INHIBITORY CONTROL AND PEER PASSENGERS PREDICT RISKY DRIVING IN YOUNG NOVICE DRIVERS – A SIMULATOR STUDY

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BACKGROUND

• Driving with peer passengers increases young novice drivers’ crash risk (Williams et al., 2007).
• Two potential explanatory factors from developmental cognitive neuroscience (Yurgelun-Todd, 2007): suboptimal cognitive control and increased reward sensitivity.

COGNITIVE CONTROL

Cognitive control/executive functions:
• Collection of cognitive functions including inhibitory control, working memory, mental flexibility and planning.
• Important for the regulation of complex behavior, including performance of appropriate and inhibition of inappropriate actions.
• Adolescence: suboptimal cognitive control; it still advances until the age of about 30 (Cranen & Dahai, 2012).
• Present study: inhibitory control.

REWARD SENSITIVITY

• Sensitivity of the affective brain system involved in the evaluation of rewards.
• Adolescence: increased reward sensitivity at the start of adolescence. Important source of rewards during adolescence: peers, their opinions and social evaluations.
• Especially in rewarding contexts adolescents may be prone to risk taking behavior, when their increased reward-seeking impulses are not appropriately inhibited by cognitive control (Figner et al., 2009).

PREVIOUS RESEARCH

• 2 previous studies: relation of cognitive control and reward sensitivity to the effect of peer passengers on risky driving for adolescent versus adult drivers in a driving video game (Gardner & Steinberg, 2005; Chin et al., 2010).
• Stronger increase in red light running in the presence of peers occurred in adolescents than adults.
• Lower cognitive control in adolescents independent of peer presence, greater reward-related brain activity in adolescents when peers were present.
• Methodological aspects to be improved: video game played from a third-person, non-participating, side-view perspective, risky driving measurement limited to red light running, no discrimination of different functions of cognitive control (e.g., inhibitory control).

AIMS

To investigate developmental differences in the effect of peer passengers on driving:
(1) 2 age groups given the hypotheses of lower cognitive control and reward sensitivity.
(2) measures of risky driving (i.e., SDLP, road hazards, speeding, red light running),
(3) in a medium fidelity driving simulator,
(4) 1 function of cognitive control (i.e., inhibitory control) to investigate possible moderating effects of cognitive control.

METHOD

SIMULATED DRIVING TASK
STISIM 400 fixed-base driving simulator, large 180° field of view seamless curved screen.
2 Experimental sessions (after practice): 2 km, daylight driving, two-lane road, bidirectional traffic, including both inner - (50km/h) and outer-city sections (90 km/h).
-LCD road hazards (e.g., a pedestrian crossing the road, a car suddenly appearing from behind a building and pulling back at the street)
-6L interactions equipped with traffic lights (red: 4 green: 2 below in randomized order).
Experimental session 1: participants were instructed to drive as they would normally do.
Experimental session 2: participants drive together with a peer that they had been asked to invite and bring to the experiment. The peer sat in a chair to the right of the driver’s seat. The instruction to the driver was to drive as they would normally do. Furthermore driver and peer were asked during the drive to behave and interact as they would normally do.

Risky driving behavior: standard deviation of lateral lane position (SDLP), responses to critical events (number of collisions), speeding (% total distance), and red light running.

RESULTS

PEERS PREDICT RISKY DRIVING. The influence of peers can either be negative (‘risk increasing’) or positive (‘protective’), depending on the specific driving measure.

(1) RISK INCREASING PEER EFFECTS: RED LIGHT RUNNING & SPEEDING.
• Prevaling explanations:
  • heightened reward sensitivity (Chin et al., 2010) - young drivers are more sensitive to the pressure from risk-loving friends (Monahan et al., 2009). In a previous study a comparable increase of speeding and red light running was found with a monetary reward (Engström et al., 2011);
  • Suboptimal cognitive control (see below).
• Typical driving violations: large motivational component, conscious deviations from rules and safe practices (Reason, 1990), supported by the decrease in violations in the ride without peers: young novice drivers are able to drive in a safer manner, but when peers are present they fail to do so.

(2) PROTECTIVE PEER EFFECTS: SDLP & COLLISIONS ROAD HAZARDS.
• SDLP: possibly due to increased cognitive workload resulting from driver-passenger conversation (Heck & Carlos, 2008; Lee, 2007), as increased cognitive workload can lead to a decrease in lateral variation (Engström et al., 2005).
• Road hazards: possibly peers monitored the road and served as additional ‘risk detectors’ thereby improving the driver’s ability to detect and respond to road hazards. Similar positive effects for passenger conversation when compared with a hands-free phone conversation: as passengers made references to traffic conditions, adjusted their conversation based on driving difficulty, and helped the driver navigate and identify hazards on the roadway (Strayer & Drows, 2007).

INHIBITORY CONTROL MODERATES PEER EFFECTS ON SPEEDING.
• In a sub-group with low inhibitory control an increase in speeding occurred with versus without peer passengers, while in a sub-group with high inhibitory control there was no effect of peer passengers on speeding. This suggests that within a socio-emotional context, those adolescents with higher inhibitory control are more successful in resisting peer pressure effects.
• Cognitive control can be trained, leading to improvements in driving performance (Cassavaugh & Kramer, 2009), but only speeding was affected: cognitive training as part of a broader program that teaches young drivers strategies of how to resist peer influences, and could be combined with an initiative such as GDL, requiring drivers to wait in driving together with peers (Fell, Todd & Voas, 2011).

LIMITATIONS
• Sample composition: simulated sample in terms of gender of both driver and passenger would have been interesting, given differences in driving performance in function of gender differences that have been shown by others (McKenna et al., 1998; Ouimet et al., 2010; Simons-Morton, Lemer & Singer, 2005).
• No observation of the interaction of driver and passenger, e.g. to verify workload hypothesis SDLP.
• Not balancing order of trips across subjects: possible order effects.