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An examination of the relationship between measures of impulsivity and risky simulated driving amongst young drivers

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ABSTRACT

The risky driving of young drivers may owe in part to youthful motivations (such as experience-seeking, authority rebellion, desire for peer approval) combined with incompletely developed impulse control. Although self-reported impulsiveness has been positively associated with self-reports of risky driving, results based on objective measures of response inhibition (e.g., Go/No-go tasks) have been inconclusive. The present study examined interrelationships between measures of response inhibition, self-report impulsiveness scales, and responses to events during a simulated drive that were designed to detect impulsive, unsafe behaviours (e.g., turning across on-coming traffic). Participants were 72 first-year Psychology students. More speeding and "Unsafe" responding to critical events during simulated driving were associated with poorer impulse control as assessed by commission errors during a Go/No-Go task. These results consolidate evidence for a relationship between impulse control and risky driving amongst young drivers.

1. Introduction

Risky driving is recognized as a major cause of young drivers'[1] over-involvement in road trauma (Ivers et al., 2009; Jonah, 1986) and may result from factors related to both inexperience and immaturity (Hatakka et al., 2002; McCartt et al., 2009). Inexperience is likely to result in unintended risky behaviours, such as errors in vehicle handling, in traffic manoeuvring, or in recognizing on-road hazards. Immaturity may further contribute to young drivers' engaging in behaviours that they know to be risky. Hatfield and Fernandes (2009) found that, compared to older drivers, younger drivers have stronger motives for engaging in risky driving (particularly in terms of scales measuring excitement, sensation-seeking, experience-seeking, social influences, prestige-seeking, confidence/familiarity, underestimation of risk, irrelevance of risk, "letting off steam," and "getting there quicker"; see Hatfield and Fernandes, 2009) combined with a greater proclivity to accept risks.

Young drivers may also lack the self-control required to resist these impulses to engage in risky behaviour, even if they have understood messages about the possible consequences. Neuroscientific and cognitive research suggests that executive brain functions, including impulse control, are not fully developed until the mid-twenties (for review see Blakemore and Choudhury, 2006). Thus, when young people are motivated to engage in behaviour that they recognize as risky, they may be too impulsive to resist this urge (Keskinen et al., 1999).

Several studies have demonstrated a positive relationship of self-reported impulsiveness with self-report measures of risky driving (Constantinou et al., 2011; Dahlen et al., 2005; Pearson et al., 2010; Sarma et al., 2013; Treloar et al., 2012; Wickens et al., 2008), self-reported offenses (Dahlen et al., 2005 Pearson et al., 2010), and having committed at least one speeding offense (O'Brien and Gormley, 2013; see also Paaver et al., 2013) amongst younger drivers. Beyond younger drivers, Cheng and Lee (2012) reported that scores on the Chinese Barratt Impulsiveness Scale 11th version (CBIS-11) were associated with self-reported risky motorcycle riding and crashes in a general population sample (*rs* around .4). Owsley et al. (2003) reported that scores on the Impulsiveness scale of the Eysenck Impulsivity Inventory were significantly associated with the Errors and Violation scales of the Driver Behaviour Questionnaire, and recorded crashes, amongst older adults (> 60 years).

There are concerns with self-reported measurements. For example, self-reports of driving behaviour, like all self-report measures, are subject to errors of recall and reporting (including social desirability bias). Moreover, when both independent and dependent variables are measured using self-report the relationship between them may be artificially inflated by shared sources of systematic error variance, such as similar content, item structure, and response biases (for a review of literature relating to such "method bias" see Podsakoff et al., 2012). In

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[1] The age range of "young driver" samples has varied somewhat across studies. Both 16 and 17 are typical lower bounds, while 24 and 25 are typical upper bounds.

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addition, some of the items used in impulsiveness questionnaires are ambiguous. For example, a positive response to the item "I act on the spur of the moment" from the Barratt Impulsiveness Scale may reflect a "carpe diem" attitude rather than inadequate self-regulation (O'Brien and Gormley, 2013).

Three recent studies have used objective measures of response inhibition, which is thought to be an important aspect of impulsiveness. The results of these studies have yielded, at best, a weak, inconsistent relationship between response inhibition and measures of risky driving.

First, Jongen et al. (2011) used Stop Signal Reaction Time (SSRT) task to measure response inhibition. They found no significant association of SSRT with speeding, red-light running, or crashing during a simulated drive in samples of 17–18 and 22–24 year olds. However, higher SSRT (taken to indicate poorer response inhibition) was significantly associated with higher variability of lateral position in the simulated drive, a measure with no apparent connection with response inhibition.

Second, O'Brien and Gormley (2013) used a Go/No-go task as well as the SSRT task. Commission errors on No-go trials are considered to indicate poor response inhibition. On the Go/No-go task, 17–21 year-old drivers who had at least one speeding offense demonstrated more commission errors on No-go trials, and faster responding on Go trials, compared to those who did not have a speeding offense. However, the two groups did not differ significantly in their SSRTs. O'Brien and Gormley (2013) noted that the significant findings for the Go/No-go task may have reflected a speed-accuracy trade-off (rather than a pure difference in inhibitory ability)–although this, too, could be considered a marker of poor self-regulation. The authors also recognized that novice drivers with a single speeding offense may not be particularly "risky drivers" – so that this measure of risky driving is coarse. Moreover, they used a somewhat atypical Go/No-go task which draws on short-term memory because participants were instructed to respond to each letter in series of alternating Xs and Ys (i.e. X Y X Y etc.) but to withhold a response when a letter was repeated (e.g. X Y Y). Thus in order to respond correctly to the "no-go" stimulus participants needed to remember the previous letter, whereas in more typical Go-No-go tasks the No-go stimulus is imbued with this meaning (e.g. via instructions such as "Do not respond when you see a Y").

Third, in a sample of Chinese motorcycle commuters with a wide age range (rather than just young drivers) response inhibition was measured using a Stroop colour-naming task (Cheng and Lee, 2012). Higher Stroop interference scores reflected longer reaction times for colour-incongruent than control trials, and were taken to indicate poorer inhibition. Stroop interference scores were significantly but weakly positively associated with self-reported motorcycle violations ($r = .13$, $p < .005$), and significantly positively associated with the CBIS-11 total score and subscale scores (lowest $r = .19$, $p < .001$).

The numerous differences among these three studies make it difficult to identify what might be the crucial contributors to the variation in the observed relationship between response inhibition and risky driving. Of particular note, the studies used various measures of response inhibition, which may assess different aspects of impulse control, each with differential relevance to risky driving. The studies also employed different outcome measures. Jongen et al. (2011) measured driving behaviour in a simulator, albeit with somewhat unclear operationalization of aspects of driving that might influenced by impulse control. O'Brien and Gormley (2013) used an objective but imprecise measure of risky driving; i.e. having had at least one speeding offense. Cheng and Lee (2012) relied on self-reports of risky driving, with their inherent shortcomings (see earlier).

The present study re-examined the relationship between driving performance and measures of impulse control in young drivers by overcoming some of the problems identified in previous studies. Driving performance was assessed in a simulator using driving scenarios specifically designed to be sensitive to failures in impulse control. Two laboratory measures of response inhibition were employed: a Go/No-go task and a Stroop task. Each have employed in previous studies (O'Brien and Gormley, 2013; Cheng and Lee, 2012). In addition, self-report measures of impulsiveness (Barratt, 1959; Eysenck et al., 1985) were included to allow comparison with previous relevant research.

2. Method

2.1. Participants

Psychology 1 students at the University of New South Wales were recruited into a study "to investigate the risky driving of young drivers" via a scheme in which they receive a small amount of course credit for participating in research. A total of 71 participants took part in the research with 43 female participants. Age ranged between 17 and 24, with a mean of 18.96 (SD 1.29). Among the participants for whom their license type was known ($n = 67$) 41.8% had a learner's license, 20.9% had a first-year provisiona1 license, 32.8% had a second-year provisional license, and 4.5% had an unrestricted license.[2] The majority of participants (60.6%) had less than 120 h of supervised driving experience as a Learner driver, 26.8% had 120–159 h, and the remainder had more.

2.2. Materials - Hardware

The driving simulation was presented using an HP Compaq desktop PC, running Microsoft Windows XP (SP3). This 32-bit system was powered by an Intel Core 2 Duo 3.00 GHz processor with 4 GB of RAM. Participants viewed the simulation on a 27-inch LCD monitor and heard auditory stimuli (i.e. engine noises) via a Dell 2.1 sound system. The computer was fitted with a Logitech G25 Racing Wheel set (steering wheel, shifter module, accelerator pedal, and brake pedal) and driver's seat from of a 2002 Mazda 626.

All remaining computer tasks and questionnaires were presented using a Dell Alienware laptop PC running Microsoft Windows 7 (SP1). The 64-bit system was powered by an i7 2.30 GHz processor with 8 GB of RAM. The 14-inch monitor had a resolution of 1600 × 900. Participants responded using a wireless QWERTY keyboard and a wireless optical mouse.

2.3. Materials - software

2.3.1. Driving simulation

All driving simulations throughout the experiment were run through STISIM Drive™ driving simulator (Build 2.08.04) by Systems Technology Inc.

A 1.6-km (approximately 2-min) practice drive was designed for participants to familiarize themselves with the driving simulation (including the lack of inertial feedback). The practice track consisted of straight roads with four sets of traffic lights spaced between 250 m and 500 m apart. Exactly 200 m prior to each set of traffic lights, a female voice-over instructed participants to either turn right, turn left, or continue straight at the traffic lights. Three of the four traffic lights remained green. The remaining traffic lights changed from green to orange to red as the participant approached. These events were intended to familiarize participants with the voice-over, and the

[2] New South Wales (Australia) has a Graduated Licensing Scheme in which novice drivers hold a learner licence for at least 12 months, and complete 120 hours of supervised driving practice, including 20 hours of night driving (unless you're 25 or older), before they are eligible to undertake a Driving Test to obtain their provisional P1 licence. Novice drivers hold their P1 licence for at least 12 months before they are eligible to undertake the Hazard Perception Test to obtain their provisional P2 licence. They hold their P2 licence for at least 24 months before they are eligible to undertake the Driver Qualification Test to obtain their full licence. The P1 and P2 licences allow unsupervised driving, but with conditions that allow novice drivers to safely build experience on the road and improve driving skills as they move to a full licence. The conditions are more restrictive on the P1 than the P2 licence.