introduction

According to Najm, Smith, and Yanagisawa (2007), in the United States, 66% of accidents involving just one light vehicle are related to road departure. As a solution, driver assistance systems are becoming more and more sophisticated. Various kinds of devices are being developed and these systems can be positioned on a continuum according to their degree of intervention (Hoc, Young, & Blosseville, 2009). For example, lane departure warning systems (LDWS) are created to improve drivers' alertness when a situation becomes dangerous. By way of contrast, lane keeping systems (LKS) share control of the vehicle with drivers (Griffiths & Gillespie, 2005). These are aimed at improving on simple warning systems with only minimal intervention on the steering wheel; such a system, called "motor priming" (MP), has been designed by Navarro, Mars, and Hoc (2007). MP triggers small asymmetric oscillations on the steering wheel when the car is about to cross one of the lane edge lines. The first movement of the steering wheel and every second movement are directed toward the road centre, with a stronger torque and speed than those directed

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