Investigation of relationships between performance measures and self-report measures of impulse control and risky driving on a simulator

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Extended Abstract

Introduction

Young drivers are overrepresented in crash statistics, partly because of their risky driving. Some risky driving results from inexperience and error, but intentional risky driving probably owes more to youth-related factors, such as risk motivation and poor impulse control. Research demonstrating relationships between impulse control and risky driving has typically relied on self-report measures of impulsivity and risky driving. To avoid the concerns with self-reported measurements, a few recent studies have considered relationships of performance measures of response inhibition with driving. However, the results of these studies are somewhat ambiguous. The Hazard Perception Test [HPT] that is used in the licensing procedures in New South Wales [NSW] Australia includes some scenarios that appear to involve impulse control. Performance on these scenarios demonstrates the best prediction of later offenses and crashes, but association with performance during a continuous drive is yet to be assessed. Further investigation of the relationship between performance measures of impulse control and risky driving is warranted.

Method

A total of 71 participants took part in the research (61% female; mean age of 18.96, s.d.= 1.29; 96% on Learners or Provisional licences) and were randomly allocated into one of three main counterbalance groups [Table 1].

Table 1: Order of completing tasks and questionnaires for each Group

Group A	**Group B**	**Group C**
Driving Simulation	Computer tasks[a]	HPT
HPT	Driving Simulation	Computer tasks[a]
Computer tasks[a] Cued Go/No-go Task Stroop Colour Naming Task Reward Saccade Task [RST]	HPT	Driving Simulation
Barratt Impulsiveness Scale V11 Eysenck Impulsiveness Questionnaire V7 Personal Characteristics	Barratt Impulsiveness Scale V11 Eysenck Impulsiveness Questionnaire V7 Personal Characteristics	Barratt Impulsiveness Scale V11 Eysenck Impulsiveness Questionnaire V7 Personal Characteristics

[a]Order counterbalanced. Results of RST not presented here.

The driving simulation was presented using desktop PC, with a steering wheel, accelerator and brake set, and a car seat. The 6km test drive, run through STISIM Drive™, was designed to be sensitive to impulsive driving behaviour, while being fairly typical of real-world driving. The drive included 7 further critical events (see Table 2). A female voice-over instructed to either turn right, turn left or continue straight at traffic lights. Speed limit signs throughout the drive indicated a 60km/h limit, except for one 500m section at 2.45km which was 40km/h. Table 2 describes the dependent variables that were derived from each critical event. Speed measures were computed for the 40km/h zone, and for the drive as a whole.

Table 2: Critical events in simulated drive, and operationalization of impulsive responses

Event	Position	Event Type	Other Details	Responses
1	0.85km	Traffic lights; Turn left	Lights change from green through red	Turned on orange light? Yes(1)/No(0)
2	0.88km	Potential overtake; 40km/h lead-vehicle in 60km/h zone	Double unbroken centreline; Oncoming traffic with one safe gap (120m)	Overtook? Yes(1)/No(0)
3	2.40km	Traffic lights; Turn right	3 gaps: 50m, then 120m, then following all traffic	Turned on which gap? 50m (2)/120m (1)/After traffic (0).
4	3.05km	Traffic light; Continue straight	Lights change from green through red	Drove through orange light? Yes(1)/No(0)
5	3.35km	Cyclist travelling 23km/h in 60km/h zone	Single broken centreline; No oncoming traffic	Failed to accommodate cyclist (did not slow down or deviate right)? Yes(1)/No(0)
6	4.35km	Potential overtake; 50km/h lead-vehicle in 60km/h zone	Single broken centreline; no oncoming traffic	Overtook? Yes(1)/No(0)
7	5.32km	Traffic Lights; Turn right	3 safe gaps: before traffic[a], then 40m, then following all traffic	Turned on which gap? Before traffic (2)/40m (1)/After traffic (0).

[a] The size of this gap varied depending on drivers speed approaching the intersection.

The *HPT* was an extract of the NSW “Driver Qualification Test”, and consisted of 17 video clips presented on a laptop PC. There were three types of clip: “Turn right” clips in which there was none, one, or more, periods during which it was safe to turn right (7 clips), “(Do not) overtake” clips in which it was never safe to overtake a slower lead vehicle (3 clips), and “Slow down” clips in which safety required that the participant slow down for a discreet period (4 clips). Three “turn right” clips were regarded as control clips because it was safe to turn right from the outset. Participants press the spacebar when they believed it safe to turn right (“Turn right” clips), safe to overtake (“Do not overtake” clips), or safe to slow down (“Slow down” clips). Responses were dichotomized as safe or not.

In the *Cued Go/No-go Task* (Fillmore, Rush and Hays, 2006) participants respond by pressing the spacebar when shown green rectangles on a laptop PC, and not pressing when shown blue rectangles. Each target stimulus was preceded by the presentation of a black rectangular outline (without coloured fill) oriented either vertically (75 trials) or horizontally (75 trials). 80% of vertical outlines became filled with green whilst 80% of horizontal outlines became blue. Thus, a vertical outline cues a green (Go) target stimulus, whilst a horizontal outline cues a blue (No-go) target stimulus. Percentage of correct responses was calculated for Vertical NoGo (VNOGO) trials and the Horizontal NoGo trials (HNOGO).

A standard *Stroop Colour Naming Task*_was employed. Participants indicate the colour of the stimulus for 4 control stimuli (a rectangle presented in each of 4 colours), 4 congruent stimuli (colour name presented in each of 4 matching colours), and 12 incongruent stimuli (colour names presented in non-matching colours) – each presented 4 times (for a total of 80 trials). Higher interference was operationalized as a higher percentage of correct responses for control versus incongruent trials (control minus incongruent), and by a longer latency for incongruent versus control trials (incongruent minus control).

Results

The relationships of impulse control measures with HPT and simulated drive measures were assessed using bivariate 2-tailed tests and a Type I error rate of 0.5.

Speed measures were positively associated with Barratt's Motivational Impulsiveness, Barratt Non-planning Impulsiveness and Eysenck's Impulsiveness. Further, participants who accommodated the cyclist scored lower on Barrett's Motivational Impulsiveness.

Speed measures also demonstrated significant relationships with % correct for Vertical and for Horizontal No-go trials, as well as with Stroop interference in terms of % correct and in terms of latency. Those who were less likely to correctly withhold their responses on No-go trials, those who were more likely to make errors on incongruent trials (relative to control trials), and those were slower to respond to incongruent trials (relative to control trials), were more likely to travel fast and speed.

Overtaking slower lead vehicles was also associated with % correct for Vertical No-go trials and for Horizontal No-go trials, and with Stroop interference in terms of latency. Those who were less likely to correctly withhold their responses on No-go trials, and those were slower to respond to incongruent trials (relative to control trials), were more likely to overtake.

Choosing unsafe gaps to turn right was associated with % correct for Horizontal No-go trials and with Stroop interference in terms of % correct. Those who were less likely to correctly withhold their responses on cued No-go trials, and those who were more likely to make errors on incongruent trials (relative to control trials), were more likely to choose unsafe gaps.

Conclusions

Computer tasks hypothesized to measure impulsivity demonstrated consistent relationships with risky driving on a driving simulator. No observed significant relationships were in the direction opposite to prediction. No relationships were observed with HPT performance. Results are consistent with the view that impulse control contributes to the risky driving of young drivers, and suggests the value of developing and evaluating driver training to improve impulse control