Effect of Interpersonal Competition on the Driving Performance of Young Male Drivers Accompanied by Young Male Passengers

by

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ABSTRACT

EFFECT OF INTERPERSONAL COMPETITION ON THE DRIVING PERFORMANCE OF YOUNG MALE DRIVERS ACCOMPANIED BY YOUNG MALE PASSENGERS

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Motor vehicle accidents are the leading cause of death and injury among teenagers. The crash risk is highest for young male drivers with young male passengers. The goal of this study is to find out why young males are at such high risk. One possible explanation could be the Sexual Selection Theory (Darwin, 1871), which emphasizes the competitive nature of young males that may determine their behaviour for future benefits. I tested if there was competition between males that made them take more risks while driving in the simulator. Various driving performance variables (speed, car following distance, standard deviation of the lateral position, hazard response times, number of vehicles passed) and individual differences variables (risky driving, risk perception, sensation seeking, competitiveness) were measured. Results provided little support for the effect of interpersonal competition and an opportunity for discussion arose.

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Table of Contents

List of Tables

List of Figures

Introduction

Road traffic accidents found its place as the 10th most common cause of death in the Top 10 Causes of Death list of World Health Organization (WHO, 2008), by representing 2.1% of deaths worldwide. Every year, it is estimated that between 20 and 50 million people suffer injury or disability from motor vehicle crashes (WHO, 2011) and in Canada the estimated financial cost is approximately $62.7 billion per year (Transport Canada, 2007). A cause for concern is that a large portion of these statistics are attributed to the young population. According to National Highway Traffic Safety Administration (2008), motor vehicle crashes are the leading cause of death among teenagers and young adults. They not only represent the highest frequency of crash rates but also take the lead in severity of crashes (Ferguson, 2003 as cited in Neyens & Boyle, 2007). Specifically, young drivers aged between 16 – 20 have the highest fatal crash rate per 100 000 individuals as opposed to drivers older than 20 years of age, where the fatal crash risk is much lower (Chang, 2008). In North America, 16 – 19 years old drivers have three to four times higher crash rates causing injury when compared to drivers who are 40 years old or older (Stewart & Sanderson, 1984; Massie et al., 1995 as cited in Doherty, Andrey, & MacGregor, 1998).

As a result of these serious or fatal injury statistics, financial and societal costs, it is not surprising that young drivers have been rigorously studied by researchers. However, most of the interpretations used epidemiological methods (i.e. exploited the crash databases and relied on naturalistic observation and self-reports). This study explored one of the important factors that could be responsible for overrepresentation of young male drivers and passengers in crash databases: Risk-taking behaviour and its relation to social competition between the driver and the passenger. I studied this using a driving simulator in a controlled experimental setting, which past research had lacked.

In the following sections of the introduction, I will first discuss the research on young drivers and some challenges that ensued. Second, I will explore the reasons why young drivers are overrepresented in road accidents. Third, I will identify the gender differences in motor vehicle accidents as it relates to risk-taking behaviour, and then I will talk further about the dynamics of risk-taking. Finally, I will add an evolutionary perspective to the research by presenting sexual selection theory, which may explain our phenomenon at hand. After all this, I will be talking about the experiments I carried out to examine this phenomenon in a controlled lab environment.

Research on Young Drivers

One important factor that has been associated with higher collision risk for young drivers is their lack of experience. Inexperience plays an important role in increasing the risk of a collision, as novice drivers lack the necessary perceptual and cognitive skills (Deery, 1999). For one, automaticity of the behaviours develops as the drivers gain more experience. This idea of behaviours becoming automatic with practice comes from the theory of information processing which separates automatic and controlled processes (Shiffrin & Scheider, 1977). Behaviour is said to be "controlled" if there is a need for deliberate effort and concentration to carry out that behaviour. This adds high demands on a person's resources for information processing and such behaviours are done one at a time. Automatic behaviours on the other hand are carried out without conscious intention, that is, the person is unaware of the steps of the behaviour, which is carried out effortlessly (this type of information processing requires few cognitive resources). Thus, until drivers gain experience and turn controlled processes of driving into automatic ones, they are likely to have difficulty doing several things at the same time such as checking the mirrors simultaneously while checking the road and giving a signal to turn. This trouble inexperienced drivers have with dual-tasking also manifests itself when the drivers are accompanied by passengers or are busy with devices such as cell phones during the drive. That is, the driver's attention allocated to the task of driving shrinks when there are distractions. Previous studies have established that passengers and cell phones are sources of distraction that reduces the driver's capacity to deal with the demands of driving task (e.g. Strayer & Johnston, 2001; Vollrath, Meilinger & Kruger, 2002; Strayer & Drews, 2004). This might also cause drivers to have trouble responding to changes in the driving environment (hazards) fast enough while performing the routine operations of steering and controlling vehicle speed. In fact, a study by Deery (1999) found that hazard response times are much slower in beginner drivers compared to experienced drivers, which might account for an important portion of the higher rates of road accident involvement of young drivers. Numerous studies have demonstrated that novice drivers detect hazardous situations less rapidly compared to their experienced counterparts (Soliday & Allen 1972; Ahopalo et al. 1987; Quimby & Watts 1981; Finn & Bragg 1986 as cited in Gregersen & Bjurulf, 1996).

Inexperience can be more dangerous when it is combined with other factors such as risk-taking behaviour (Preusser, Ferguson, & Williams, 1998). Risk taking is another factor that increases young drivers' risk of collision and constitutes a big portion of it, since 27% of accidents young drivers involve are due to speeding, a form of risky driving behaviour (Neyens & Boyle, 2007). Jonah (1986) goes as far as saying that risk-taking is the major reason why teenagers are overrepresented in accident rates. Risky driving behaviour can be classified as speeding, tailgating (i.e., following the lead vehicle very closely), delayed response to oncoming hazards, non-use of seatbelts, and driving under the influence of alcohol, all of which are more common in teenage drivers (McKnight and McKnight, 2003; Neyens & Boyle, 2007). For example, a study on use of seatbelts showed that drivers who were involved in more collisions and had more traffic violations were mostly non-seatbelt users, as a result of which, non-use of seatbelts have been interpreted as a reflection of risk-taking (Evans, Wasielewski, & Von Buseck, 1982; Wasielewski, 1984 as cited in Jonah, 1986). Even 30 years later, the relationship between non-use of seatbelts and crash rates persists. According to Centers for Disease Control and Prevention (2010a), young adults (especially men) are found to be less likely to wear seatbelts. Young drivers are not only identified as risk takers, they also tend to underestimate the risks of driving while they overestimate their skills (Deery, 1999). This is likely to be a part of the reason why young drivers appear to be more likely to take risks compared to other age groups.

Inexperienced young drivers are also more susceptible to challenging road conditions. For one, it was observed that driving at night increases their likelihood of being involved in collisions (Ferguson, 2003). This is likely because of a combination of decreased visibility and their inexperience in adapting to varying driving conditions. In fact, Mueller and Trick (2012) showed that inexperienced young drivers fail to reduce their speed in fog, which suggests that they do not accordingly alter their driving behaviour in the face of demanding road conditions.

It has been argued that overrepresentation of young population in road accidents could be due to the fact that the frontal lobe, which is responsible for managing impulsivity and working memory (a part of memory that holds the information to deal with tasks such as reasoning and further information processing), continues to develop until mid-20s (Romer & Hurt, 2010). It has been further suggested that the immaturity in these brain regions might cause teenagers to be oversensitive to rewards (Van Leijenhorst et al., 2009). Thus, young drivers might be acting impulsively and be more accepting of the risks that in the end would give them something in return (e.g. increased feelings of confidence) because of poor executive functioning that includes cognitive processes such as planning, problem solving, attention, working memory, and reasoning. This indicates a relationship between risk taking and impulsivity as well as working memory. In fact, Romer and Hurt (2010) found that young people who scored high on impulsivity measures were also risk-takers. However, they also showed that these impulsive risk-takers did not necessarily have poor working memory, which suggests that the "poor executive functioning" explanation is not enough by itself to explain why young people are prone to taking more risks while driving.

Situational factors also play an important role in determining the crash risk of young drivers. It was observed that if teenage drivers have passengers present in the car with them, then they are more likely to have collisions (Doherty et al., 1998). In fact, as the number of passengers increases the death risk also increases (Chen et al., 2000). It is important to note that this negative effect of passengers was only found for drivers between the ages of 16 – 19 (Doherty et al., 1998). One explanation for this is that perhaps passengers are a source of distraction for drivers. This is observed in young and less experienced drivers because their attention is more easily diverted from the focused task of driving due to their difficulty in doing two things at once (Doherty et al., 1998). Yet, the negative effect of passengers seems to be dependent on passenger characteristics. That is, teenagers' driving behaviour changes drastically when driving with their parents, with whom they drive safely with, as compared to when driving with peers, with whom they show a greater degree of risky driving behaviour (Rolls et al., 1991; Parker et al., 1992; Rolls & Ingham, 1992; Arnett et al., 1997 as cited in Doherty, 1998). As Preusser (1998) also states, risky driving behaviour of teenagers does not reflect a general pattern of the way teenagers drive, but when teenage drivers are accompanied by peers, presence of passengers become a factor that increases the driver's risk taking. According to a survey on 192 high school drivers, risky behaviour such as driving under the influence of alcohol or drugs, speeding, swerving, running a red light, crossing the centre line and skidding on purpose, was linked to the peer presence in the car (Chen et al., 2000). As a result, it should come as no surprise that crash databases are likely to be overwhelmed by young drivers and their young passengers' fatality rates.

Challenges that come with studying young drivers

All research questions come with challenges in terms of measurements and methodologies to be used to adequately address the phenomenon at hand. Studying young drivers is no exception in that there are challenges that researchers face that make young drivers a difficult sample to work on. Some of these challenges include ambiguity about what the term "young drivers" really refers to, and the relationship between driver age and experience.

There is no consensus among past researchers as to which age group the term "young drivers" refers to. As Jonah (1986) stated, some studies focus on adolescents aged 16 – 20, whereas in other studies, age range can be as wide as 16 – 25 or 18 – 25. For my study, I focused on drivers aged between 16 and 20, because road accidents represent 36% of deaths in this age demographic (Chen, Baker, Braver, & Li, 2000). Moreover, the Insurance Institute of Highway Safety (IIHS, 2010) quotes that 16 and 17 year-olds constitute the highest crash risk group. In fact, the fatal crash rate per million miles appears to be seven times higher for 16 year-olds than for drivers whose ages range between 30 and 59 (IIHS, 1999 as cited in Chen et al., 2000).

Another challenge that deserves attention is the relationship between driver's age and experience level: usually the more experienced the driver is, the older they are. It is unlikely that 16 year-old drivers have years of driving experience; therefore, experience is a measure that is difficult to control while comparing young drivers to older drivers (Jonah, 1986). That is, it is hard to distinguish the effects of driving experience from the effect of driver age. This is especially problematic in comparison studies done with younger and older drivers;

however, I was free of this concern since my samples only consisted of young drivers compared to each other.

Gender Differences in Crash Rates and Risk-Taking Behaviour

The young population is not represented equally in accident statistics in terms of gender. A study done by the Insurance Institute of Highway Safety (2009) demonstrates that in 1975 – 2009 per every 100 000 teenage drivers, two out of three killed were males even though the mileage reports were similar between genders. This suggests there is a gender effect that influences teenagers' driving behaviour. For example, young male drivers appear to be engaged in more rear end collisions compared to older counterparts (Lalonde, 1979 as cited in Jonah, 1986). This indicates that young male drivers follow other cars too closely leaving an unsafe following distance, which is again a form of risky driving behaviour.

The disproportionate fatality rates of young male drivers are also present for young male passengers (IIHS, 2010). In fact, presence of a male passenger is a factor that increases crash risk for both gender groups (Chen et al., 2000). These risky behaviours were less prominent if the young drivers were alone or with female passengers instead (Chen at al., 2000). The male passenger effect is remarkable in that as the number of male passengers increase, the risk of fatality increases (Chen et al., 2000). The highest risk group is young male drivers accompanied by 16 – 20 year old male passengers (Ouimet et al., 2010). It was observed that especially young males, when accompanied by male passengers, were speeding and tailgating compared to other driver groups (Simon-Mortons, Lerner, & Singer, 2005). Therefore, it appears that young males are risk-takers especially in the presence of other young males.

Risk-taking seems to be a male-dominated phenomenon which has been referred to as “the young male syndrome” (Wilson & Daly, 1985). Evidence suggests that males, in general, are more likely to take risks compared to females in that more males die as a result of accidents (Holinger, 1987; Wilson & Daly, 1997 as cited in Daly & Wilson, 2001). Males also engage in hazardous recreational activities (e.g. parachuting) to a greater level compared to females (Lyng, 1990, 1993 as cited in Daly & Wilson, 2001). Similarly, men are found to be more likely to choose low probability, high payoff options when engaged in simple betting paradigms where subjects were asked to pick a number between 1 and 100 and draw a number from a bag that has the same portion of numbers (Daly & Wilson, 2001). They were told that they would win if the number they drew was higher. In such a paradigm, choosing lower numbers have lower pay-offs and give more chance of winning but even though choosing higher numbers have higher pay-offs, it is risky because the likelihood of winning is decreased. The results suggest that when the prize of winning is greater than the negative consequences, men tend to underestimate the risks and choose the risky option. The presence of an audience also affects men and women differently, in that men made riskier bets when they were being watched by an audience than when they were alone, whereas women were not affected by the audience (Daly & Wilson, 2001). Perhaps, the presence of a young male passenger serves as an audience that "watches and judges" the young male driver, which creates a dynamic where the driver has to prove himself.

We need to explore the reasons behind risky actions and how they are formed in order to better understand the motives behind young male drivers' risky driving behaviour. There are two aspects to risk-taking that are in constant interaction with each other: the perception of risk and the utility of risk (Jonah, 1986). The way this works is that the driver first needs to judge the situation according to his perspective (i.e., in a subjective way) and then combine this perception with the possible uses of taking the risky action (e.g. impressing others). Thus, when the utility of the risk overcomes the perceived risk, we could expect that there would be a higher chance the driver will attempt to take the risk. In fact, it is argued that risk-taking can often be a way of gaining prestige that indicates a driver's confidence and competence over the task (Daly & Wilson, 2001). It is further argued that for young people, risk has a larger utility in gaining peer approval, providing a sense of power, control and enhancement of self-esteem (Jonah, 1986). This suggests that for young male drivers, being engaged in risky driving behaviours might be a way of gaining approval from their peers. Thus, risky behaviour might have an adaptive function that helps an individual to stand out amongst others.

One way of interpreting these findings is to take sexual selection theory into perspective. This theory, which was originally formulated by Darwin (1871), offers a possible explanation of why young male drivers driving with young male passengers constitutes the highest risk group. It essentially posits that in the context of evolutionarily adaptive competition, risky or violent behaviours are used as means to compete for reproductive success (Wilson & Daly, 1985). This implies the possibility of risk taking behaviour as a product of an underlying social competition between the involved parties. Thus, we can expect that the reason why young male drivers are taking risks while driving – especially when young male passengers are present – could be that there is a competition between them over resources that would attract females. Men would care about enhancing their resources because reproductive success is strongly related to the social status of men (Low & Heinen, 1993 as cited in Wilson, Daly, Gordon, & Pratt, 1996). In fact, the major way that men attract women has been identified as the display of these resources (Buss, 1994 as cited in Wilson et al., 1996). In order for men to be concerned for their social status and comparisons, their competitive mechanism needs to be activated through a competitive social context (Wilson et al., 1996). This implies that a carefully designed social context where competitive efforts are rewarded would cause men to act competitively to gain social status. In our case, young male drivers, if put in a socially competitive context with a young male passenger, will compete over resources that would get them higher social status and confidence that could be used to attract females.

Young men were also identified to be greatly motivated by competition and careless about dangerous consequences that might be fatal to themselves (Jonah, 1986). Moreover, results suggest that men's competitiveness and risk acceptance is greatly influenced by the strength of the competition (Wilson et al., 1996). This competition was proposed to be greater during early adulthood because competitive success at an early age has a permanent impact on reputation (Daly & Wilson, 2001), which can influence future reproductive success.

In the sections that follow, I am going to describe two experiments designed to explore this idea in different ways. The first attempts to look at the effects of competition on driving performance among young men by endeavouring to manipulate the nature of the relationship between young men who do not know each other. The second focuses on manipulating competition among young males and young females who are friends.

Experiment 1

The purpose of this study is to explore the extent to which social competition is a factor in young male drivers' risk taking behaviour, when drivers are accompanied with a young male passenger. Most of our understanding about the higher road accident involvement rate of young drivers driving with young passengers comes from inferences that were made based on crash databases and comparison studies (e.g. Chen et al., 2000; Chang, 2008). This is a good starting point; however, with such methods causal relationships are not easy to establish. Collision statistics can only tell us so much. It gives us the numbers and demographics but it does not provide us with other important details such as the nature of the social interaction between the driver and the passengers in the moments leading up to the collision, which may be fundamental in understanding the causes behind high numbers of collisions. Hence, while past studies showed that there was a relationship between the increased crash risk and teenage drivers carrying passengers (especially if both the driver and the passenger is a young male), they failed to provide information about the nature of the driver and passenger interaction (Chen et al., 2000), and did not propose a theoretical explanation (Wiesenthal & Singhal, 2011). There is also a lack of research on how social influences affect driving in young drivers, as most of the research in the past focused on alcohol (e.g. Gregersen & Bjurulf, 1996). Therefore, a carefully controlled lab experiment where social dynamics between the driver and the passenger are manipulated is required to assess the cause behind risk-taking. I used a computer game to put the drivers into a competitive social dynamic and mindset with the passenger (a male confederate), and observed their driving behaviour in a driving simulator, comparing it with their behaviour when the preceding task did not introduce a competitive social dynamic.

Research Question

Could a history of competition between driver and passenger be a factor in explaining the higher accident involvement rates of young male drivers accompanied by young male passengers? To answer this question, we tried priming the participants into a desired set of mind by making them play a computer game with a male confederate they would drive with later. I chose to do this not only because young male population is familiar with video games, but also because there are a number of studies looking at racing video games and risk-taking that found a relationship between the two in that playing such video games caused more risk-taking (Fischer, Kubitzki, Guter & Frey, 2007; Beullens, Roe & Van den Bulck, 2008; Fischer et al., 2009). While they looked at the direct effect of playing racing video games on risk-taking tolerance on an individual, I looked at the primed competition created through a game that was not driving-related and strove to observe the persistent competition among two young people during the driving task.

In *Flag Hunter*, which is the competitive game, participants were racing with one another to flag more mines than the other person in a limited time. I also told them the winner would get 5 dollars. Hence, there was a competitive effort on both individuals that helped my purpose of establishing a competitive atmosphere. Determining the effect of a competitive social dynamic requires comparison conditions less likely to incite competition. In the cooperative game *Minesweeper*, participants were assisting each other while completing the game together. I stated that I would give 5 dollars to both of them. This way, I tried to minimize any motive for competition. Participants in the control condition – conversation – did not play any games. This last condition was a control where there was no manipulation with respect to explicit competition or cooperation (i.e. no priming), yet there was still social contact between the participants before the drive. It should be noted that all of the participants were instructed to remain silent during the drive.

I hypothesized that as a result of a primed competition between the young male driver and the young male passenger, the driver would show riskier driving behaviours compared to those who were primed to be cooperative, or were not primed at all. As for the driving performance, I measured the following driving behaviours: speed, lead vehicle following distance, stopping distance from the lead vehicle at the intersections, Standard Deviation of the Lateral Position (SDLP), and hazard response times to hazardous situations (e.g. a vehicle suddenly appears from the side of the road and blocks the driver’s way, forcing the driver to stop). SDLP is the average distance that the position of the car deviates from moment to moment from the centre of the lane (measured in meters). For the lead vehicle following task, I measured the distance between our car and the lead vehicle by time to collision if the lead driver stopped (e.g. “our car was 1.5 seconds behind the lead vehicle”). Consequently, we could say the driver is taking risks if (1) they are speeding, (2) they follow the lead vehicle in such way that there is small distance between the driver's car and the lead vehicle in terms of time to contact, and if (3) they leave the shortest distance between their car and the lead car at the intersections. The other two measures – SDLP and hazard response times – were only measured as general measures of driving performance (steering and breaking response times).

Method

Participants

A total of 45 male participants were recruited for this study from the subject pool. They were all undergraduate students at the University of Guelph and they have been granted course credit and 5 dollars cash for participation. I had to exclude the data of 7 participants for one of the following reasons: contravention of the instructions (e.g. some participants were texting or talking while driving despite instructions to the contrary), simulator adaptation syndrome (i.e. some participants felt physically uncomfortable during the drive), or failure of the experimental deception (some participants figured out that their partner in the experiment was a confederate). Of the remaining 38 participants, 1 had G1, 33 had G2 and 4 had G level licenses. In Ontario's graduated licensing program, G1 is given to "learner" drivers who are not allowed to drive without supervision. After a year, they can take a road test and receive a G2 license, which has still some restrictions, for example, the driver's blood alcohol level must be zero. They then have to wait another year to take another road exam. If they successfully pass, they receive a G, which is the full graduated license with no restrictions. Participants were randomly assigned to one of the three conditions. There were 13 in the competition, 12 in the cooperation, and 13 in the conversation condition. The age range was 18 – 20 (M = 18.6, SD = .63). On average, they drove 17 times per month (SD = 10.65), spent

47 minutes each day on the road (*SD* = 31), and drove 27km per day (*SD* = 24.25). See Table 1 for information on the participants.

Stimuli and apparatus

A DriveSafety DS-600c driving simulator was used for the study: a Saturn model sedan car surrounded by 6 viewing screens which provides 300 degrees wrap-around virtual driving environment. Two different road scenarios were created using HyperDrive, which is a computer programme that comes with DriveSafety simulator. One of the scenarios was for a training drive and was 6km long. The other was for an experimental drive that was 33km long total: 2km of it was the school zone, 4km was the residential area, and 27km was a rural highway. In the training drive, the simulated environment consistent only of a rural highway while different driving environments were simulated for the experimental drive: highways, residential areas, school zones with speed limits of 80, 40 and 30 KpH respectively. Speed signs were automatically incorporated every 200 meters on rural roadways, and one sign was placed at the beginning of residential and school zones to indicate a change in speed. Roads consisted of two lanes and oncoming traffic was created where necessary for both experimental task purposes (i.e. to prevent the driver from passing the lead vehicle during a car following task) and realism (i.e. it is unlikely not even a single car present on the road in the real world). Eight hazards appeared unexpectedly from the left and the right side of the road (e.g. a vehicle suddenly appears from the side and blocks the roadway). The hazards and lead vehicle following tasks were only put on the high speed portion of the road (highway) because (1) including 8 more hazards on each of other speed zones would cause the scenario to be very long and as a result drivers would be sentisized to hazards, and (2) close following is more of an issue at higher speeds because drivers do not have enough time to stop in case of an emergency. See Appendix A for the screenshots of the roads.

As for the games, *Windows XP Minesweeper* (Intermediate level) was used for the cooperative condition (Figure 1a). *Flag Hunter*, an online two-player version of *Minesweeper* that can be accessed via *Windows Live Messenger,* was used for participants in the competition condition (Figure 1b). In addition, poker chips were used as an incentive during the competitive game. More specifically, in order to give participants a sense of competition, I gave them a poker chip for each of the five mines that they flagged.

I also administered a driving behaviour questionnaire (see Appendix B) and a Simulator Adaptation Syndrome (SAS) pre-screening test (see Appendix C). While the former collected information such as age, licence type and general driving habits, the latter assessed how likely they are to experience physical discomfort when in the driving simulator. The discomfort associated with being in the simulator is similar to that of motion sickness. Symptoms include nausea, fatigue, or difficulty in focusing their eyes. Some individuals are more prone to SAS than others, this is why we screen the participants regarding the predictors of SAS and we only recruit participants that are less likely to experience the symptoms mentioned above. At the end of the drives, each participant also completed a post-experiment Simulator Sickness Questionnaire (SSQ), which asks participants to rate possible symptoms that they might have experienced (see Appendix D).

Procedure

A between-subjects design was adopted for this study. I randomly assigned participants into one of three conditions: competition, cooperation or conversation. These conditions referred to the ways in which the participants interacted with the male confederate before the drive. During the experiment, the research confederate acted as if he was another participant (playing the games with the actual participant in the competition and cooperation conditions and talking with the actual participant in the conversation condition). In each condition, the confederate was also responsible for sitting silently in the car while the actual participant did the driving task. The confederate was youthful-looking man who was only a few years older than the actual participants. The reason I needed a confederate was to control the social environment in the car while holding the nature of the pre-existing relationship between driver and passenger constant. The games were supposed to trigger a certain kind of social atmosphere (e.g. competitiveness, cooperativeness), and the non-game conversation served as a control condition in which participants still had some kind of social interaction with the confederate before the drive that was not explicitly competitive or cooperative. In order to study social competition and whether it affects driving behaviour of young drivers, I needed to make the participants blind to the true purpose of the study in case they adjust their behaviour knowingly or unknowingly to confirm or contradict my hypotheses. That is also why I presented the study as if it had two independent components: the game-playing and the driving components. The procedure is explained in six sub-sections below:

(1) Arrival. The confederate was in the waiting room before the participant had arrived. Participants were told that the research confederate was another participant who had arrived early and completed a part of the paperwork (consent forms, driving behaviour questionnaire and the SAS pre-screening test) and the procedure (the training drive).[1] Because of this lead-in there was no need to waste time having the confederate (who was not truly a participant) go through these phases of the experiment.

(2) Consent and questionnaires. Participants were told they would take part in two independent studies. Thus, they were asked to fill in two consent forms: one for the problem solving study and one for the driving simulator study (see Appendix E). Right after they signed the consent forms, they also completed a questionnaire about their driving experience

[1] There was one incident where a participant arrived earlier than the confederate, in which case, he just played the participant who had just arrived (i.e. filled out the paperwork the same time as the participant).

and medical history that helped assess the likelihood of experiencing simulator sickness. Only the participants who passed the SAS pre-screening test were allowed to participate. They were then told that they would be the driver and the confederate would be the passenger according to a random assignment done before they arrived and that they would take turns at the end.

(3) Training. Participants were then seated in the driving simulator for their practice drive that lasted for approximately 5 minutes. The purpose of training was to familiarize the participants with the car itself, driving in a simulated virtual environment and the tasks required in the experimental drive. They were alone in the vehicle during this phase of the study.

(4) Part A: Establishing the social relationship between the actual participant and the confederate. The first part commenced right after the practice drive. Participants were randomly assigned to one of three conditions, and the procedures for these three conditions are described below:

- *Competition condition.* Participants (both the actual participants and the confederate) were given instruction about the rules and strategies of the game *Flag Hunter* (see Appendix F). They were seated at the table during the instruction phase in order to prevent their attention from being divided by other items (e.g. a computer screen). After they were comfortable about the instructions, they were directed to take their place in front of a computer. They were told that they would be given a poker chip for every group of five mines that they flagged and that at the end of 10 minutes, whoever had the most chips would receive a monetary prize of 5 dollars. The purpose of chips and a monetary prize was to motivate the participants to be competitive. I also controlled the wins and losses of the participants by having the confederate win against half of the participants belonging to the competition group, and lose against the other half. I did this in order to avoid potentially complicating effects of emotions.

It is difficult to control emotions, but by having half of the participants win and half lose in this condition, it was possible to ensure that all of the participants in the competitive condition were not in a better mood or a worse mood than those in the other conditions. The confederate was instructed to play the game in a competitive manner in that he was using the word “I” which implies non-cooperation (i.e. every man for himself) and was making positive remarks to congratulate his own success like “Nice”, “I found another” and “I will buy myself a sandwich afterwards” when he flagged a mine.

- *Cooperation condition.* Participants (both the actual participants and the confederate) were given instruction about the rules and strategies of the game *Minesweeper* (see Appendix F), and then they were directed to take their place in front of a computer. They were told that they had to take turns with each mouse click and that they would both receive 5 dollars only if they successfully flag all 40 mines together without blowing up at the end of 10 minutes. It was stressed to the participants that they could start a new game any time that they set off a mine, “blowing up”, but that they had the time limit of 10 minutes to complete the game. In this condition, money served to motivate participants to assist each other and work together during the game. The confederate was instructed to play the game in a cooperative manner in that he was using the word “We” to imply cooperating with the subject and was telling participants things like “Should we click open this one?”, and “We found another”. Both the participants and the confederate were given their money (5 dollars) right after the game ended even if they failed to complete the game in 10 minutes. They were told that they still did a good job of solving the game and cooperating together, therefore deserved the prize.

- *Conversation condition.* Participants were left at the waiting room with the confederate, who was instructed to start conversation about neutral topics, including school year, residences, weather etc. They waited for 10 minutes, at the end of which they were told that the online game did not work due to service maintenance. They were told they would directly begin the second experiment. See Appendix F for the details.

(5) Part B: Driving simulation. Participants and the confederate were told that we could carry on with the second experiment, which was a driving simulator study. They were lead to the simulator. The confederate was seated as the passenger and the actual participant as the driver. They were both informed that the study was on observational learning where they were supposed to be watching and learning from each other non-verbally; therefore, they were explicitly instructed not to engage in conversation during the experimental drive that lasted for approximately 30 minutes.

(6) Debriefing. After the experimental drive was over, the participant and the confederate were lead to the lab area again. After the participants completed the SSQ, they were informed about the true purpose of the study and were told that their partner in the experiment was a confederate. Participants were also told reason for the deception. They were told that a confederate was necessary to in order control the nature of the social interaction during game-playing and simulated drive. An apology was given to the participant by the researcher and the confederate for the deception involved in my study. The researcher then paid them (5 dollars) if the participants were in the competition condition and lost the game to confederate, or if they were in the conversation condition. People in the competition condition who won the game and the ones who were in the cooperation condition were given their prize at the end

of the games. Thus, regardless of conditions or scores, all participants received 5 dollars as a result of participating in the study. The whole experimental session lasted for an hour.

Results

Data were analyzed using factorial mixed analysis of variance (ANOVA) that had two independent variables with three levels each: both the between-subjects factor of experimental condition (competition, cooperation, conversation) and the within-subjects factor of speed zone (highway, residential, school) were analyzed for every dependent variable except headway and hazard RT, where speed zone was not included as factor. As it turns out, the experimental manipulations (competition, cooperation, or conversation) did not have the predicted effect on the dependent measures and the effects were all statistically non-significant. In the paragraphs that follow, I will consecutively discuss our measures of driving speed, car following, braking distance at the intersection, steering performance, and finally hazard reaction times.

Speed

Participants were instructed to maintain a maximum speed of 80 KpH while driving on the highway, 40 KpH in the residential areas, and 30 KpH in the school zones (Figure 2). A factorial ANOVA revealed a significant main effect of different speed zones, where drivers were faster the higher the speed limit for the particular zone was, $F(2, 70) = 609.5$, $p < .001$, $\eta^2 = .95$. On the other hand, the main effect of experimental conditions was not significant, that is drivers did not differ in their speeding across different experimental manipulations, $F(2, 35) = .67$, *ns*. The interaction between speed zone and experimental condition was also non-significant, $F(4, 70) = 1.14$, *ns*.

Headway

Another aspect of risky driving behaviour is the headway drivers maintain between their car and the lead car as measured in time to collision (the number of seconds it would for the driver to collide with the lead vehicle if the lead vehicle suddenly came to a complete stop). Results are plotted in Figure 3. ANOVA revealed that there was no significant effect of conditions on following behaviour, $F(2, 35) = .334$, *ns*. There was a non-significant trend such that the conversation condition participants left the most distance whereas those in the competition and cooperations groups followed more closely (with almost identical results). I also looked at the average stopping distance in meters from the lead vehicle at the intersection where both vehicles stopped (Figure 4). Once again, there was no significant difference among conditions, $F(2, 35) = .028$, *ns*.

SDLP and hazard responses

Last, I looked at basic measures of driving performance (steering and hazard response). One measure was weaving (i.e., deviating from the centre of the lane). Standard Deviation of the Lane Position (SDLP) assesses how far the position of the car varied from moment to moment from the centre of the lane where the drivers were to drive. Essentially, I measured how far they the drivers deviated from the centre lane by distance in meters and took an average. Results are plotted in Figure 5. I carried out a factorial ANOVA and found a significant main effect of speed zone on SDLP, where drivers' lane keeping behaviour differed across different speed zones, $F(2, 70) = 10.74$, $p < .001$, $\eta^2 = .24$. Lane keeping was increasingly worse with higher speeds: drivers were deviating more from the center of their lane when on a highway compared to when on a residential road. The best lane keeping performance was observed on school zones, where the posted speed limit was the lowest (30 KpH). However, the main effect of experimental conditions on the SDLP performance was not significant, *F*(2, 35) = .525 , *ns*. I also failed to show a significant interaction of speed zones and experimental manipulations on SDLP, *F*(4, 70) = .697, *ns*. Hazard response times (RT) are presented in Figure 6. This is a measure of how quickly participants responded to hazardous situations (i.e. a sudden, unexpected event such as a car moving onto the participants' way) by braking only. I did not observe a significant difference across conditions for this measure also, *F*(2, 35) = .307, *ns*.

Discussion

This study aimed to show that a recent history of social competition between a young male driver and young male passenger may be one risk factor that leads to more dangerous driving behaviour. My results showed an unanticipated pattern. I hypothesized that the participants who played the competitive game with the confederate right before they drive would show riskier driving behaviour with the effect of social competition lingering between them. Participants who played the game cooperatively and the ones who had a neutral conversation before the drive were not expected to be risk-takers. However, these manipulations failed to have significant effects of on any of the measures taken.

One possible explanation for why these manipulations failed to have an effect is that the games failed to manipulate the participants into the "rivalry" or "brotherhood" mindset and as a result, the social dynamics (e.g. competition or cooperation) that we were hoping to create through the games were not established. Through the games, I attempted to create an instant social relationship between two people who had never met before. This lack of social familiarity between the participant and the confederate (a research intern) might have affected my attempt at creating a "socially competitive atmosphere" or a cooperative one. As a result, in the second study I tested pairs of friends (individuals who knew each other for at least 5 months).

As well, my driving scenario was not designed to put drivers in situations where risk-taking might be seen. I hoped that the game would serve the purpose of competition and this mindset would be reflected on the driving task. However, this study was done in a laboratory where there was no actual risk and the participants knew they were being monitored by the experimenter and the cameras. I made the mistake of giving them a neutral driving road scenario (i.e. a scenario where there was no encouragement for risk-taking). On top of that, I told the participants that it was an "observational learning" study, which may have distorted participants' behaviour. It is possible that the drivers wanted to be a good role model for the passenger (the confederate). Maybe because drivers knew they were observed by the confederate, they changed their behaviour, thus causing my manipulations to be ineffective.

Given the problems encountered in the first experiment, a second experiment was devised to investigate the role of competition in facilitating risk taking and dangerous driving in young male drivers. This experiment is described in the sections that follow.

Experiment 2

The goal of this experiment was to follow-up on the Experiment 1 with a design that might better address my research question: Can interpersonal competition between young males explain the higher collision statistics concerning young male drivers driving with young male passengers? I tried to answer this question by recruiting pairs of actual friends and by designing a driving task that could promote implicit competition. In the following paragraphs, I will first discuss the previous literature as it relates to the rationale and design of the current experiment, and then I will discuss the flaws in Experiment 1 that made Experiment 2 necessary. Then I will explain the type of design and adjustments I will have for the Experiment 2 and talk about the hypotheses.

The previous literature has shown that, in the general domain of adolescent risky behaviour peer influence stands as one of the most important predictors of engagement (Andrews, Tildesley, Hopps, & Li, 2002; Horvath & Zuckerman, 1993 as cited in Gardner & Steinberg, 2005). Earlier research has already demonstrated that greater risk-taking occurs when adolescents act with groups rather than alone (Gardner & Steinberg, 2005). For example, in a simple 2D video game called “Chicken” participants were controlling a car and they needed to make a decision as to whether they should stop the car when the traffic light turned yellow (the yellow light indicated that the light might randomly turn red any second). If drivers ran a red light it would result in a crash. Thus, they had to make an immediate decision to stop or go when the light turned yellow, while keeping in mind the risk of a crash the more they choose to “go” through a yellow light instead of “stop”. The results indicated that compared to adults, adolescents took more risks (choosing to “go” instead of “stop”), especially when they were accompanied by a group of friends. Therefore, it is proposed that the reason why adolescents are greater risk-takers compared to adults could be because of their susceptibility towards influence from likewise risk-prone peers (Gardner & Steinberg, 2005).

Other researchers, such as McPhee (1996) studied peer influence by comparing same-sex friends to strangers. He found that, given vignettes that described a risky behaviour, such as shoplifting, adolescents were more inclined to apply pressure to influence their friends rather than strangers. Therefore, even though the stranger belonged to the same group (simply another peer), they were more concerned about influencing their friends. This shows that familiarity was a determinant of a particular social interaction between the two parties. From this, we can infer that an adolescent will most likely be influenced by their friends rather than by other kinds of figures. Indeed, as actual friends usually share a similar environment, this can make them more like rivals. There is more relevance that makes it important for them to maintain their reputation (social status) among their own social group. It makes sense that they would want to prove themselves to people around them but not to a random stranger walking down the street. Thus, they would take more risks when among friends in order to achieve a better social status. The risk-taking behaviour is used as a means for “proving competence”, and this creates competition between friends to overcome one another. The competition between male friends specifically is likely to be adaptive in terms of evolution since successful risk-taking and overcoming one another will be known among their social group (Wilson & Daly, 1985). This will raise their status among their friends and give them an advantage in terms of reproductive success in that particular social group. This social group naturally has both males and females, and rivalry among males is essentially about attracting the females for reproductive success.

In the driving literature, researchers such as Simons-Morton, Lerner and Singer (2005) concluded that young males drive more dangerously when accompanied by friends based on observational methods used on real world examples. The researchers recorded the speed and headway of the teenage drivers around a public high school while recording the driver and passenger characteristics such as age and sex. As a result of this unusual naturalistic observation study, the researchers confirmed that male drivers accompanied by male passengers showed higher speeds and closer headways. Even though the researchers inferred the risk-taking occurred, the reason for the risk-taking is unclear. Previous researchers have not determined why the driving behaviour of young male drivers accompanied by young male passengers is considerably riskier than other combinations of drivers and passengers. Even though distraction was cited in earlier research (e.g. Doherty et al., 1998) as a factor for the higher crash rates, this does not explain why certain types of passengers such as young males would be more distracting than older males or females. The current experiment aimed to reveal just that by a specifically designed driving task which focuses on implicit competition:

the competition that emerges even when there are no explicit rewards for outperforming others. This implicit form of competition appears to have a strong effect that shows itself in other domains such as linguistics. Tannen (1990), who considers individuals as a part of a hierarchical order, demonstrated that in daily conversations, males try to maintain their social status through one-upmanship. This takes place during conversations by behaviours such as cutting the person off the conversation, outdoing the other in story telling (interrupting the speaker with a competing story that is even more extreme or dramatic), or otherwise trying to gain control over the conversation and is a way of exerting one's dominance over the others (Tannen, 1990). In contrast, females were more likely to support the other speaker, probing for more information or indicating solidarity in terms of how they might feel in that situation. The fact that the one-upmanship type of behaviour is more common in males inevitably leads to evolutionary arguments. We can infer that males seem to act competitively in several domains of their lives as a way of proving themselves to other male rivals in order to impress females. In this phase of the study, I also introduced female drivers driving with female passengers, in order to further show that this competitiveness is mostly specific to males because of evolutionary advantages. I intended to confirm the socially competitive nature of young males and discuss this factor as it relates to risky driving behaviour resulting in higher number of collisions.

Following the results of Experiment 1, the need to adjust my study focus and design became evident. I hypothesized that young male drive more dangerously when a young male passenger accompanies them due to mutual competition. Contrary to my hypothesis, I failed to observe the effect of competition on young male drivers' risk-taking behaviour on the road when I tried to prime unrelated individuals to be more or less competitive based on previous activity (a game or conversation). There are two possible reasons why the results of Experiment 1 did not turn out as expected. One, my attempt to construct an instant social relationship between two strangers failed because this is not how relationships normally develop. In real life, it is unlikely that adolescents would engage in some risky behaviour such as committing a crime or driving under the influence of alcohol in the company of a stranger. I tried to create a competitive mindset by having two strangers engage in a competitive game. This might have made my experiment too artificial for them to behave as they normally would in real life when competition was quite explicit. Second, the driving task I used was not designed to facilitate risk-taking. In general terms, risky behaviour can be defined as a behaviour that might have a costly outcome when alternative behaviours do not have the possibility of a negative outcome. My driving task involved a typical driving scenario where there was neither an indicated cost of engaging in risky actions, nor any encouragement towards risk-taking. Therefore, it can be argued that when there are neither rewards nor actual costs, there would be no reason for participants to “show off” to others by driving more aggressively.

In this experiment, an attempt was made to remedy these problems. I shifted my focus to actual friends (i.e. people who already have an established social relationship) rather than attempting to create an instant relationship during the experiment. Unlike Experiment 1, I chose to avoid explicit competition but instead had competition occur implicitly by simply having drivers take turn driving and recording how far they managed to drive in a given time limit. Therefore, I highlighted the role of competition by manipulating it during the drives by having the participants take turns. Specifically, a pair of same-sex friends participated (one was the driver while the other was the passenger), and each took turns driving while the other became the passenger. Each pair had a total of two driving trials. Implicit competition was provided by recording the distance travelled after each drive and by attaching it on an in-car device visible to the participants until the end of the experimental session. That way each driver could see how far the other drove. The expectation was that the second driver in the sequence would try to travel further than the first driver, thus going with faster speeds ("one-upmanship"). This expectation was based on the basic factors in competition: one person gets a "score", and the other one tries to beat his/her "score".

As for the driving task itself, I created a driving simulator task where risky behaviours such as speeding and dangerous car passing could potentially occur. I encouraged speeding by presenting a countdown clock that participants could see while driving and I informed the drivers that the distance travelled would be recorded at the end of their drive, when they run out of time (See Figure 7 for the screenshot and details). Thus, if they were competitive, they would want to drive faster to travel further, which also involves passing slower moving vehicles ahead. However, there was also a cost associated with the number of collisions this type of risky driving could cause. For every collision, participants were told that they would lose 10 seconds of their time. Thus, speeding and passing cars would get them further in the end but there was a risk of a penalty if they engage in collisions on the way. This competition was encouraged implicitly by recording the distance travelled only. I did not expose the participants to any explicit encouragement for competition. I wanted to free the participants from an obvious experimental task and let them choose to behave how they wanted to behave, just as they would outside of the laboratory. Along with number of collisions and speeding, I also measured the number of lead vehicles they passed. I focused on speeding as a key determinant of risky driving behaviour because research suggests that young drivers are more likely to speed in real world and in the presence of a male passenger (CDC, 2010b).

In this experiment, the two friends (male-male and female-female) drove together, but they took turns, so one drove before the other until each of the participants had driven twice (trial 1 and trial 2). I also compared performance as a function of whether the participant drove first or second in the sequence. I was interested in determining whether the second driver in the sequence would be more competitive (i.e. drive faster, travel further) than the first, and if this effect was even more prominent in trial 2. One advantage of this experimental procedure is that the distraction caused by having a passenger in the car was held constant (there was always a passenger). In this case, the effect that is observed can be interpreted as gender differences in competition.

In addition to measuring driving performance, I also measured relevant personality factors because individuals differ in their risk-taking propensity and competitiveness. These factors cause difficulties in studying social behaviour and having full control over the experiment. Because of the danger that individual differences in risk-taking and competitiveness (especially as it relates to gender) might serve to obscure the effects of my experimental manipulations, I measured individual risk-taking propensity by using an adapted version of Sensation Seeking Scale (SSS), developed by Zuckerman (1994). I administered this test because sensation seeking was found to be a factor that contributes to higher risk of crash involvement in adolescents (Shope & Bingham, 2008). That is, sensation seekers are more likely to engage in risky behaviours. Sensation seeking encompasses a variety of different contributors to risky behaviour such as thrill seeking, behavioural intensity, and inhibitory control (Morrongiello, Lasenby-Lessard & Corbett, 2009). In the original test, participants were presented with 40 paired statements and were asked to choose a statement among each paired statement that describes them the best. Some examples are the following: (a) I would like to try parachute jumping, (b) I would never want to try jumping out of a plane, with or without a parachute; (a) I enter cold water gradually, giving myself time to get used to it, (b) I like to dive or jump right into the ocean or a cold pool. This widely-used scale received some criticisms regarding its reliability and validity over the years (e.g. Ridgeway & Russell, 1980; Gray & Wilson, 2007), however Zuckerman (2007) insists that the updated version of the test (the one I benefitted from) is still valid and reliable, and problems regarding the early versions, which most criticisms are directed to, were corrected.

As well, at the end of the study I had the participants complete a questionnaire that assessed what kind of risky driving behaviours they engage in (if any) and to what extent they consider risky driving behaviours as dangerous. For purposes of this thesis, I shall call this the Driving Behaviour Questionnaire (DBQ). I adapted this questionnaire to my purposes from two different sources, the Manchester Driver Behaviour Questionnaire (Lajunen, Parker & Summala, 2004) and the Unsafe Driving Behaviors Questionnaire (NHTSA, 1998). The former is a questionnaire that was widely used in predicting self-reported accidents (Wahlberg, Dorn & Kline, 2011). In the original test, there are three components: violations (e.g. disregard the speed limit on a motorway), errors (e.g. brake too quickly on a slippery road), and lapses (e.g. forget where you left your car in a parking lot). The latter questionnaire was administered as a phone survey and was used to document the frequency of unsafe driving behaviours in the US. I wanted to collect information on the participants' risky driving behaviours and their perceptions about those behaviours because this information gathered from the questionnaire might be useful when comparing the males and females by the scores obtained from the questionnaire. It had the potential to be an interesting addition on the driving characteristics of my participants.

In addition, I measured individual differences in competitiveness by using Competitiveness Questionnaire (CQ) (Griffin-Pierson, 1990). It focuses on two components: goal competitiveness (GC) and interpersonal competitiveness (IC). While the GC is only about striving for a goal, IC is essentially about beating others by doing or being better than them, which is more relevant to our understanding of competition in this study. Thus, I only used the IC items in this experiment. It consisted of 5-point likert-scale questionnaire that presents participants with statement such as "I have always wanted to be better than others", or "In school, I always liked to be the first one finished with a test". The developer of the scale, Griffin-Pierson (1990) noted that it is a validated measure that promises useful insight on gender-related differences in competitiveness.

These individual difference measures (Sensation Seeking Scale, Driving Behaviour Questionnaire, and the Competitiveness Scale) were collected in case there were differences specific to genders. If any differences in gender across these measures emerged, then I planned to include them as covariates into my analyses to have a pure competition effect free from possible individual differences in risk-taking tendencies between different gender groups. I was also interested in seeing how the scores obtained from these measures relate to the participants' driving performance in the simulator.

It is hypothesized that after the first driver was told how far s/he drove, the second driver would show riskier driving behaviour that manifests itself as faster speeds, higher number of collisions, and more vehicle passes compared to the first driver. This was expected because telling the distance travelled to them would produce implicit competition in the second driver in that s/he would endeavour to travel further than his/her friend. In the second driving trial, a similar pattern is expected but the magnitude of the increase in each of the measures is expected to be higher, especially for males. When the two friends are females, there should not be as large of difference in driving performance between the first and second drivers. Therefore, a three-way interaction between gender, trials and the order of drivers is expected (See Figure 8 for the predicted results). Also the average speed and the number of passes would be lower in females driving with females in general, regardless of whether they drive first or second.

Method

Participants

Participants were drawn from the participant pool of the University of Guelph. They were asked to bring a friend belonging to the same sex and age range to participate in the study. In a pair of friends, both of the participants drove twice. One of them was randomly assigned to drive first and the other was assigned to drive second based on the order that they signed up (i.e. participants who signed up for the experiment were the 1^{st}, and their friends were the 2^{nd} drivers). Participants switched roles as driver and passenger. A total of 68 participants between the ages of 18 – 20 (M = 18.97, SD = .84) participated in this experiment. Thirty-six of the participants were males and 32 were females. Each pair had been friends for a duration between 5 months to 11 years (M = 2.8 years, SD = 3.1). A total of 10 participants had G1, 39 of them had G2 and 17 of them had G licences (For driving frequency demographics of the participants, see Table 2). One female pair was excluded from the data because one of them told the experimenter that she had never driven a vehicle before. Participants who were drawn from the participant pool were given course credit for participation while the other participants were compensated for their time by receiving $10 cash.

Stimuli and apparatus

As in Experiment 1, this experiment also used the DriveSafety DS-600c driving simulator. HyperDrive was used to create five different road scenarios: one for the training drive and four for each of the experimental drives. The lengths of the experimental scenarios were 11.2km with speed limit signs (80km) incorporated every 120m. These scenarios involved a two-lane straight highway in country scenery. The passing intervals (i.e., the distance between the lead vehicle and the oncoming traffic) were either 600m or 800m.

Passing in either of these distances were an indication of risk-taking, as the research suggests that the minimum safe passing distance is 1000m for vehicles travelling around 80KpH (Greenshields, 1935). See Figure 8 for the screenshot of the experiment and the detailed explanation.

To assess individual differences in risk-taking, Sensation Seeking Scale (SSS) was used (Zuckerman, 1994) though due to time constraints the abbreviated 14-item version of the test was used (See Appendix G). A driver behaviour questionnaire (which shall be referred to as the DBQ) was used to gather information about the participants' driving history and perceptions about potentially risky behaviours in traffic. I divided this test into two parts within itself: part I was about risky driving and part II was about risk perception. This questionnaire was adapted from the Manchester Driver Behaviour Questionnaire (Lajunen, Parker & Summala, 2004) and National Highway Traffic Safety Administration's (NHTSA, 1998) Unsafe Driving Behaviour Questionnaire. The questionnaires were quite long and included a lot of items that were irrelevant to our purposes including questions on non-risky driving behaviours and US traffic regulations. I wanted to be time-efficient and used only the items that were specifically about risky-driving. Participants needed to indicate how often they engage in a particular driving behaviour (e.g. disregard the speed limit on a residential road) (see Appendix H for part I: risky driving), and they also needed to indicate how safe or dangerous they thought some behaviours were (e.g. how dangerous is it to drive through a stop sign without slowing down?) (see Appendix I for part II: risk perception). I also administered a Competitiveness Questionnaire (CQ) developed by Griffin-Pierson (1990) to measure individual differences in competitiveness. Recall that I only used the items from the Interpersonal Competition section of this test because it was more appropriate for our purposes. The other section on Goal Competitiveness was omitted (see Appendix J).

Design

In this study, I had three independent variables each with two levels. Two of those variables were between-subjects: the gender of the pair of friends (male or female), the order in which they drove (1st driver or 2nd driver in the pair). One within-subjects variable was the driving trials (trial 1 or trial 2). I measured driving speed and the number of passing events in terms of driving performance. I also measured individual differences in sensation seeking, risky driving behaviours and competitiveness because I wanted to see if I could show gender differences (which would warrant adding these variables as covariates into the analysis) and if there was a relationship between individuals' scores on these measures and their simulator driving performance measures.

Procedure

Participants arrived at the research site with their friend. They were greeted by the (female) experimenter, and then they were invited to have a seat in the waiting room. All participants were required to sign a consent form upon arrival and complete a short questionnaire about their driving history and the simulator adaptation syndrome (SAS) questionnaire that assesses if there is a risk for encountering simulator sickness, as in Experiment 1 (see Appendix K for the consent form). Participants were told that they would drive in the simulator with their friends switching roles as the driver and passenger and then complete some questionnaires at the end. As well, before driving with a passenger, each of the participants underwent a 4 minutes training phase alone in the simulator to become familiarized with the task. They experienced the simulated environment as well as elements of their experimental drive such as the car-passing task, the time left meter, and distance meter on the screen. This gave them an idea about what to expect during the course of the experimental drive. We then moved on to the experimental drives where participants were to drive with their friends as passengers.

After the participants took their seats in the vehicle, the experimenter informed them of the driving task as follows: "For this experiment, you will be driving in a virtual environment that has the same traffic regulations as Ontario. You are expected to drive as you normally would. You will see on the left side of the screen that the "Time left" is going to be counting down from 3 minutes, which is 180 seconds. And when you run out of time, the simulator will automatically stop. On the other hand, on the right side of the screen, the "Distance" is going to be increasing as you go because it basically refers to the distance traveled by meters. You are free to pass vehicles as you go. However, if you get into any sorts of collision, you will lose 10 seconds of your time". After this instruction, the experimenter gave the passenger the paper where their names were written indicating their driving order and where the numbers from distance traveled would be written. The experimenter explained it in the following way "This refers to the order of your drives. Can you attach it on the screen there? Could you do me a favour and write down the number from the distance after each drive? Whoever is sitting at the passenger seat at the time can do that. Thanks". Therefore, after each drive, participants ended up with a number of distance traveled. The hope was that by presenting a record of the number in the car it would facilitate competition between friends and thus risk-taking. The experimenter also told them not to talk to each other during the drives and monitored the drivers to ensure there was no talking. After the first drive, participants alternated roles, so the friend who was the passenger became the driver, until each of the pair drove twice (trial 1 and trial 2 for each drive).

At the end of the drives, both participants completed the questionnaires in the following order: the post-experiment Simulator Sickness Questionnaire (SSQ), Driving Behaviour Questionnaire (DBQ), Sensation Seeking Scale (SSS) and finally the Competitiveness Questionnaire (CQ). Participants completed these tests individually, and they were not allowed to see each other's tests or interact with one another. These three measures were taken after the experiment so that participants would not reflect what they thought the real purpose of the drive might have been into the experimental drives. Finally, participants were debriefed at the end of the study, which did not last for more than an hour. Participants who were not a part of the subject pool were compensated for their time by a payment of $10 cash. For the full experimental protocol, see Appendix L.

Results

Recall that there were three independent variables: the gender of the pair of friends (male or female), the order in which they drove (1^{st} driver or 2^{nd} driver in the pair), and the driving trials (trial 1 or trial 2). The first two variables were between-subjects whereas the driving trials were within-subjects. Driving speed and the number of vehicles passed were measured. Two mixed factorial ANOVAs were carried out for each of these driving performance measures. These 3-factor analyses results are presented in Figure 9 for speed and in Figure 10 for the number of passes. The number of collisions was not analyzed due to insufficient data. There were only four participants who were involved in collisions: two females (one 1^{st}, one 2^{nd} driver) and two males (one 1^{st}, one 2^{nd} driver). Individual differences in sensation seeking, risky driving behaviours and competitiveness were also measured. T-tests were used to determine whether there were sex differences in these individual difference variables (there were none). Then correlations and regressions were used to look at whether there were relationships within these measures as well as between these measures and the driving performance measures. None of the participants experienced Simulator Adaptation Syndrome and there were a total of 66 participants whose data I analyzed.

In the sections that follow, I will talk about the results as they relate to driving speed and the number of vehicles passed. Then, I will talk about individual differences measures where I will explore two things: the effect of gender and the relationships between the individual difference variables and driving performance measures.

Driving speed

Results for the driving speed analysis are presented in Figure 9. It should be noted that some participants were going as fast as 15 kph over the speed limit (80 kph), therefore no ceiling effect was introduced. There are a large number of effects to consider in a three-factor factorial design, and for simplicity, I will begin with a discussion of the main effects. I expected to find that males would drive faster than females. The results revealed the predicted main effect of gender ($F(1, 62) = 5.512$, $p < 0.05$, $\eta^2 = .082$), where males had a mean speed of 79.40 kph (*SD* = 5.16) and females had a mean speed of 76.55 kph (*SD* = 4.37). However, I also hypothesized that second drivers in the pair would drive faster than the first drivers, and on average there were no significant differences between drivers in speed (Driver Order: $F(1, 62) = .106$, *ns*.). I also expected that driving speeds would be faster on the second trial than the first and the predicted effects emerged (Trial: $F(1, 62) = 25.98$, $p < 0.00$, $\eta^2 = .30$).

There were also a number of interactions to consider, but as it turned out none of them were statistically significant. In particular, the predicted three-way interaction was not significant (Gender X Driver Order X Trial: $F(1, 62) = 1.124$, *ns*.) and the pattern of results was very different from the expected pattern (compare predictions in Figure 8 with the results in Figure 9). None of the two-way interactions were consistent with the predicted pattern either. For example, the expectation was that there would be a Gender x Driver Order interaction in which the difference between the first and second drivers would be larger for males than females. However, this interaction was not significant ($F(1, 62) = .021$, *ns*.). I also expected to find that the difference between males would be larger on the second trial. Contrary to my expectation, the Gender X Trial interaction was not significant ($F(1, 62) = .126$, *ns*.). Furthermore, I expected that the differences in driving speed between the first and second driver would be larger on the first trial than the second, but this interaction effect was not significant either (Driver Order X Trial: $F(1, 62) = .229$, *ns*.).

Number of passes

Given that faster driving speeds should also result in more vehicles passed, I predicted the same pattern of differences in the passing data as in the speed data. As can be seen in Figure 10, the results also did not conform to hypotheses when it came to the number of vehicles passed, and if anything, some of the effects were weaker. For example, the main effect of gender was not significant in this analysis (Gender: $F(1, 62) = 1.779$, *ns.*) and males and females differed little in terms of the average number of vehicles passed (Males: $M = 1.75$, $SD = 1.67$; Females $M = 1.25$, $SD = 1.40$). There was also no significant difference between the first and second drivers in the pair (Driver Order: $F(1, 62) = .013$, *ns.)* but as with the speed data, there was evidence of more aggressive driving in the second trial than the first insofar as drivers passed more vehicles (Trial: $F(1, 62) = 7.897$, $p < 0.01$, $\eta^2 = .11$).

As with the speed analysis, none of the interactions were significant. The predicted three-way interaction turned out to be non-significant (Gender X Driver Order X Trial: $F(1, 62) = 1.062$, *ns*.), as well as the two-way interactions of Gender X Driver Order ($F(1, 62) = 1.593$, *ns*.), Gender X Trial ($F(1, 62) = .877$, *ns*.), and Driver Order X Trial ($F(1, 62) = .009$, *ns*.).

Individual differences measures

Given that the first stage of individual differences analysis is to ensure that there is no restriction of range in any of the measures, the first phase of this analysis involved listing the descriptive statistics for each of the tests. As can be seen from Table 3, there was no restriction of range in any of the measures in the sample as a whole.

Effect of gender. I expected to find that males would be more prone to be the risk-takers and therefore would have higher sensation seeking, higher risky driving, lower risk perception and higher competitiveness scores. However, there was no significant difference between males and females in terms of the individual differences measures of SSS, $t(64) = -1.202$, *ns*., risky driving, $t(64) = .150$, *ns*., risk perception, $t(64) = 1.852$, *ns*., and Competitiveness, $t(64) = -.732$, *ns* (See Table 3 for the descriptive statistics). Therefore, I did not include these individual difference measures into the analyses as covariates.

Relationships among the variables. I was hoping to see that the participants' individual differences scores would reflect onto their performance in the simulator. For example, if they had a higher SSS score (which would indicate that they were sensation seekers), then I expected them to have higher speeds in the simulator. Pearson's correlation coefficient revealed several relationships between the individual differences measurements and the average speed and the number of passes variables (See Table 4 for the correlation matrix). Scores gathered from SSS and CQ did not correlate significantly with any of the variables. On the other hand, the part of the Driving Behaviour Questionnaire (DBQ) where drivers reported on their real life risky driving behaviours correlated with the average speed in the simulator in a such way that the riskier people drive in real life the faster they drove in the simulator, $r(64) = .354$, $p < 0.01$ (Figure 11). Similarly, the part of the DBQ that measured participants' perceptions of how risky certain driving behaviours were showed that those who perceived the least risk in the listed driving manoeuvres tended to drive faster, $r(64) = -.479$, $p < 0.001$ (Figure 12). This relationship was also found in terms of the number of passes where people tended to pass more cars when their perception of risk was lower, $r(64) = -.448$, $p < 0.01$ (Figure 13). I also found a consistent relationship between real life risky driving and perceived risk of risky driving behaviours, $r(64) = -.469$, $p < 0.001$ (Figure 14). That is, people tended to drive more dangerously the lower their perception of risk. Also, the participants' average speed in the simulator strongly correlated with the number of passing events, that is the more vehicles they pass, faster their speed is, $r(64) = .893$, $p < 0.001$ (Figure 15).

Finally, a multiple regression analyses were run to assess whether each of the individual differences measures (SSS, risky driving and risk perception from the DBQ, and the CQ) made an independent contribution toward in predicting our dependent variables (speed and number of passes) or whether some of the measures were predicting the same variance. In addition, I was interested in finding out if some of the variables would begin to predict driving speed and passing once the effects of other more robust variables were statistically controlled (for example, the impact of competitiveness (the CQ) on driving speed and passing might be being suppressed by the risk perception component of the DBQ). I used standard multiple regression (in which all the predictor variables are entered at the same stage), first with speed as the criterion variable and then with the number of vehicles passed as criterion variable. As a group, the individual differences variables significantly predicted both driving speed, $R^2 = .270$, $F(4, 60) = 5.541$, $p < 0.01$, and the number of passes, $R^2 = .232$, $F(4, 60) = 4.535$, $p < 0.01$. However, only the risk perception measure from the DBQ was a significant predictor for driving speed when the other variables were controlled, $b = -.36$, $t(64) = -3.31$, $p < 0.01$. This was also the case for the number of passes, $b = -.13$, $t(64) = -3.68$, $p < 0.01$, when other variables were statistically controlled. Thus, the other individual differences variables made no independent contribution to predictions of driving speed or the number of vehicles passed after accounting for risk perception.

Discussion

In Experiment 2, I attempted to show that implicit competition would alter young males' driving more than females' when drivers were accompanied by their same-sex counterparts. To test this hypothesis, I designed a driving scenario where competition through risk-taking was implicitly encouraged by recording the distance traveled. I recruited actual pairs of friends and had each of them drive twice one after another in our driving simulator while their friends were acting as spectators in the passenger seat.

Consistent with the previous literature (McKnight & McKnight, 2003; Ouimet et al., 2010; Simon-Mortons, Lerner, & Singer, 2005), I found that males tended to drive faster than females. However I could not find evidence that this was due to interpersonal competition between male friends. That is, I failed to observe that the 2nd drivers were significantly faster or passed more cars than the 1st drivers across the trials. I also found no evidence for the two and three way interactions that we predicted. I predicted that the difference between first and second drivers would be larger in males than females (a two-way interaction) and that this difference would be particularly strong on the second trial (the three-way interaction). However, I found that overall the participants drove faster in their second trial than the first. Although this might mean that participants strived to do better (i.e. go further) than they did before, we still need to be cautious with this kind of an interpretation. One of the biggest problems with within-subjects measures is practice effects. That is, a change in performance on the second trial might not reflect competition, but rather drivers getting more comfortable driving in the simulator, improving their virtual-environment driving skills. This could very well explain why there was a significant increase in speed the second time participants took on the role of the driver. Therefore it is difficult to make inferences about presence of a competitive effort.

Even though I failed to show the expected effect of competition and how it modifies driving behaviour of young people when they are accompanied by their same-sex friends, in between trials and sometimes during the drive I witnessed verbal indications of competition and risk-taking from a couple of participants. These indications include participants saying, “You drove further than me” in between trials or forming a silent “Yes!” when they successfully overcome a risky situation while passing a slow-moving lead vehicle. At the end of the debriefing session, some participants also stated that they were indeed keeping the track of the distance traveled and that they endeavoured going further each time. These qualitative measures were collected but not added into the analyses because there were only a small number of these statements (See Appendix M). In future studies on in-vehicle competition it would be beneficial to include a simple questionnaire as to how competitive the participants felt during the experimental drives and whether they thought the number from the distance traveled was important. This could serve as a way of double-checking if the task actually promoted competition.

Individual differences measures were collected under the assumption that gender differences would be observed. My results were discrepant from the previous literature (e.g. Wilson & Daly, 2001; Roberti, 2004; Niederle & Vesterlund, 2008; CDCP, 2010a) in that I found no significant sex differences. However, I still gathered interesting results. I found that participants' real life risky driving behaviour reflected itself in the simulator as higher speeds. These risky driving behaviours were also related to how dangerous they thought these behaviours were. That is, the safer they thought actually risky driving behaviours were, the more they tended to drive in a risky manner. For example, if their risk perception about going 20km over the speed limit on highway was "somewhat safe", then they acted in a way that reflects these perceptions by disregarding speed limits. This brings out a noteworthy assumption: if we want drivers to stop driving dangerously and follow the rules, we need to modify their perceptions about how safe or dangerous certain behaviours such as following speed limits are. This risk perception was also linked with the speed in the simulator. Participants tended to drive faster if their overall risk perception scores about risky-driving behaviours were lower (i.e. they thought risky behaviours were safer). These results also served as instruments that helped validate the measurements taken in the driving simulator. They showed us that measurements gathered through simulators might predict real life behaviour. Therefore, driving simulators can be useful tools of studying risk-taking behaviour in a non-risk environment.

Correlations showed that the personality measures (SSS and Competitiveness Questionnaire) were not related to the risk perception or dangerous driving as measured by the Driving Behaviour Questionnaire or the participants' driving speed in the simulator. SSS is a widely used and a validated tool that the previous research on risk-taking has benefited from (e.g. Chein et al., 2011). In this study, I used an adapted version of the test that only had 14 items as opposed to the full 40, though other studies have used abbreviated versions of this test with success. Similarly, the competitiveness questionnaire consisted of only 6 items. These questions referred only to competitiveness in the context of academic life. Both of the questionnaires were kept short because of the time constraints regarding the experimental session, which had to be no more than one hour long (Session length had to be restricted to one hour in order to attract a sufficient number of participants. The winter term subject pool had fewer participants than usual and researchers were forced to economize in terms of the number of hours required per study). It is possible that I might have sacrificed the reliability or validity of these measurements by adapting them to require less time.

Another explanation for why I could not find an effect of competition in risk-taking may originate from distortions produced by testing in a lab environment. Although risk-taking behaviour was expected, participants may have acted in a risk-averse way simply because they were observed in a lab environment by an experimenter, who also older than the participants and may have represented an authority figure to them. Although psychology attempts to create circumstances to show real-life phenomena in the lab environment, the observations sometimes suffer because of factors not present in real life, such as being watched by an experimenter. Although drivers might normally compete in ways that made their driving dangerous, in our case, while being watched, some might even be competing to be the safer driver. However, this is a difficult argument to make because the trends still seemed to be in the other direction, that is, they drove more dangerously the second trial. It is more plausible to infer that some of the participants acted in a risk-averse way while others did not. Among the participants there might have been major individual differences that made it difficult for us to see consistent trends. That is, some of the drivers might have been competing to drive safe and some to drive more dangerously, which would cancel out any effect that could have been observed in this study.

Nonetheless, in the real-world, young male drivers driving with young male passengers are the group at the highest risk (IIHS, 2009; Ouimet et al., 2010). Surely, this group cannot be competing among themselves to be the safest drivers. There must have been something about young males that make them more risk-prone, and I started off by what Wilson and Daly (2001) have talked about: males, especially young males, compete with each other to increase their social status among others which then gives them evolutionarily advantages over common resources. Both of my experiments attempted to show how competition might alter driving behaviour of males (or females, in my second experiment) by either priming them to be competitive through computer games or by modifying the task in a way that encouraged being competitive.

It may be that I failed to observe the effects in my second experiment simply because young males do not compete more than females. However, when we compare young males and young females in accident statistics, we can easily infer that the difference in risky driving must be gender-related. When we also add in the passengers into the equation, social dynamics between the driver and the passenger must surely be playing a role that results in male-male pairs being the most dangerous combination. Young males, who normally drive more dangerously than young females, drive even more dangerously when they have their male friend in the vehicle with them. Competition was one aspect that could contribute to this but the explanation might also be as simple as the two risk-prone friends “egging each other on” to engage in risky actions while driving (e.g. a passenger telling his friend to just pass the vehicle ahead even though it is risky). In this case, a large-scale, detailed survey exploring what actually is going on within the vehicle between young friends might come in handy.

It is possible that the procedures used in this study (role switching and recording the distance traveled) were not enough to induce competition, and thus no “one upmanship” was observed when drivers were driving in pairs. For example, if drivers failed to pay attention to the distances recorded, there would be no basis for competition. Furthermore, there was nothing that would explicitly encourage competitive risk-taking behaviour. In no part of the study did I mention anything that implied competition. I talked about the distance traveled, not the score, and never mentioned any competition related task during the instructions. The reason I favoured an implicit competition was because my goal was to observe the behaviour of the participants under more naturalistic conditions. I wanted to answer the question: how would the young people behave given opportunity to compete by taking risks when they were driving in the presence of their friends? If I made the task explicitly competitive, then I would have to deal with measures that reflected the competition effect that was not applicable to the real-world situations, which was what I was interested in observing in the lab environment. However we cannot be sure that participants felt that they were encouraged to be competitive unless we check with them at the end about their feelings and what they thought about the overall experience. This was an important factor that I overlooked in this study.

There was also a possible problem regarding the random assignment in Experiment 2. Participants were randomly assigned based on the order that they signed up (i.e. whoever signed up through the participant pool was the first driver and their friend was the second). This might have caused a problem in that first drivers might be more assertive than the second drivers because they took the initiative to sign up for the study in the first place. They might also be more interested in driving or more confident about their driving skills. This should have been considered before, but looking at our pattern of results (Figure 9 and 10), it appears that counterbalancing would only make the results even less different for the first and the second drivers. Therefore, this situation likely did not cause any damage to the study.

It is worth stressing that the individual differences between subjects may have overwhelmed my variables. Thus, in future investigations, it would be important to have a non-competitive condition with which to compare the competitive task. This way, we could get a baseline measure of driving that would allow us to subtract out individual differences in performance, and only look at how driving changes when drivers were in implicit competition. This could be done by having a condition in which the distance traveled would not be measured or recorded (eliminating the implicit competition effect I attempted to create). There were only so many factors that I could include in a single study and in this study, gender was the chosen factor because evolutionary theory predicts sex differences in both competition and risk-taking. Although I expected male friends to drive more dangerously than females as a result of competition, it is hard to say if I would have observed similar amounts of risky driving for non-competitive task (in which drivers were alone, for example). A baseline condition where the pairs of friends drive alone first would have made it clearer whether the presence of passengers modified driving behaviour. However, this would have caused me to stray from my research question. Moreover, we already know through previous research that passengers indeed alter driver's behaviour, especially if the passenger is a male (e.g. Ouimet et al., 2010). What I wanted to show was the competitive nature of this interaction between young male drivers and young male passengers. I was more focused on answering this question and therefore I wanted to keep the presence of a passenger constant. It would also be a good idea to test male-female pairs to have a comprehensive study on the nature of social interaction between the driver and the passenger.

Related to individual differences, there might also have been differences observed in driving exposure between males and females (see Table 2). However, independent samples t-tests revealed that the differences between males and females were not statistically significant for the number of days driven in a month (p>.05), average time driven in a day (p>.05), and average km driven in a day (p>.05). There is a reason to believe that these self-assessed measures are extremely unreliable. This is because people are not good at estimating how many minutes they drive in an average day and are usually clueless about the kilometers they travel. For example, it is not uncommon to hear people say they drive for two hours everyday and go 20km. Given that these measures are somewhat suspect, they will not be discussed any further.

It should be noted that I based my hypothesis about competition on evolutionary theories (sexual selection) and sexual selection suggests that there should be some sort of benefit to risky behaviour in terms of reproductive success. It is difficult to study long-term reproductive success without a longitudinal study where we follow up on our participants' relations with the opposite sex and keep track of the number of offspring. I am aware that evolution and competitiveness does not constitute the only hypothesis as to why young male drivers could be prone to be risk-takers when driving with other young males. Several factors could be associated with this trend and these factors are most certainly worth being investigated. For example, culture may play a role. This study was carried out with a North American sample. However, cultures may differ in terms of the way they think about "risk-taking". In fact, a study showed that even the proverbs that are risk-related differed across cultures (Weber, Hsee & Sokolowska, 1998). It was found that American proverbs were risk-averse compared to German and Chinese proverbs. As well, some cultures such as the eastern cultures put more pressure on males to be successful at everything. Thus, in these cultures, being competitive and taking risks could actually bring even more approval from the people and it might simply be considered a “lifestyle”. Returning to driving, it might be interesting to compare the driving-related statistics of North America, Europe and Asia. However, it should be kept in mind that the trends seemingly reflecting cultural differences in driving could also be a result of the varying traffic regulations of the countries, financial resources, and education.

Conclusion

Motor vehicle accidents are a leading cause of death in young people. Although a number of factors contribute to the statistics, situational factors such as passengers in the vehicle could play a different role in collision rates for drivers depending on their gender or age. In our case, I wished to focus on investigating the highest risk group: young male drivers driving with young male passengers. I theorized that male-male interaction was competitive in its nature and that this competitiveness manifested itself as participating in risky driving behaviours. Risk-taking is sort of a gamble that is not always successful and it can result in fatal consequences in the case of driving. There is more chance for things to go wrong when a risk is taken (i.e. there are costs associated with the failure of overcoming the risks). However, if the driver takes the risk and successfully overcomes it, then comes the reward of “proving oneself” in front of the observing audience (such as a passenger in this case). That is why I thought that if I put male drivers and male passengers into the car and let them drive, I would have observed “one-upmanship” in risk-taking in the vehicle.

In my first experiment, I tried priming two strangers into a competitive mindset through playing a competitive game and had them drive a regular driving scenario. In my second experiment, I recruited pairs of actual friends and had them drive a scenario that was risky in itself and tried to find evidence of implicit competition between drivers in terms of the distance traveled. I also recruited female pairs to emphasize gender differences. I could not demonstrate an effect of interpersonal competition in either of these experiments, even though I did note verbal indications of competition in the second experiment. The fact that I could not show this effect in the lab environment does not mean it still cannot be “out there”, as there is a huge difference between being “tested” in a lab while watched by an experimenter. I still think future research on this aspect of social dynamics is warranted and whether male-male competition is a factor in high accident rates remains an open question.

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Tables

Table 1

Mean driving frequency demographics of the participants in Experiment 1 (with Standard Deviations in Parentheses)

Experimental Conditions	Days driven/Month	Mins driven/Day	Km driven/Day
Competition Condition *n* = 13	15 (10.34)	50 (36.31)	32 (26.23)
Cooperation Condition *n* = 12	18 (12.01)	46 (31.17)	20 (17.32)
Conversation Condition *n* = 13	17 (10.29)	46 (26.96)	30 (27.36)
Total *N* = 38	17 (10.65)	47 (31)	27 (24.25)

Table 2

Mean driving frequency demographics of the participants in Experiment 2 (with Standard Deviations in parentheses)

Gender	Days driven/Month	Minutes driven/Day	Km driven/Day
Males *n* = 36	15 (12.26)	48 (39.80)	30 (38.01)
Females *n* = 30	10 (10.97)	33 (28.58)	19 (23.95)
Total *N* = 66	12 (11.61)	41 (34.19)	25 (30.98)

Table 3

Descriptive statistics of the individual differences measures (Standard Deviations in parentheses, R refers to the range). SSS refers to the Sensation Seeking Scale and CQ is the Competitiveness Questionnaire.

	Risky driving Max = 54	Risk perception Max = 85	SSS Max = 14	CQ Max = 30
Total N = 66	17.21 (4.31) R = 9 - 26	69.93 (5.95) R = 52 - 81	6.92 (2.62) R = 0 - 12	17.15 (3.59) R = 9 - 27
Females n = 30	17.3 (4.75) R = 9 - 26	71.4 (5.56) R = 58 - 81	6.5 (2.62) R = 0 - 11	16.8 (3.5) R = 9 - 24
Males n = 36	17.13 (3.97) R = 10 - 24	68.72 (6.07) R = 52 - 81	7.2 (2.61) R = 2 - 12	17.45 (3.68) R = 11 - 24

Table 4

Correlation matrix for the individual difference measures, speed, and the number of passing events. Abbreviations used are SSS for the Sensation Seeking Scale and CQ for the Competitveness Questionnaire.

	Speed	Number of Passes	Risky driving	Risk perception	SSS	CQ
Speed	___					
Number of passes	.893**	___				
Risky driving	.354**	.209	___			
Risk perception	-.479**	-.448**	-.469**	___		
SSS	.125	.140	.080	.010	___	
CQ	.027	.019	-.044	-.199	.163	___

** $p < 0.01$ level

Figures

a) Minesweeper b) Flag Hunter

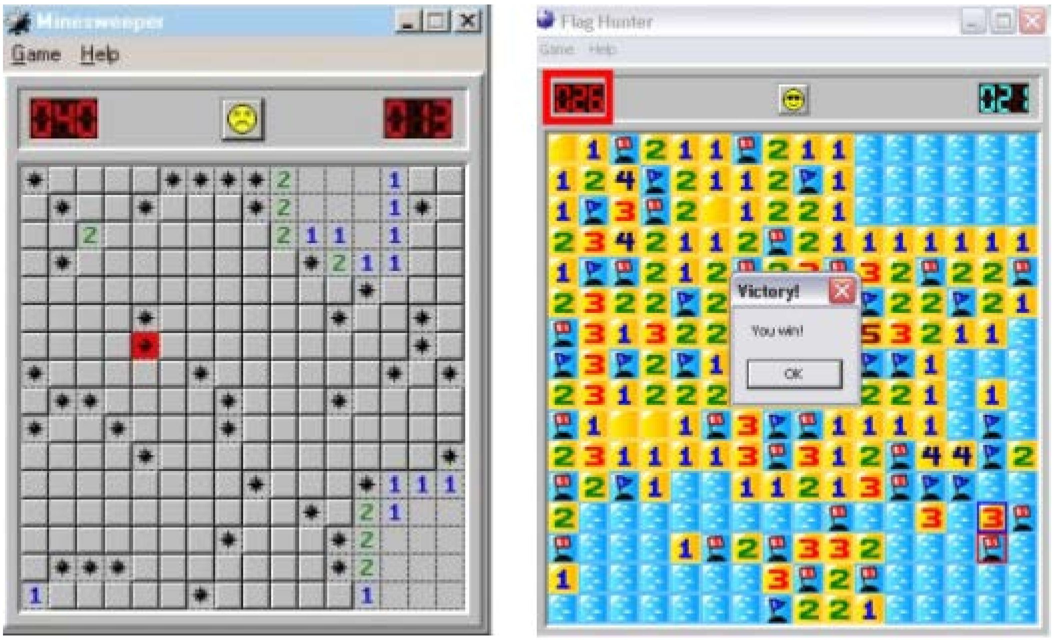

Figure 1. Screenshot of the games in Experiment 1. (a) The purpose of *Minesweeper* is to find all the 40 mines in a total of 256 squares and “flagging” them by right-clicking on a square. If left-clicked on a square where there is a mine, the game will come to an end with an explosion. When left-clicked on a square where there is no mine, empty squares or numbers will appear. The numbers give the player a clue as to the number of mines located in the adjacent squares. (b) In *Flag Hunter*, players always click with the left button of the mouse and they are free of the concern of being blown up. By clicking on a square, either the mines will automatically be flagged or the empty squares and numbers will come up. There are total of 50 mines and the players need to flag the most mines (at least 26) in order to win. When they flag a mine, it will still be their turn to play. If they come across a number or an empty square instead, it will be the other player’s turn.

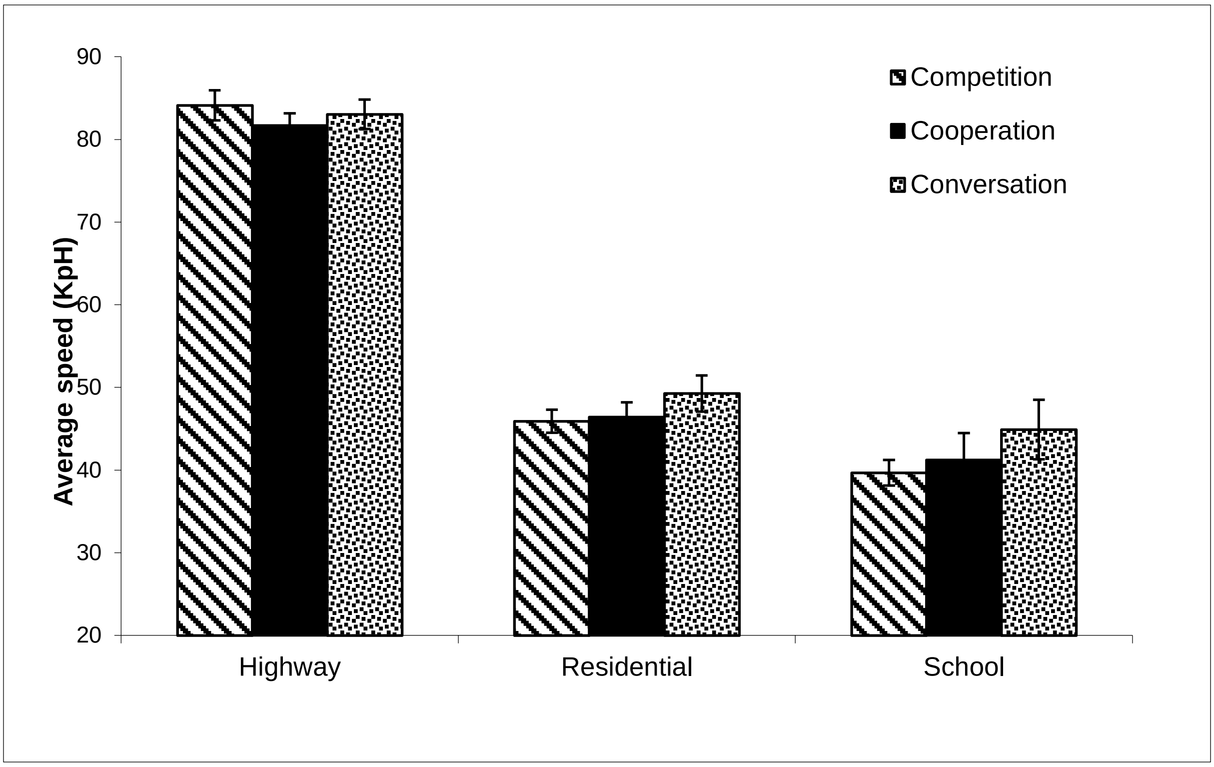

Figure 2. The average speed in different road areas across three experimental conditions. The speed limit for the highway was 80KpH, for the residential areas 40 KpH, and for the school zones 30 KpH. Error bars represent +-1 standard errors.

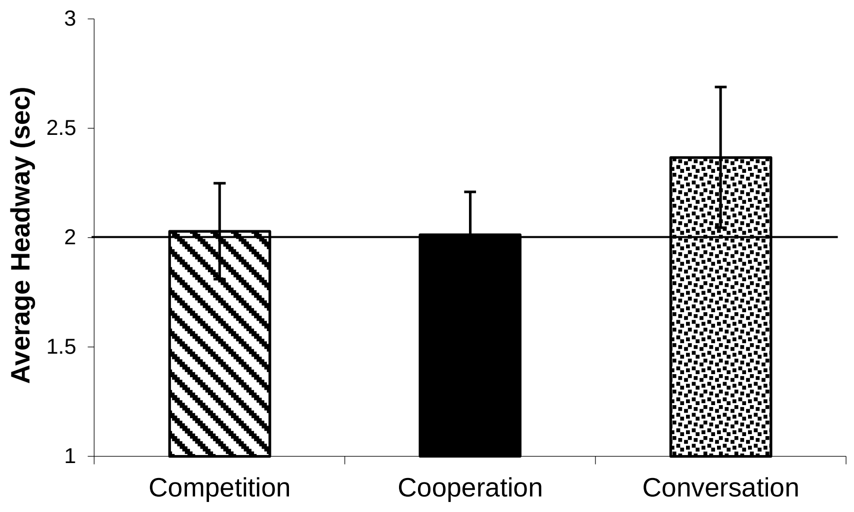

Figure 3. The average headway in time between the participant and the lead vehicle across three conditions. The solid line indicates the minimum safe headway that is suggested by the “2 seconds rule”. Error bars represent +-1 standard errors.

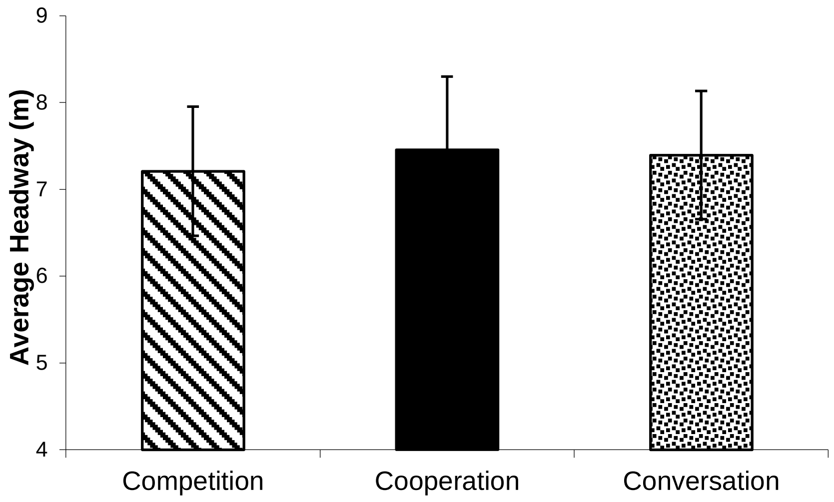

Figure 4. The average stopping distance in meters from the lead vehicle at the intersection where both vehicles stopped. Error bars represent +-1 standard errors.

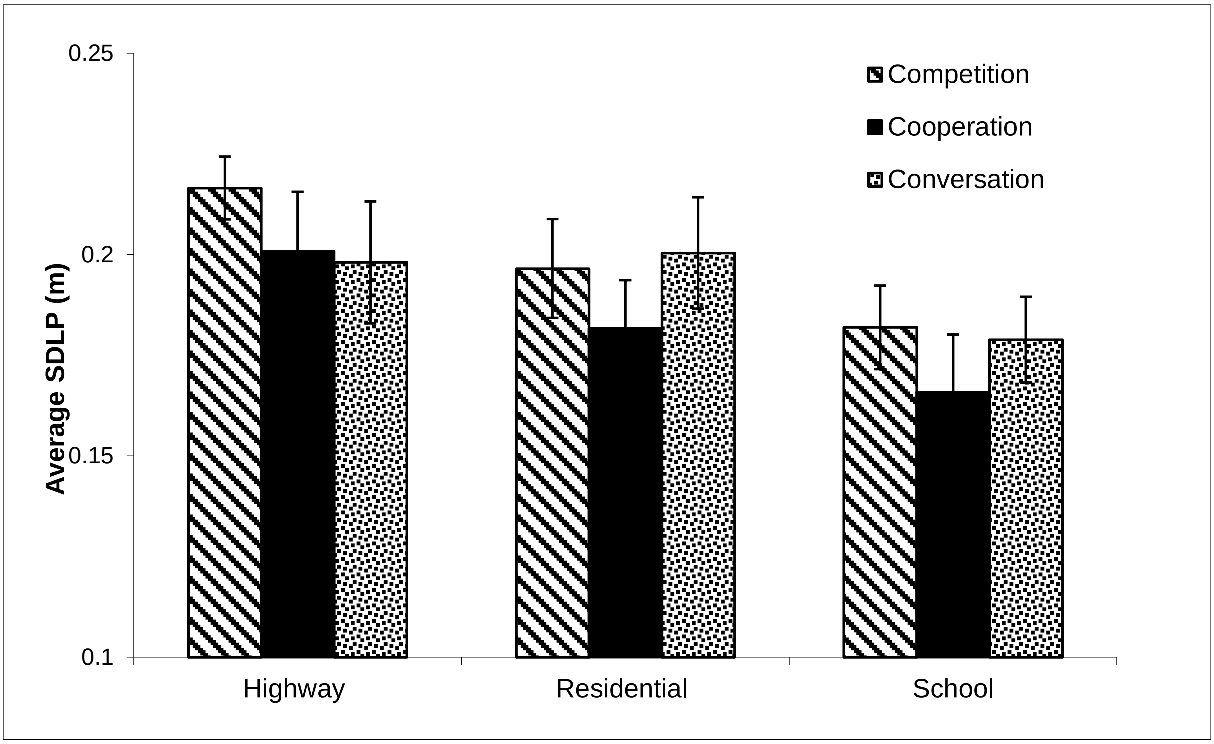

Figure 5. The average Standard Deviation of the Lane Position (SDLP), measured in meters, across different road areas and three experimental conditions. Error bars indicate +-1 standard errors.

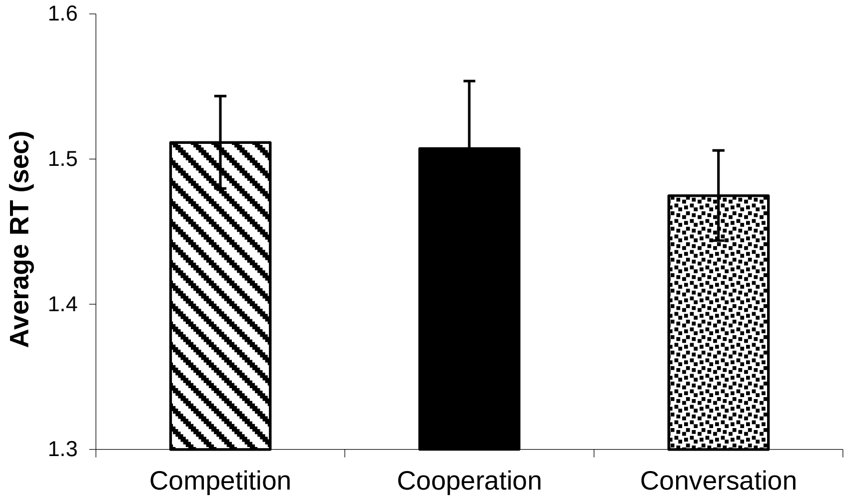

Figure 6. The average hazard reaction times (RT) across three experimental conditions. Error bars represent +-1 standard errors.

Figure 7. Screenshot of the experimental drive. The speed limit posted was 80KpH. On the left, “Time Left”, which counts down from 180 seconds, indicates how much time participants have before simulator automatically stops when the time reaches 0. On the right, the distance meter is increasing as the participant drives, and it simply refers to the distance travelled by meters.

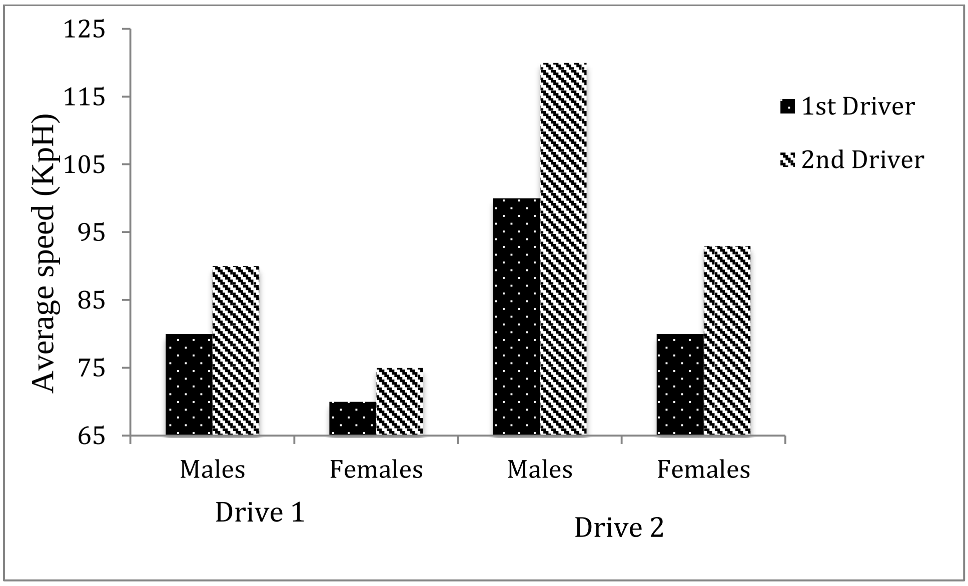

Figure 8. Predicted results for speed displaying the 3-way interaction by driving trials, driver order and gender.

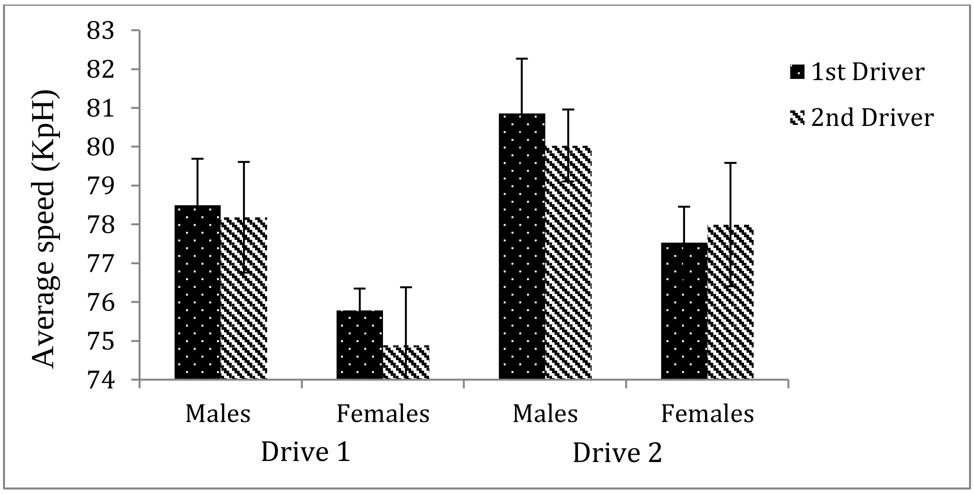

Figure 9. Average speed across trials for males and females. Error bars represent +-1 standard errors.

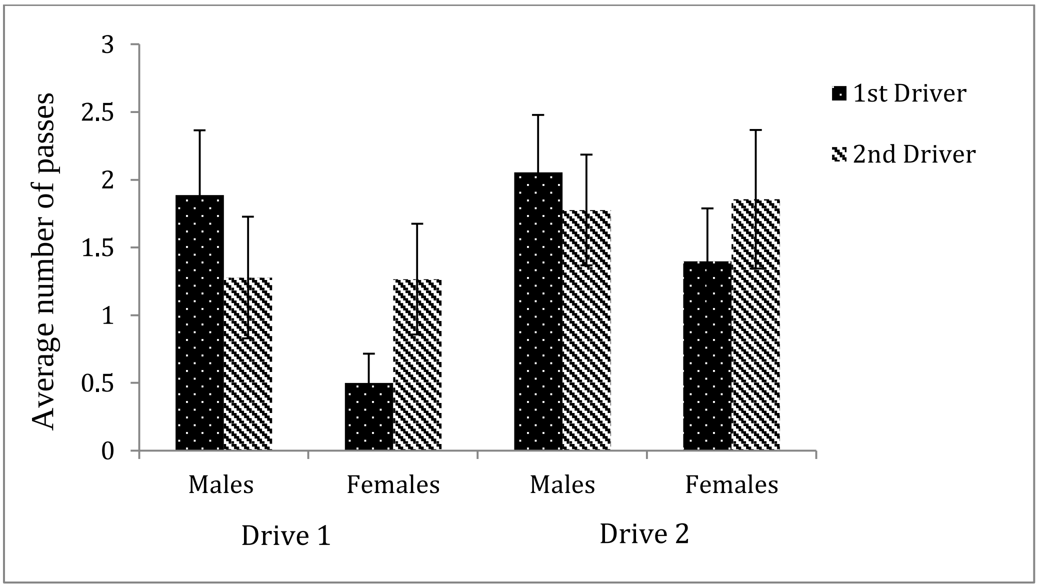

Figure 10. Average number of passes across trials for males and females. Error bars represent +-1 standard errors.

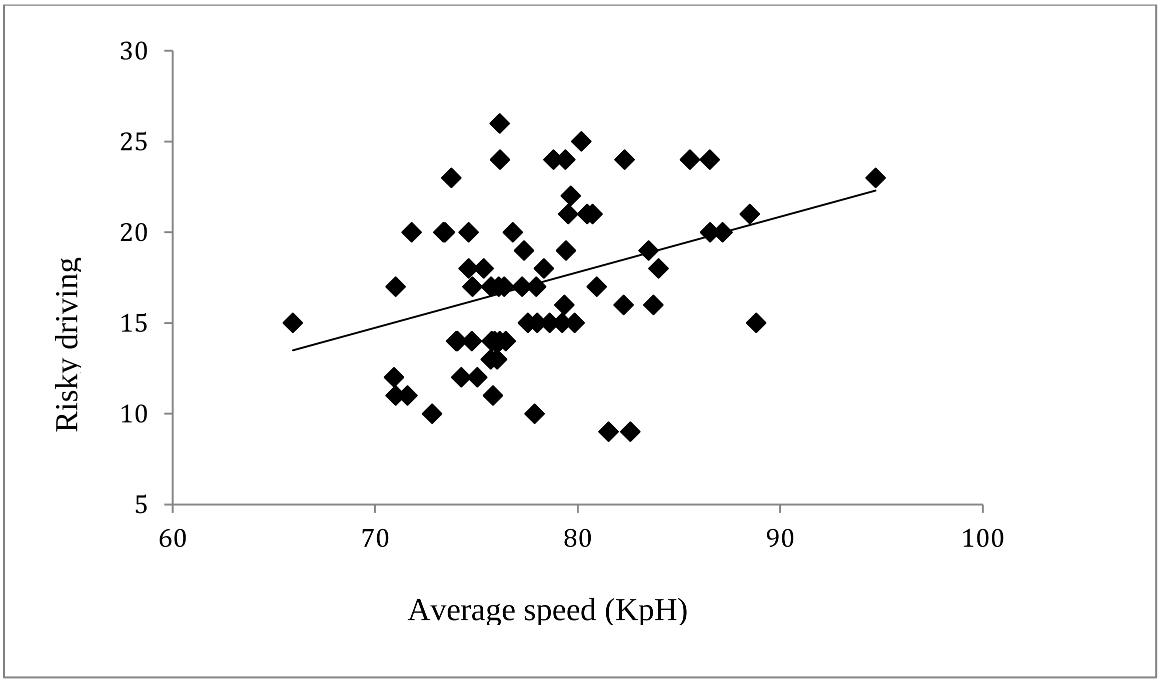

Figure 11. Relationship between the average speed and risky driving scores. Higher the scores in risky driving measure, more risky behaviours drivers engage in.

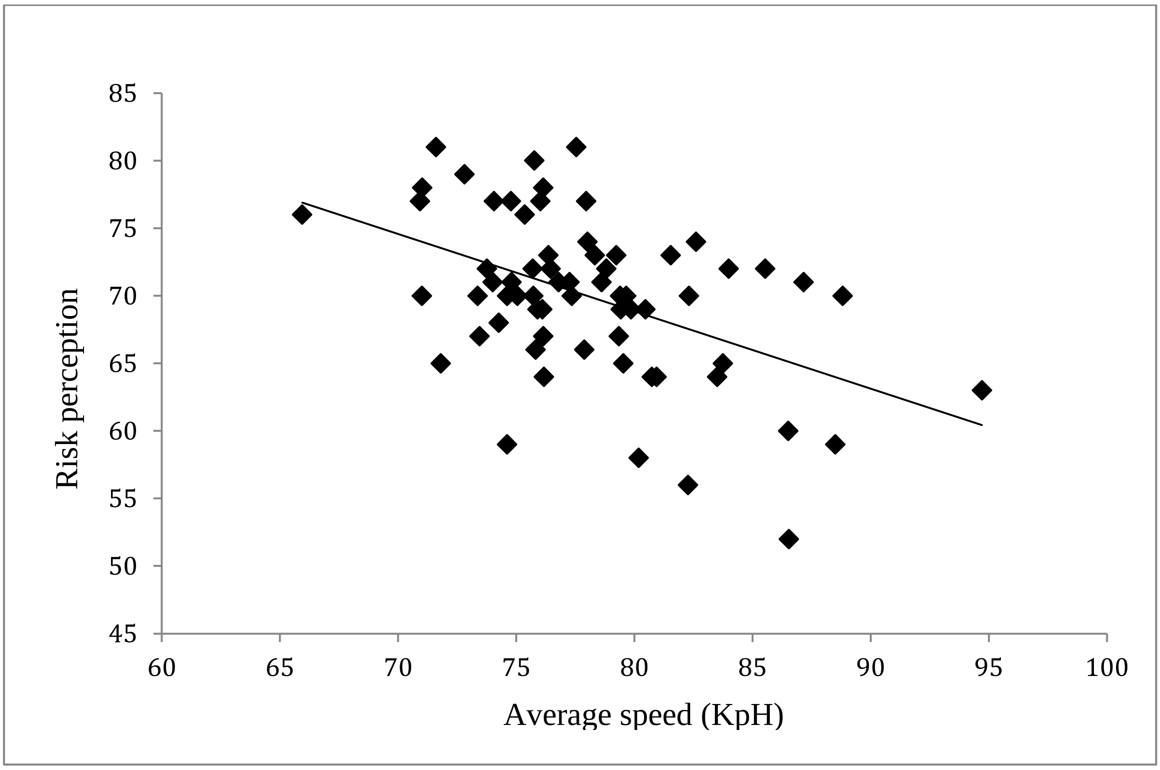

Figure 12. Relationship between the average speed and risk perception scores. Lower risk perception scores indicate that drivers think risky behaviours are safer than they really are. Thus, they underestimate the risks of risky behaviours.

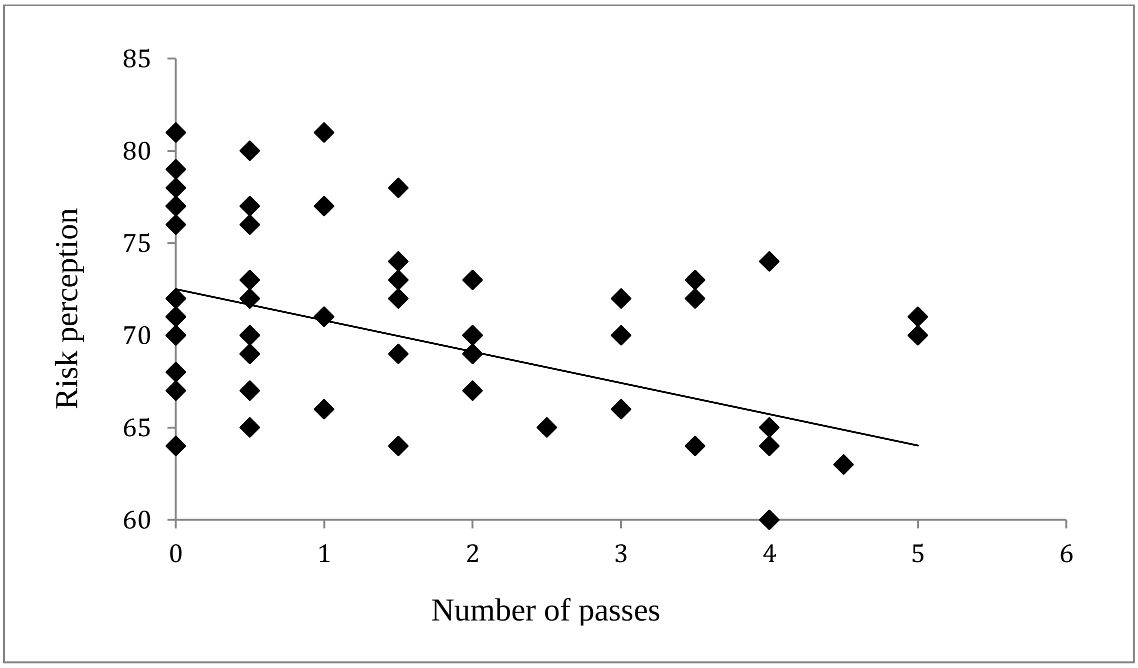

Figure 13. Relationship between the number of passing events and risk perception scores. Lower risk perception scores indicate that drivers think risky behaviours are safer than they really are. Thus, they underestimate the risks of risky behaviours.

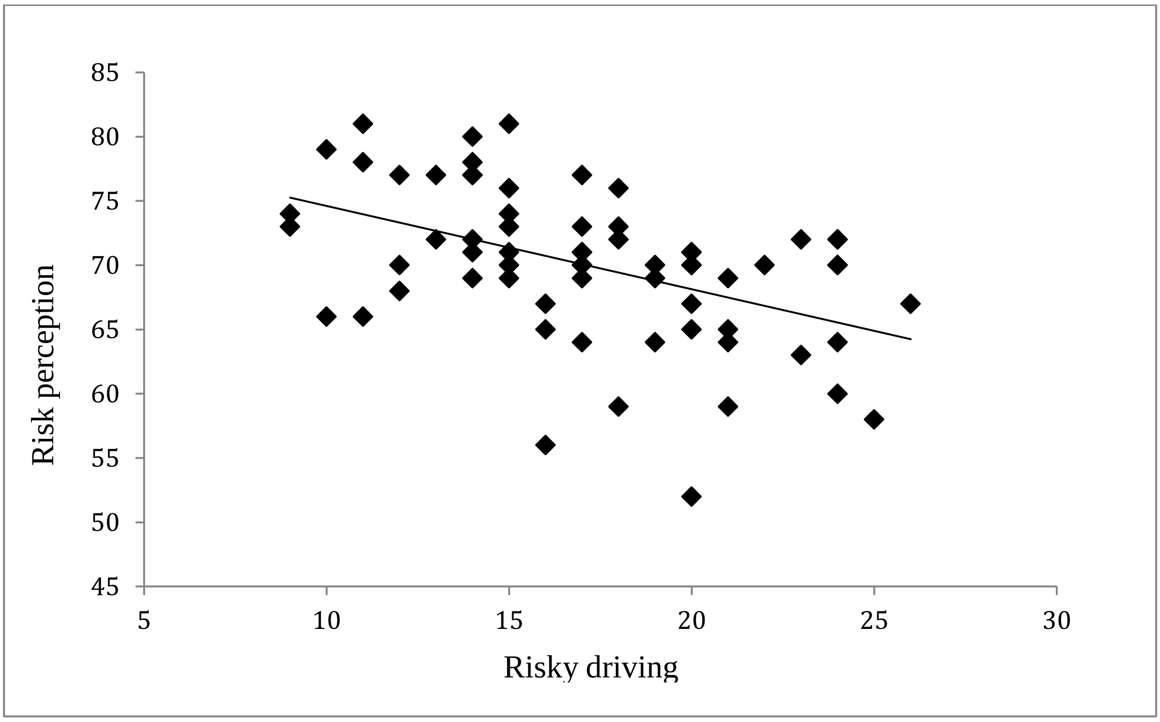

Figure 14. Relationship between risky driving and risk perception scores. Higher the scores in risky driving measure, more risky behaviours drivers engage in. Lower risk perception scores indicate that drivers think risky behaviours are safer than they really are. Thus, they underestimate the risks of risky behaviours.

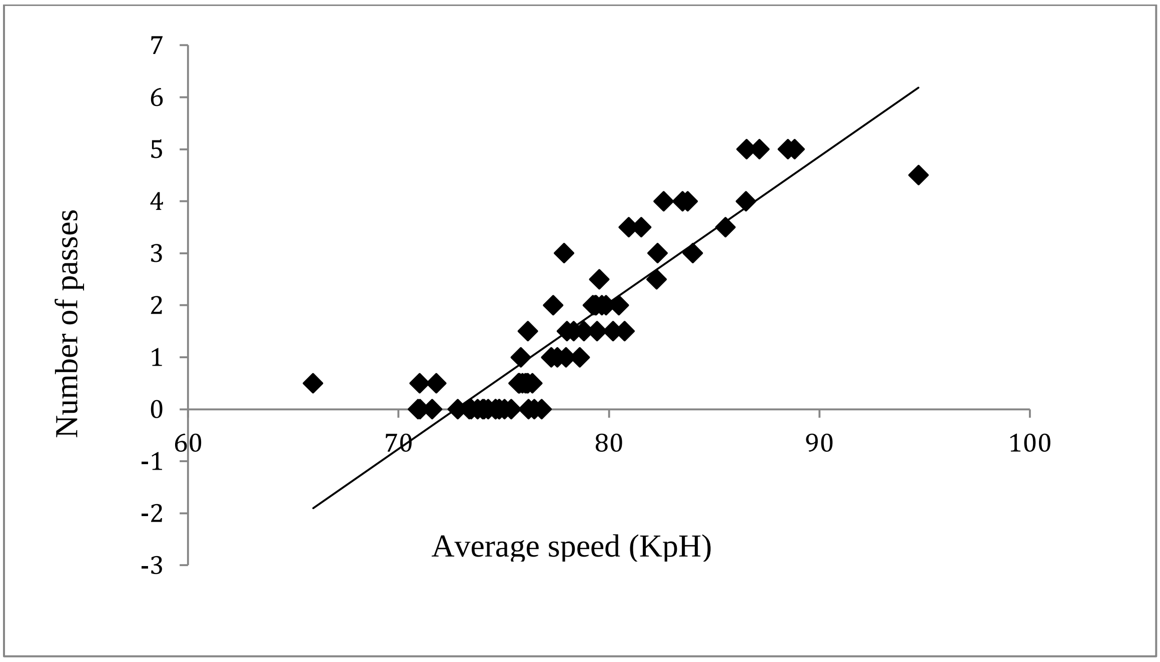

Figure 15. Relationship between the average speed and number of passing events.

APPENDIX A. Screenshots of the experimental road scenarios for Experiment 1

Screenshot of the car following task in Experiment 1.

Screenshot of a hazard in Experiment 1.

APPENDIX B. Driving behaviour questionnaire used in Experiment 1.

Driving Questions

At what age did you first start driving?____

When was the last time you drove? _____ days

How many times a month do you drive on average?____

How long do you drive on an average day?____

How far do you drive on an average day?____

What kind of driving do you do most often? Urban____ Rural____ Highway____

What level is your driving licence? _____

Is there anything else you would like to add about your driving experience?

APPENDIX C. Simulator Adaptation Syndrome (SAS) Pre-screening test.

General Medical History Questionnaire

Do you have heart problems or have you had a heart attack?

Have you ever had a stroke, brain tumour or head trauma?

Do you experience lingering effects from stroke, brain tumour or head trauma?

Do you suffer from epileptic seizures?

Do you have inner ear problems (vertigo)?

Do you have diabetes for which insulin is required?

Do you have problems with low blood sugar (hypoglycaemia)?

Are you currently taking any medications that make you feel extremely dizzy or nauseated?

If the participant answered yes to any of the above questions indicate that they may be at a higher risk of problems resulting from simulator exposure and ask if they want to continue. If the participant answered yes to two or more of the above questions do not permit them to continue in the study.

Specific Predictors

Some participants feel uneasy after participating in studies using a simulator. To help identify people who might be prone to this feeling we would like you to answer the following questions.

Do you experience migraine headaches?

Do you experience claustrophobia?

Do you have any history of motion sickness?

(If yes, please describe where and when)

Have you ever experienced dizziness or nausea while looking at a wide screen (e.g. Silver City or Omnimax Theatre)?

Do you experience dizziness or nausea while reading in a moving car?

Do you experience dizziness or nausea on carnival rides?

Do you prefer to be the driver rather than the passenger, because otherwise you experience dizziness or nausea?

If the participant answered yes to any of the above questions indicate that they may be at a higher risk of problems resulting from simulator exposure and ask if they want to continue. In particular, viewing a computer screen may cause eye-strain and eye-strain triggers migraines for some migraine sufferers; the confined space may be a challenge for claustrophobics; people who have experienced dizziness or nausea as a result of motion (especially recently) or while viewing wide screen movies may experience similar symptoms in a simulator. However motion sickness experienced on a boat is much more typical. We are especially worried about people who get car sickness or motion sickness on a train or those who cannot read in a moving car.

APPENDIX D. Post-experiment Simulator Sickness Questionnaire (SSQ)

There is a small risk associated with driving in the driving simulator. Some individuals experience feelings of dizziness or nausea, and an increase in body temperature, which are symptoms of a temporary condition called Simulator Adaptation Syndrome. We are tracking the severity of any discomfort felt by those who drive in the driving simulator.

1. How many times have you been in the driving simulator? (Check one)

   First time______ Second Time______ More than two times______

2. Please rate the following symptoms of discomfort on a scale of 0 to 3, where 0 = none, 1 = slight, 2 = moderate, and 3 = severe.

Symptom	**Rating**
General Discomfort	_____
Fatigue	_____
Headache	_____
Eyestrain	_____
Difficulty Focusing	_____
Increased Salivation	_____
Sweating	_____
Nausea	_____
Difficulty Concentrating	_____
Fullness of Head	_____
Burping	_____
Dizzy (Eyes Open)	_____
Dizzy (Eyes Closed)	_____
Vertigo	_____
Stomach Awareness	_____
Blurred Vision	_____

APPENDIX E. Consent forms used in Experiment 1

UNIVERSITY of GUELPH

CONSENT TO PARTICIPATE ON RESEARCH

Social problem solving and its relation to strategy games

You are asked to participate in a research study conducted by Lana Trick and Ece Subasi, from the Department of Psychology at the University of Guelph. The results of this study will be contributed to a side-project.

If you have any questions or concerns about the research, please feel free to contact Lana Trick by phone, 519-824-4120 (ext. 53518) or by e-mail, ltrick@uoguelph.ca.

PURPOSE OF THE STUDY

This research study investigates the social problem solving and how it relates to strategy games. Strategy games such as minesweeper require problem solving skills. We will look at how introducing a social factor (i.e. playing while interacting with another person) will affect the performance of the player.

PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

You will be playing a computer game (minesweeper) with another participant during which your performance will be assessed by the investigator. You will be playing the game once, twice or up to three times depending on your performance (i.e. how long it takes for you to complete one game).

This session should take not more than half an hour. It will only be one session and you will not be contacted for follow-ups. The research findings will not be available until the data collection and analyses is completed.

POTENTIAL RISKS AND DISCOMFORTS

There are no potential risks or discomforts as a result of participating in this study.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

You will be supplying valuable information about the inner workings of problem solving skills and whether social factors can help improve or worsen the performance. You might also enjoy playing a computer game.

PAYMENT FOR PARTICIPATION

You will be paid in course credit, 1 credit for each hour of participation (half a credit for this part).

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. Your data will be kept strictly confidential and will be kept in a locked laboratory.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent anytime and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the University of Guelph Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

Research Ethics Officer
University of Guelph
437 University Centre
Guelph, ON N1G 2W1

Telephone: (519) 824-4120, ext. 56606
E-mail: sauld@uoguelph.ca
Fax: (519) 821-5236

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study "The phenomenon of observational learning on driving performance of young adults" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

____
Name of Participant

____
____
Signature of Participant   Date

SIGNATURE OF WITNESS

____
Name of Witness

___________________________________ ____________________________
Signature of Witness Date

UNIVERSITY of GUELPH

CONSENT TO PARTICIPATE ON RESEARCH

The phenomenon of observational learning on driving performance of young adults

You are asked to participate in a research study conducted by Lana Trick and Ece Subasi, from the Department of Psychology at the University of Guelph. This research is a Master's Thesis sponsored by Auto 21.

If you have any questions or concerns about the research, please feel free to contact Lana Trick by phone, 519-824-4120 (ext. 53518) or by e-mail, ltrick@uoguelph.ca.

PURPOSE OF THE STUDY

This study investigates the effect of observational learning on driving performance of young adults. In this study you will be asked to drive with another participant who will be the "learner". We will then assess the driving performance of the learner and compare it to your performance. This way, we hope to see if there has been any effect of observational learning.

PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

You will be "driving" in the University of Guelph Phase I Driving Simulator. In this study, you will be asked to drive through a simulated driving environment (e.g. a country road, city street, or highway). The simulator will measure your driving performance (speed, ability to stay on the road, braking etc.) while you have another participant in the vehicle with you.

This session should take half an hour. It will only be one session and you will not be contacted for follow-ups. The research findings will not be available until the data collection and analyses is completed.

POTENTIAL RISKS AND DISCOMFORTS

Some people experience a temporary feeling of uneasiness, dizziness, or feelings of mild stomach discomfort when in a driving simulator. However, for people who passed the initial Simulator Adaptation Pre-screening test (administered before the study begins) this will be unlikely to occur.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

You will be supplying valuable information about the effect of observational learning on driving performance. You might also find using the driving simulator enjoyable.

PAYMENT FOR PARTICIPATION

You will be paid in course credit, 1 credit for each hour of participation (half a credit for this part).

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. Your data will be kept strictly confidential and will be kept in a locked laboratory.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent anytime and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the University of Guelph Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

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Fax: (519) 821-5236

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study "The phenomenon of observational learning on driving performance of young adults" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

____
Name of Participant

____
____
Signature of Participant Date

SIGNATURE OF WITNESS

____

Name of Witness

____
____

Signature of Witness Date

APPENDIX F. The instructions/protocol for the conditions in Experiment 1

Greeting:
Hello! Welcome to DriveLab. What is your name? Ok, please have a seat. *I direct them to the waiting area.* Your partner's already arrived too, kind of early! He even did a part of the procedure. His name is…..Ryan. And my name is Ece and I am a first year Master's student. Thank you both for taking the time to participate in my studies.

Consent forms:
Before we begin, you will need to sign consent forms. Ryan's already done it. *I read the consent forms aloud (Just the study and risks & benefits part). One of you will be the driver first and then passenger for the second round. I have randomly assigned you guys to conditions. In the first round, *insert participant name here*, you will be the driver and Ryan, you will be the passenger.* Please have a look at them and sign below if you still agree to participate.

Questionnaires:
Okay, now please answer this questionnaire as accurately as possible. The first part is about your normal driving behavior. *I give them the SAS questionnaire. If they answer YES to any of the questions in section B, I will thank them for coming and inform them that they cannot participate. If they answer 4 or more questions "Yes" for Part C, again I will thank them for their time, but that they cannot participate. If they answer 1-3 questions "Yes" for Part C, I will inform the participant that they are at a slightly elevated risk of feeling uneasy in the simulator, and if they want to end their participation at that time they are free to do so without penalty.*

Training:
For you to get a sense of what it is like to drive in a simulator, you will need to undergo 5 minutes training phase in the simulator. *Ryan: Hahah, I did that too, it was fun*! Yeah, it can be quite fun actually. So, if you could come with me now...

So, this is the Driving Simulator. It is pretty much like a regular car except it's not going anywhere. But, act like how you would act driving a real car. *Have him seated.* Be aware that sometimes when you want to begin driving, it might start going reverse, in this case just wiggle the stick a bit and try to put it into D again.

Experiment I:
Great, now we can begin the first study. Please have a seat *(at the table)*. Have you guys ever played Minesweeper before? *If yes, go over things quickly. If no, go over things slowly with the instructions paper (See below)…..* Now that you know the rules, we can begin. Please have a seat now in front of the computer. *Participants take their place in front of the computers.*

<u>Competition</u>: Remember, you will just need to flag most of the mines before other person to win. You will be playing the game for maximum of 3 times. Here are your chips. Each time, the winner will get half of the chips in front of you. And in the end, the winner, who ends up with all the chips, will get a monetary prize. *Ryan: Cool.*

Instructions:

1) This game is called "Flag Hunter". The goal is to flag as many mines as possible before the other participant. There is no blowing up – You will simply click on a square with the left button of the mouse and it will automatically be flagged if there is a mine there.

2) If you flag a mine, it will be your turn again until you click on a square without a mine (so you will not be flagging anything).

3) Each player has a color: Blue and Red.

4) The arrow indicates whose turn it is. You can also see the writing "Your buddy is making a move" and "It's your turn" under your name.

5) There is a total of 51 mines to be flagged. Red is winning, Blue is losing here.

6) The bomb opens 25 squares at the same time. You can only use it once and only when you are behind (i.e. losing).

7) The numbers in the screen tell you about the mines nearby. For instance.......

8) The game tells you in the end if you win or lose.

<u>Cooperation</u>: Remember, you will flag the mines together and assist each other while doing so, taking turns with each click. You are expected to play until you solve this game. If you come across a mine, just start a new game and play until you improve together and solve the game. You will both get a monetary prize at the end. *Ryan agrees to whatever the person wants to click. If more than 15 mins passed say: Okay, you are going well but we're running out of time. However, since you cooperated so well together solving this game, I will give you the money anyway.*

Instructions:

1) This game is called "Minesweeper". The goal is to flag the mines without blowing up. Use the right button of the mouse to flag a mine, the left button to click on "safe" squares where you don't think is covered with a mine.

2) There are total of 40 mines. You are expected to flag all the mines successfully and complete the game together. If you come across a mine, just start over and try to improve together.

3) You will take turns with the mouse click.

4) The numbers in the screen tell you about the mines nearby. For instance.......

<u>Conversation</u>: *Go back to waiting area.* We will shortly begin the first experiment. Please have a seat here while I am making some arrangements regarding the games. *Point at the magazines.* Sorry for the inconvenience. *Ryan will talk to the participant about the weather, the courses they take, spring break plans, movies & TV. Control the conversation and keep it neutral. If it goes out of hand and become competitive (like talking about sports), agree with*

the other participant. Unfortunately, the online game that you were supposed to play is not working because they are having a service maintenance, and I couldn't find it. We will have to skip the first experiment… We can continue with the driving study…

Thank you for your participation. Now we can resume with the second experiment with the driving simulator.

Experiment II:
For this experiment, you will be driving for 30 minutes in various road environments. This is a non-verbal observational learning study, so please do not talk once the drive begins. *Participants take their place in the simulator.* If you start feeling uneasy or bad, let me know. I will be able to hear you through speakers. *Study begins. Ryan should not talk to the participant. If the participant asks or says something, he will respond with yes/no/right, etc.*

Wrap up & Debriefing:
Experiment ends. Please have a seat *(in the lab).* Here I have couple of Simulator Adaptation Syndrome that I need to ask the driver *insert participant name here*. *Read and take notes.* Thank you for participating. *Talk about debriefing. Give them the debriefing paper.*

Did you know that Ryan was a confederate?

Give the conversation group their $5.

Please do not mention this little twist in the study to anyone. This is my Master's thesis and it is very important to keep the participants blind to the real purpose of the study to be able to investigate the issue of social competition. Thank you.

APPENDIX G. Sensation Seeking Scale (Zuckerman, 1994)

Directions: Each of the items below contains two choices, A and B. Please circle the letter of the choice which most describes your likes or the way you feel. In some cases you may find items in which both choices describe your likes or feelings. Please choose the one which better describes your likes or feelings. In some cases you may find items in which you do not like either choice. In these cases mark the choice you dislike least. Do not leave any items blank.

It is important you respond to all items with only one choice, A or B. We are interested only in your likes or feelings, not in how others feel about these things or how one is supposed to feel. There are not right or wrong answers as in other kinds of tests. Be frank and give your honest appraisal of yourself.

1 A The most important goal of life is to live it to the fullest and experience as much as possible.
B The most important goal of life is to find peace and happiness.

2 A I get bored seeing the same old faces.
B I like the comfortable familiarity of everyday friends.

3 A I like to explore a strange city or section of town by myself, even if it means getting lost.
B I prefer a guide when I am in a place I don't know well.

4 A I would like a job that requires a lot of travelling.
B I would prefer a job in one location.

5 A I enter cold water gradually, giving myself time to get used to it.
B I like to dive or jump right into the ocean or a cold pool.

6 A A sensible person avoids activities that are dangerous.
B I sometimes like to do things that are a little frightening.

7 A I like to try new foods that I have never tasted before.
B I order the dishes with which I am familiar, so as to avoid disappointment and unpleasantness.

8 A I would like to take off on a trip with no pre-planned or definite routes, or timetable.
B When I go on a trip I like to plan my route and timetable fairly carefully.

9 A I would like to try parachute jumping.
B I would never want to try jumping out of a plane with or without a parachute.

10 A I prefer people who are emotionally expressive even if they are a bit unstable.
B I prefer people who are calm and even-tempered.

11 A I am not interested in experience for its own sake.
B I like to have new and exciting experiences and sensations even if they are a little

frightening, unconventional, or illegal.

12 A I enjoy spending time in the familiar surroundings of home.
B I get very restless if I have to stay around home for any length of time.

13 A A good painting should shock and jolt the senses.
B A good painting should give one a feeling of peace and security.

14 A I have no patience with dull or boring persons.
B I find something interesting in almost every person I talk with.

APPENDIX H. Driving behaviour questionnaire part I: risky driving used in Experiment 2.

The Driving Behaviour Questionnaire Part I

How often do you usually drive a car or other motor vehicle? Circle the answer.

1=Never 2=A few times a year 3=A few days a month 4=A few days a week
5=Almost everyday

How often do you do each of the following when driving?

1=Never 2=Hardly ever 3=Occasionally 4=Quite often 5=Frequently 6=Nearly all the time

1. Pull out of a junction so far that the driver with right of way has to stop and let you out____

2. Disregard the speed limit on a residential road_____

3. Stay in a motorway lane that you know will be closed ahead until the last minute before forcing your way into the other lane____

4. Overtake a slow driver on the inside_____

5. Race away from traffic lights with the intention of beating the driver next to you____

6. Drive so close to the car in front that it would be difficult to stop in an emergency____

7. Cross a junction knowing that the traffic lights have already turned against you_____

8. Disregard the speed limit on a motorway_____

9. Do not wear a seat belt_____

APPENDIX I. Driving behaviour questionnaire part II: risk perception used in Experiment 2.

The Driving Behaviour Questionnaire Part II

People feel differently about how safe or dangerous different types of driving behavior are. How safe do you feel it usually is to do the following?

1. Extremely safe
2. Somewhat safe
3. Neither safe nor dangerous
4. Somewhat dangerous
5. Extremely dangerous

a. Drive through a light that is already red before you entered an intersection_____

b. Drive 15 KpH faster than most other vehicles are going_____

c. Drive 20 KpH over the speed limit on a highway_____

d. Tailgate another vehicle on a highway with one lane in each direction____

e. Enter an intersection just as the light is turning from yellow to red_____

f. Drive through a stop sign without slowing_____

g. Slow but not completely stop at a stop sign_____

h. Cut in front of another car in order to make a turn_____

i. Race another driver_____

j. Drive just under the legal alcohol limit____

k. Use the shoulder to pass in heavy traffic_____

m. Drive through traffic by switching quickly back and forth between lanes____

n. Pass a school bus that has its red lights flashing and the stop arm in full view____

p. Go 15 KpH over the speed limit in a residential neighborhood___

r. Go 15 KpH over the speed limit on a two-lane rural road____

s. Drive 20 KpH over the speed limit on a rural road_____

t. Drive 20 KpH faster than most other vehicles are going____

APPENDIX J. The Adapted Competitiveness Questionnaire

Instructions: Please rate the following items in accordance with the scaling below.

(1) Strongly Disagree
(2) Disagree
(3) Neither disagree nor agree
(4) Agree
(5) Strongly Agree

a) I do not feel that winning is important in both work and games. ______

b) When I win an award or game it means that I am the best compared to everyone else that was playing. It is only fair that the best person win the game. ______

c) In school, I always liked to be the first one finished with a test. ______

d) I have always wanted to be better than others. ______

e) When nominated for an award, I focus on how much better or worse the other candidates' qualifications are as compared to mine. ______

f) I would want an A because that means that I did better than other people. ______

g) Because it is important that a winner is decided, I do not like to leave a game unfinished. ______

APPENDIX K. Consent form used in Experiment 2

UNIVERSITY of GUELPH

CONSENT TO PARTICIPATE ON RESEARCH

Driving performance of young adults driving with their friends

You are asked to participate in a research study conducted by Lana Trick and Ece Subasi, from the Department of Psychology at the University of Guelph. This research is for Ece Subasi's Masters Thesis, and it is sponsored by Auto 21: Network Centres of Excellence.

If you have any questions or concerns about the research, please feel free to contact Lana Trick by phone, 519-824-4120 (ext. 53518) or by e-mail, ltrick@uoguelph.ca.

PURPOSE OF THE STUDY

This study looks at driving behaviour when young adults are driving with passengers who are their friends.

PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

You will be "driving" in the University of Guelph Phase I Driving Simulator. In this study, you will be asked to drive through a simulated driving environment (e.g. an urban street or highway). The simulator will measure your driving performance (speed, ability to stay on the road, etc.) while you have another participant in the vehicle with you.

You will then be completing three short questionnaires about your driving behavior and personality.

The whole experimental session should take an hour. It will only be one session and you will not be contacted for follow-ups. The research findings will not be available until the data collection and analyses is completed.

POTENTIAL RISKS AND DISCOMFORTS

Some people experience a temporary feeling of uneasiness, dizziness, or feelings of mild stomach discomfort when in a driving simulator. However, for people who passed the initial Simulator Adaptation Pre-screening test (administered before the study begins) this will be unlikely to occur.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

You will be supplying valuable information about the effect of observational learning on driving performance. You might also find using the driving simulator enjoyable.

PAYMENT FOR PARTICIPATION

If you are part of the Introductory Psychology Participant Pool, you will be paid in course credit (1 credit for each hour of participation). If you are not in the Introductory Psychology Participant Pool, you will be paid $10 for your participation. (Participants who are in the Introductory Psychology Participant pool may choose to be paid INSTEAD of receiving credits, but a participant can only receive 1 credit or $10: not both.)

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. Your data will be kept strictly confidential and will be kept in a locked laboratory.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent anytime and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the University of Guelph Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

Research Ethics Officer
University of Guelph
437 University Centre
Guelph, ON N1G 2W1

Telephone: (519) 824-4120, ext. 56606
E-mail: sauld@uoguelph.ca
Fax: (519) 821-5236

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study "The phenomenon of observational learning on driving performance of young adults" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

____
Name of Participant

____
____
Signature of Participant Date

SIGNATURE OF WITNESS

____
Name of Witness

____
____
Signature of Witness Date

APPENDIX L. The instructions/protocol for the Experiment 2

Greeting:
Hello! Welcome to DriveLab… Your names? *Check against the list and make sure they're on it.* OK, please have a seat. *I direct them to the waiting area.* My name is Ece and I am a Master's student. Thank you both for taking the time to participate in my study.

Consent forms:
Before we begin, you will need to sign consent forms. *I read the consent forms aloud (Just the study and risks & benefits part). I also remind them that they can only be compensated with a credit or cash, not both.* Both of you will be driving in the simulator twice while the other will be the passenger. Please have a look at the consent form and sign below if you still agree to participate.

Questionnaires:
Okay, now please answer this questionnaire as accurately as possible. The first part is about your normal driving behavior. *I read aloud the first part of SAS and take notes.* And now I have some health-related questions. *I read aloud the SAS questionnaire while taking notes. If they answer YES to any of the questions in section B, I will thank them for coming and inform them that they cannot participate. If they answer 4 or more questions "Yes" for Part C, again I will thank them for their time, but that they cannot participate. If they answer 1-3 questions "Yes" for Part C, I will inform the participant that they are at a slightly elevated risk of feeling uneasy in the simulator, and if they want to end their participation at that time they are free to do so without penalty.*

Training:
For you to get a sense of what it is like to drive in a simulator, you will need to undergo 5 minutes training phase in the simulator. So, if *insert participant name here* could come with me now... *Looking at the other participant*… Please wait here for a few minutes.

So, this is the Driving Simulator. It is pretty much like a regular car except it's not going anywhere. But, act like how you would act driving a real car. *Have the participant seated.* During the drive, if you feel weird or uncomfortable, tell me, I will be able to hear you through the speakers.

Talking through the speakers while they are in the car… You will notice a time and a distance meter. The red one is time and the white one is the distance which refers to the distance traveled by metres. In the experimental drive, the time will be counting down from 180 seconds (3 minutes) and the distance will increase as you drive.

You may begin driving now.

When the lead vehicle appears… Please pass the car in front of you. This is just for you to get used to maneuvering in the simulator.

I lead the participant back to the waiting area and direct the other participant into the lab for his/her training drive…

Experiment:

Great, now we can begin our study. *I direct them both into the lab.* The participant who did the training first will be the driver first. And then *insert participant name here* will drive. Then you will switch roles again until both of you have driven twice. *Have the participants seated.*

For this experiment, you will be driving in a virtual environment that has the same traffic regulations as Ontario. You are expected to drive as you normally would. *Stress this part...* Your task is to drive until you run out of time. You will see on the screen that there is time and distance. As I said during the training drive, time will be counting down from 180 seconds (3 minutes) and the distance travelled will increase as you drive. You are free to pass vehicles as you go. However, any collision will cost you 10 seconds of your time.

Also… *I move to the passenger side and give him the paper with their names on it…* Could you attach it on the iPad there? This refers to the order of your drives. Could you do me a favour and write down the number from the distance at the end of the drives? Whoever is sitting here as a passenger at the time can do that. Thanks.

Also, please do not talk to each other while driving.

Again, if you start feeling uneasy or bad, let me know. *Study begins… They switch their roles both of them driving twice.*

Thank you for your participation. Now we can resume with a couple of questionnaires.

Questionnaires:
I have them seated at two separate parts of the table where they cannot see each others' answers and I give them the questionnaires as a package in the following order: SAS, DBQ, SSS, CQ.

Wrap up & Debriefing:
This is the end of our experimental session. Thank you for participating. *Talk about debriefing. Give them the debriefing paper.*

Would you prefer to be compensated for your time with a credit or $10?

I have them sign the receipt book if they are paid in cash.

Please do not mention the extended purpose of the study to anyone. This is my Master's thesis and it is very important to keep the participants blind to the real purpose of the study to be able to investigate the issue of social competition. Thank you.

APPENDIX M. Comments of the participants in Experiment 2

Male pairs

1. Two male participants commented that it was like a race, the first drivers in one pair asked “Is this a race?” at the beginning.
2. Both participants in one pair admitted that they were competing and were keeping track of distance traveled.
3. First driver in one pair asked at the beginning “So are we trying to get the most distance or drive as we normally would?”

Female pairs

1. Both participants in one pair commented that it was like a race.
2. The first driver in one pair said to her friend “You went further than me” in between switching roles. The second driver in pair said “Yes!” after successful risk-taking.