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Training interventions are only effective on careful drivers, not careless drivers

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ABSTRACT

Drivers aged 16–24 are overrepresented in fatal crashes compared to middle-aged, more experienced drivers. This age-related difference in crash rates partly arises from younger drivers' poorer performance on three cognitive skills known to be related to crash involvement: hazard anticipation, hazard mitigation and attention maintenance. Training programs have been shown effective at improving these skills within a short period of time. However, young drivers are not homogenous and they have different driving styles. The driving styles can interact with driving skills by influencing both their acquisition and, once acquired, their execution. A study was undertaken on a driving simulator to determine whether the effectiveness of an already existing training program aimed at improving the three above mentioned skills is moderated by driving style. In particular, drivers were classified as either careful or careless drivers based both on their scores on measures designed to evaluate two general traits relevant to discriminating between careful and careless drivers (sensation seeking and aggressiveness) as well as on their scores designed to evaluate driving specific behaviors that discriminate between careful and careless drivers (aggressive driving behaviors and driving violations and errors). It was found that training improved the hazard anticipation and attention maintenance performance of only the careful drivers, not the careless drivers.

1. Introduction

1.1. The problem

Young drivers aged 16–24 have higher crash rates per driver than any other age group, including not only minor crashes but also crashes resulting in serious injuries or fatalities. For example, in the United States crash data from 1975 to 2014 showed that among 100,000 licensed drivers between the ages of 16 and 24, on average 32.5 were involved in fatal crashes. However, among 100,000 licensed middle aged drivers only 16.0 were involved in fatal crashes (National Highway Traffic Safety Administration - NHTSA, 2015). What is worse is that there is no sign that the high crash involvement rate of young drivers has dropped in recent years. In fact, the number of young drivers involved in fatal crashes increased by 7.2 percent in

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2015 compared to 2014, higher than the average increase for that year (NHTSA, 2016a). This increase is continuing in 2016, up 10.4 percent in the first half of 2016 over the first half of 2015 (NHTSA, 2016a, 2016b). Motor vehicle crashes have become the number one cause of death for younger adults aged 16 through 24, not only in the United States (Webb, 2016), but around the world (Hyder & Lunnen, 2016).

1.2. Risk factors

To develop interventions to improve the traffic safety of young drivers, it is crucial to identify the contributing factors to the crashes. Much evidence suggests that younger drivers are more clueless than they are careless. One of the first studies to show this was conducted by McKnight and McKnight (2003). They analyzed more than 2000 crashes involving 16–19 years old drivers. Based on that analysis, they concluded that a majority of the crashes were a result of poor skills rather than deliberate risk-taking behaviors such as alcohol-impaired driving. These skills were later summarized as hazard anticipation, hazard mitigation, and attention maintenance. This probably explains why education programs and campaigns that have heavily focused on increased awareness of risk-taking does not appear to lead to lasting behavioral change (Mayhew, Williams, & Pashley, 2014). Perhaps not surprisingly, a large number of studies have since shown that young, novice drivers cannot perform these three skills as well as older and more experienced drivers (respectively, Pradhan et al., 2005; Muttart, 2013; Chan, Pradhan, Pollatsek, Knodler, & Fisher, 2010). Finally, to complete the story, it is known that drivers who are better at anticipating hazards, mitigating hazards, and maintaining attention are less likely to crash (Horswill, Hill, & Wetton, 2015; Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006). Horswill et al. (2015), for instance, found that drivers who failed the hazard anticipation test were 25% more likely to be involved in a crash. In short, younger novice drivers are poorer than experienced drivers performing the three aforementioned skills and these are exactly those skills that are known to be related to crash risk. So it is worth delving more deeply into what it is exactly that these three skills entail in order better to understand what countermeasures might be developed.

Hazard anticipation (HA) is defined as the act of glancing towards an area of the roadway either where a visible object that is not currently a hazard may soon become a threat or where a hazard which is not currently visible may soon materialize (Borowsky, Shinar, & Oron-Gilad, 2010; Crundall & Pradhan, 2016; Crundall et al., 2012; Deery, 2000; Pradhan et al., 2005). As an example of the latter situation, imagine that the driver is traveling on a two-lane road (one travel lane in each direction) with a parking lane on each side. A truck is stopped in the parking lane next to the right curb in front of the crosswalk. Pedestrians which were hidden by the truck could emerge suddenly from in front of the truck as they made their way across the road. Successful anticipation of this latent or hidden threat requires that the driver scan for potential pedestrians already in the crosswalk who are currently blocked from view by the truck. Young drivers have been found to perform worse than the middle-aged drivers at anticipating hazards, especially latent ones (Fisher, Pradhan, Pollatsek, & Knodler, 2007; McKenna & Crick, 1994; Pradhan et al., 2005; Scialfa et al., 2012). For instance, in the example scenario, only 10% of the tested novice drivers had fixated on the potentially hazardous area while up to 57% of older drivers had scanned for potential pedestrians (Pradhan et al., 2005).

Hazard mitigation (HM) refers to any action a driver takes in an attempt to avoid crashes in hazardous situations. Novice drivers mitigate hazards less well than do experienced drivers (Fisher et al., 2002). However, this is hardly surprising given that novice drivers anticipate hazards less well than do experienced drivers. In order to determine whether novice drivers' hazard mitigation skills are less developed than experienced drivers' hazard mitigation skills, one needs to control for the level of hazard anticipation. This is exactly what Muttart, Fisher, Pollatsek, and Marquard (2013) did. They demonstrated that, conditional on a hazard being anticipated, middle-aged drivers are more likely to slow down to mitigate the danger associated with the hazard than young drivers.

Attention maintenance (AM) is the ability to maintain attention on the forward roadway and avoid looking-off the road for too long when performing secondary, in-vehicle activities. With regard to how long it is safe to glance inside the vehicle, Horrey and Wickens (2007) found that in-vehicle glances longer than 1.6 s were responsible for 86% of all crashes in a simulator-based driving experiment. Using naturalistic driving data, Klauer et al. (2006) reported that the risk of a crash/near-crash when off-road glances were longer than 2 s in a 6 s window (5 s before a crash/near crash, 1 s after the crash/near crash event) was three times greater than the risk of a crash/near-crash when the off-the-road glances did not meet the above condition. Novice drivers are more willing to glance for longer periods of time inside the vehicle than experienced drivers. Using data gathered from a driving simulator experiment, Chan et al. (2010) reported that while performing in-vehicle tasks, novice drivers (with less than 6 months driving experience) had a glance greater than 2 s in 56.7% of the scenarios while more experienced drivers (with at least five years of driving experience) had a glance longer than 2 s in only 20.0% of the scenarios.

1.3. Solutions

It has long been hoped that driver education would decrease the time it took novice drivers to overcome the critical skill deficiencies. However, the reviews of the literature that extend back to the 1980s are universal in their conclusion that there has been no evidence that such education could decrease crashes of the teens on the open roadway (Nichols, 2003; Stock, Weaver, Ray, Brink, & Sadof, 1983; Thomas, Blomberg, & Fisher, 2009). Nevertheless, progress has been made at the behavioral level. Many training programs have been developed and proven to be effective at this level, some of the earliest back in