

The existence and impact of the Psychological Refractory Period effect in the driving environment

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Abstract

Driver distraction from in-vehicle tasks can have negative impacts on longitudinal and lateral vehicle control and brake reaction time. The distraction problem is well-established in the literature, and is increasing due to advances in the functionality, availability, and number of in-vehicle systems. One approach to a solution is managing in-vehicle task presentation to reduce associated distraction. This paper reports a driving simulator experiment, designed to investigate the existence of the Psychological Refractory Period (PRP) in the driving context and its effect on driver performance. The PRP effect is observed when a surrogate in-vehicle task is presented in close temporal proximity to a lead vehicle braking event. Brake responses are subject to an increasing delay as the interval to an in-vehicle task is decreased. In-vehicle task modality modulates this effect. The impact of the PRP effect on driving performance is quantified and recommendations are made for reducing the driver distraction problem through the management of in-vehicle task timing and modality. The potential impact of these results on driver safety is discussed.

Introduction

Driver distraction

Driver distraction due to interaction with systems inside the vehicle has been the subject of research for nearly half a century (Brown, 1965) and has recently become a topical issue at both the academic and governmental level. Driver distraction is estimated to play a contributory role in approximately 25% of vehicle crashes (Stutts et al., 2001), with in-vehicle systems proving to be a prominent source of distraction (Klauer et al., 2006, Neale et al., 2005). The exact contribution of driver distraction to unsafe driving behaviours is difficult to quantify given widespread inconsistencies in the precise definition of the construct (Regan et al., 2011) and the reporting protocols used following vehicle accidents. Furthermore, the safety costs of distracted driving are likely to be under-estimated in the current statistics (Stutts et al., 2001). However, the negative impact of in-vehicle driver distraction on driving performance is indisputable, with examples of degradation of longitudinal and lateral control (Horrey & Lesch, 2009, Lansdown et al., 2004), reduced event detection (Horrey et al., 2008, McKnight & McKnight, 1993) and slower braking