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Investigating risky, distracting, and protective peer passenger effects in a dual process framework

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ABSTRACT

Prior studies indicated higher collision rates among young novice drivers with peer passengers. This driving simulator study provided a test for a dual process theory of risky driving by examining social rewards (peer passengers) and cognitive control (inhibitory control). The analyses included age (17–18 yrs, n = 30; 21–24 yrs, n = 20). Risky, distracting, and protective effects were classified by underlying driver error mechanisms. In the first drive, participants drove alone. In the second, participants drove with a peer passenger. Red-light running (violation) was more prevalent in the presence of peer passengers, which provided initial support for a dual process theory of risk driving. In a subgroup with low inhibitory control, speeding (violation) was more prevalent in the presence of peer passengers. Reduced lane-keeping variability reflected distracting effects. Nevertheless, possible protective effects for amber-light running and hazard handling (cognition and decision-making) were found in the drive with peer passengers. Avenues for further research and possible implications for targets of future driver training programs are discussed.

1. Introduction

Young novice drivers have a higher risk of collisions when they drive with peer passengers (Lee and Abdel-Aty, 2008; Simons-Morton et al., 2011). Furthermore, the risk of a fatal collision increases with the number of peer passengers (Chen et al., 2000; Tefft et al. 2013) and, for male drivers with male passenger (Ouimet et al., 2010). Although the effect of peer passengers on non-fatal collisions is less established (Durbin et al., 2014), injury risk also increases with peer passengers (Durbin et al., 2014; Orsi et al., 2013).

1.1. Dual process theory of risky driving

A dual process theory of risky driving provides a theoretical framework for the peer passenger effect by considering the imbalance between the development of the social-affective brain and the cognitive control system (Cascio et al., 2014; Lambert et al., 2014). A maturational gap between these brain systems causes this imbalance. The brain's socioemotional reward system shows early adolescent remodeling while the cognitive control system (e.g., inhibitory control, working memory, mental flexibility, and planning) matures more gradually. Neurocognitive evidence indicates that these cognitive functions improve until young adulthood (Albert et al., 2013; Bugg and Crump, 2012; De Luca and Leventer, 2008; Glendon, 2011). Adolescents and young adults were found to be prone to risk taking in response to highly social-affective situations when impulses were not appropriately inhibited by cognitive control (Albert et al., 2013; Figner et al. 2009). This was observed, even when probabilities of negative outcomes were known (Smith et al., 2014).

Jongen et al. (2011) provided initial support for a dual process theory of risky driving by showing that a momentary reward increased risky driving (i.e., speeding and red-light running) in young novice drivers, while cognitive control interacted with driving performance (i.e., lower inhibitory control related to increased lane-keeping variability). However, they did not include a full test of a dual process theory of risky driving, which would include cognitive control and a social-emotional reward context, for example a peer passenger manipulation (Lambert et al., 2014). Cascio et al. (2014) included peer passengers and found that increased inhibitory control overrode risky driving tendencies when a cautious peer was present. However, their study only included

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red-light running, therefore including only a limited reflection of the complex driving environment.

1.2. Confounding factors

According to Orsi et al. (2013), several factors might confound the peer passenger. First, within-group differences are expected to exist in young novice drivers (i.e., aged 17–25). Although recent analysis indicated that young adults displayed the highest levels of risk taking behavior (e.g., alcohol and drug use), young adults are probably less driven by situational conditions involving peers when compared with younger adolescents (Willoughby et al., 2013). Indeed, as the cognitive control system matures into young adulthood, resistance to peer influence gradually grows (Figner et al., 2009). Therefore, it was hypothesized that age would relate negatively to risky driving, with the younger segment of the range showing riskier driving when accompanied by peer passengers.

Second, novice drivers lack driving experience. As some aspects of driving are not fully automated and require a greater investment of attention, novice drivers lack spare resources to deal with the increased complexity of the driving task when adding a peer passenger (Orsi et al., 2013; Ross et al., 2014), possibly leading to increased risky driving.

Third, driver and passenger sex influence the outcome of the peer-passenger effect. Males drivers, compared with female drivers, were found to weigh the benefits of risk taking more heavily than the costs (Gardner and Steinberg, 2005) and to engage more in risky driving when accompanied by peer passengers (Curry et al., 2012). When considering passenger sex, male peer passengers were found to increase risky driving (e.g., speeding, tailgating) (Conner et al., 2003; Simons-Morton et al., 2005). Collision outcome was also found to be more severe in the presence of male passengers, probably due to increased risky driving (Orsi et al., 2013).

1.3. Peer passenger effects: mixed results

Previous studies indicated effects of peer passengers beyond risky driving. The risk-increasing effect of peer passengers can be caused by an increased tendency of risky driving or by the presence of distracting effects (Buckley et al., 2014; Orsi et al., 2013). Several studies indicated increased risky driving behaviors in young drivers when accompanied by peer passengers. For example, a stronger tendency for red-light running was established in a driving-related version of the videogame Chicken' (Chein et al., 2011). Other research found that increased risky driving was mainly present with risk-prone peer passengers. For instance, Shepherd et al. (2011) reported increased scores on a risk index that combined collisions and maximum speed during a simulated drive that included risk-prone peer passenger. Drivers in these cases may be encouraged to drive faster and not to worry about collisions.

Studies also described the distracting effects of peer passengers (Durbin et al., 2014; Heck and Carlos, 2008). It was stated that the presence of peer passengers might prevent drivers from devoting sufficient attention to the driving task, either by inducing visual (e.g., eyes off road) or cognitive (e.g., conversation) distraction (Durbin et al., 2014; Orsi et al., 2013). These distracting effects can differ for males and females. Male drivers tend to be more externally distracted, whereas female drivers tend to be more internally distracted, by peer passengers (Curry et al., 2012). Whatever the cause, distracting effects are unwanted because inattention often precedes collisions in young novice drivers (Durbin et al., 2014).

In addition to both risky and distracting effects on young novices' driving behavior, protective effects of peer passengers were found. To illustrate, Engström et al. (2008) investigated effects for three different age groups (18–24, 25–64 and >65 years) using the Swedish national collision database and exposure data. Albeit weaker for the youngest group, they found a protective effect of passengers on collision statistics that became more pronounced with an increase of passengers. Furthermore, the above mentioned study from Shepherd et al. (2011) found that verbal persuasion by peer passengers led to safer driving in a high-risk condition. In this condition, the passengers encouraged drivers to drive slower and avoid collisions. Ouimet et al. (2013) included measures of risky driving and distraction to test the effects of risk averse or prone male confederate passengers on young male novice drivers. The study found that the mere presence of a passenger caused distractive effects, as indicated by fewer eye glances towards hazards and reduced horizontal eye movements. Protective effects were also found as passenger presence related with waiting for a greater number of vehicles to pass before initiating a left turn. Counterintuitively, protective effects were even higher for risk-accepting passengers, when compared to the risk-averse passengers. With a risk accepting passenger, drivers maintained longer headway with the lead vehicle and engaged in more eye glances at hazards.

1.4. Driver error

Driver error contributes to 70–75% of driver collisions and is therefore directly related to traffic safety (Allahyari et al., 2008; Stanton and Salmon, 2009). With respect to young novice drivers, driver error was found to be the most significant cause for events immediately preceding collisions (Curry et al., 2011). Furthermore, individual differences in cognitive ability may lead to different types and rates of errors committed in similar circumstances (Allahyari et al., 2008), which can be relevant due to biological maturation. Finally, young novice drivers are more prone to errors in distracting situations when compared with older, more experienced drivers. (Romer et al., 2014).

Stanton and Salmon (2009), described a classification with five psychological mechanisms underlying driver errors. These mechanisms are: action, cognition and decision-making, observation, information retrieval, and violations. For examples of driver errors in each classification, refer to Table 1. In recent descriptions of their model, distraction is described as a contributing factor that increases the likelihood of driver errors (Young and Salmon, 2012; Young et al., 2013a). Although a full description of the model[1] is beyond the scope of this article, it was included to classify peer passenger effects on multiple driving parameters, to allow predictions for driving parameters not included in the current study.

1.5. Objectives

A more complete test for a dual process theory of risky driving is warranted. To this end, the study from Jongen et al. (2011) was repeated with the inclusion of a social reward (i.e., peer presence) instead of a monetary reward. The analyses also included possible confounding factors: age, driver experience, and sex. Results from this study were published as a conference proceeding by Jongen et al. (2013). These results were mixed and showed that

[1] Stanton and Salmon (2009) described a more extended error taxonomy not only containing psychological mechanism classifications but also subdivisions of these classifications as well as external error modes. For example, belonging to the underlying mechanism 'action', there is a subdivision of 'action execution' with a possible external error mode of 'wrong action'. A specific example of this error mode is "Press accelerator instead of brake". Furthermore, they also included a taxonomy of road transport errors. Their work led to a range of possible technologies that could be used to prevent or mitigate driver errors. This taxonomy was later revised and applied to issues such as driver distraction and intersection negotiation. For more information, refer to: Stanton and Salmon, 2009; Young and Salmon, 2012; Young et al., 2013a; Young et al., 2013b.