Exploring the Relationship between Speed Choice Behaviour, Hazard Perception and Individual Differences

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Abstract

Young, and particularly male drivers aged between 15 and 25 years of age are over represented in the crash statistics worldwide. In New Zealand, young drivers (15-24 years) represent only 15% of the driver licensed population but typically contribute to more than 50% of all fatal and injury crashes. The current study was conducted to investigate factors that may explain the over-representation of young drivers in crash statistics. For this research, a video based speed choice task was used to measure the chosen and estimated speeds on a selection of New Zealand road conditions of young inexperienced drivers and older experienced drivers. In addition, this study used a video based hazard perception dual task to compare the hazard perception skills of the same groups of drivers. Lastly, a number of self reported measures were used to examine if they could help characterise the drivers who consistently choose slower or higher speeds.

Results revealed that the young inexperienced male drivers were more accurate at estimating the vehicle speeds and chose slower speeds across all the road conditions compared to the other drivers. In addition, drivers tended to choose slower speeds during night time driving and wet road conditions compared to daytime driving and dry road conditions, respectively. The young inexperienced drivers were better at the secondary tracking task of the hazard perception dual task compared to the older experienced drivers but then detected fewer hazards than any of the other drivers. In addition, drivers who chose consistently higher speeds in the speed choice task reported being more likely to engage in speeding, drink driving and become angry at other drivers while driving. Interestingly, drivers who consistently chose higher speeds were less confident in their driving abilities.

The current findings suggest that young inexperienced male drivers were better at estimating the vehicle speeds and therefore chose slower speeds. In addition, it seems that the young inexperienced drivers tend to focus more on the secondary tracking task then detecting hazards compared to the older experienced drivers. This could relate to the fact that young inexperienced drivers need to use more attentional resources for the steering task and as a result they miss hazards.

Lastly, the driver attitude questionnaire and the driving anger scale seem to be valid self-report measures in order to help characterise the drivers who consistently chose higher speeds in the speed choice task. Implications of the current study and future research are also discussed.

Acknowledgements

This project has been very challenging for me but I have found many sources of encouragement and help which I have deeply appreciated and am grateful for. Firstly, I would like to thank my supervisors Dr. Robert Isler and Dr. Nicola Starkey for their constant support, guidance, feedback and unwavering patience through the course of my thesis. I have been extremely lucky to have worked under the supervision of two academics with such incredible knowledge and experience. It has been an honour to have studied under your guidance and you deserve the credit for what is written in this thesis.

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Ethical Information

Ethical approval for this research was obtained through the School of Psychology Ethics Committee of the University of Waikato. The ethics application was submitted to the University Ethics Committee on 6 Jul 2011 and was approved on the 13 Jul 2011.

Participants were briefed concerning their rights as participants and were informed about the nature of the experiment with an opportunity to ask any questions about the research. Participants were given complete confidentiality, anonymity and the right to withdraw at anytime with no questions asked. Participants gave written consent before undergoing testing. The participants were recruited through advertising on posters on the research notice boards around the Hamilton campus, local newspapers (Te Awamutu Courier & Waikato Times), Boys High School and through word of mouth. Each participant was also given a flyer and was asked to promote the experiment to friends and family. Participants enrolled in first year psychology papers were given a 2% course credit and the others were given a $10 MTA voucher.

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1. Introduction

On March 25th 2005, four young men lost their lives and a fifth life will be changed forever due to the reckless actions by one. On their way back to Pukekohe after a night cruising in inner-city Auckland, the driver pulled up along a Subaru as he wanted to race. The passengers didn't want him to but he went for it anyway. The driver failed to make a turn near Pukekohe at 170km/h while texting and holding a cigarette in the other hand with only two fingers on the steering wheel. He was angered at the text he received. The Honda Integra Type-R got airborne and snapped a 30cm pine tree like a twig and burst into flames. Three occupants were stuck in the car while two of the backseat passengers who weren't wearing seatbelts, were found about 30 metres from the wreckage. One died right there in the ditch while the other one was in a critical condition. The sole survivor of the crash was flown to Middlemore Hospital with multiple broken bones and massive head injuries. His head was badly smashed in the crash and it took 40 separate operations to treat the injuries. The Pukekohe community was devastated as four very talented young men died in a situation which could have been prevented.

This case is not solitary, it happens around New Zealand everyday where many young drivers act before they think of the consequences. Probably the first response to such tragedies is to increase driver education opportunities. But is this really the full answer? Could there be other factors that also contribute to this problem?

1.1. The young driver problem

It is well known across the globe that young drivers are over represented in the crash statistics. In 2007, the United States of America had 41,000 fatalities and 2.5 million injured persons as a result of police reported motor vehicle crashes. Drivers between the age of 16 and 24 contributed to 24% of all traffic fatalities which were the highest rate of crash involvement in any age group resulting in death (NHTSA, 2007). The Organisation for Economic Co-operation and Development have 34 member countries and according to them, on average between 18% and 30% of fatal crashes involved those aged between 15 and 24 years, although they only represent between 9% and 13% of the total population in their respective countries (OECD, 2006). Another study was conducted in America looking at non-fatal police reported crashes of young drivers and it was found that in 75% of all the crashes, young drivers were at fault (Braitman, Kirley, McCartt, & Chaudhary, 2008). In Australia, young drivers comprise about 15% of the driving population but they cause about 35% of fatal and 50% of injury crashes (Macdonald, 1994). In 2009, 18 to 24 year old drivers represented approximately 8.9% of the French population, yet they accounted for over a fifth of the injuries caused by traffic accidents (Observatoire National Interministèriel de Sècuritè Routière, 2010).

Similarly in New Zealand, young drivers (15-24 years) represent only 15% of the driver licensed population but contributed to 51.7% of all fatal and injury crashes in 2009. They were at fault in 89 fatal crashes, 610 serious injury crashes and 2,755 minor injury crashes resulting in 102 deaths, 797 serious injuries and 4,049 minor injuries. This group of drivers is costing the New Zealand Government around $1 Billion which is over one third of the social costs associated with injury crashes (Ministry of Transport NZ, 2010b). The 15-19 year old group is most at risk, because they contributed to the majority of fatal/injury crashes per 100 million km driven and per 10,000 licence holders (see Figure 1.1). There are several contributing factors to crashes but the primary factor is speeding.

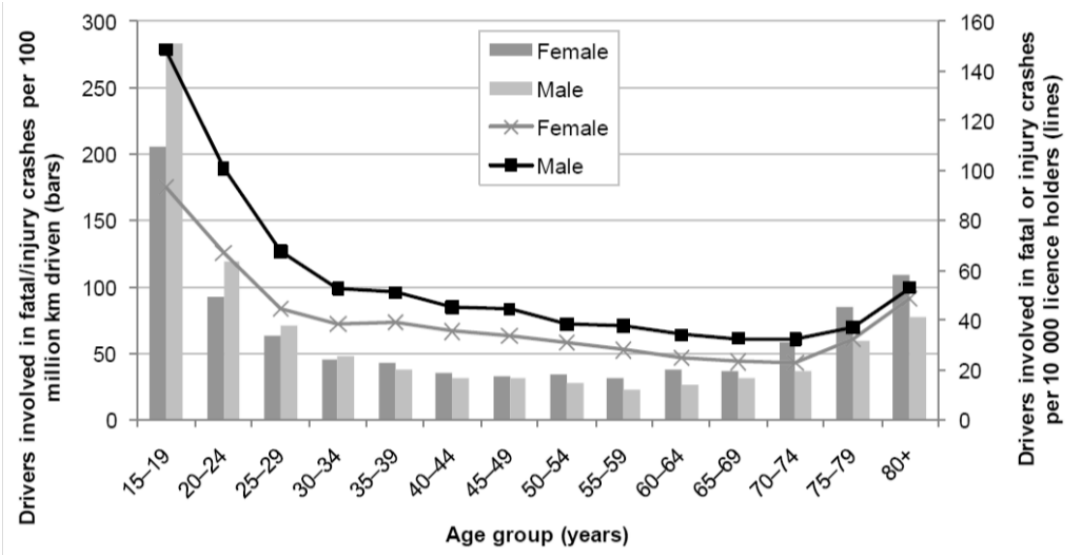


Figure 1.1: Number of drivers involved in fatal or injury crashes per 100 million km driven (bars) and per 10 000 licence holders (lines), by age and gender (2004–2009) (Ministry of Transport NZ, 2010b).

We all have heard the slogan "The faster the speed, the bigger the mess" accompanied with gruesome images of crashes that occurred due to speeding. It has well documented that there is a strong relationship between speed and both crash risk and severity (Aarts & van Schagen, 2006; Elvik, Christensen, & Amundsen, 2004). In 2009, speeding contributed to 100 fatal crashes, 361 serious injuries and 1,274 minor injuries and these resulted in 113 deaths, 516 and 1,945 injuries respectively. This was costing the taxpayer about $810 million which is over one fifth of the social cost associated with injury crashes. Speeding contributed to 46% of all fatal and injury crashes (Ministry of Transport NZ, 2010a). The 15-19 year age group had the highest number of drivers involved in speeding related fatal crashes (see Figure 1.2) which accounted for 40% of all speeding related fatal crashes.

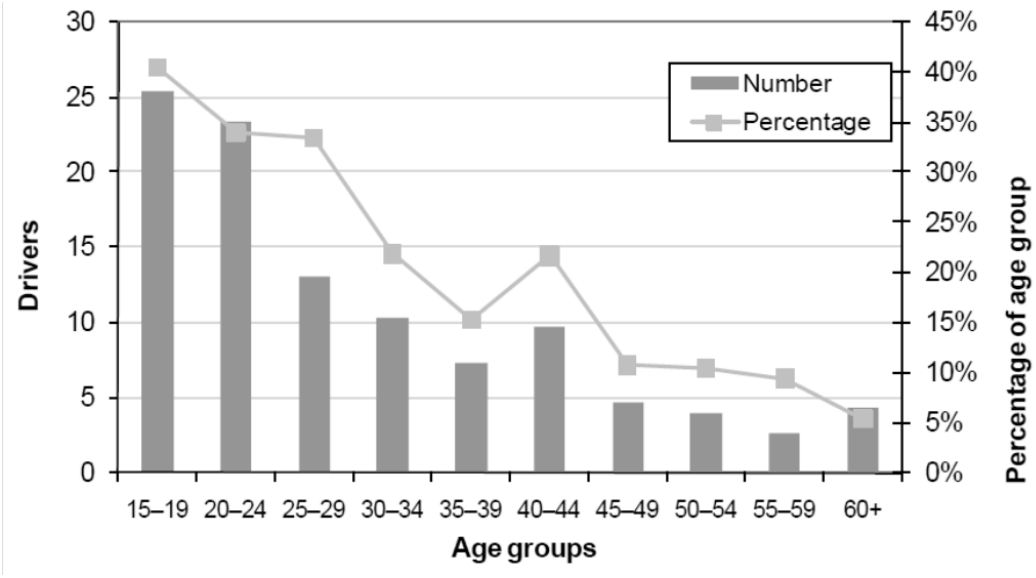


Figure 1.2: Number of drivers involved in fatal crashes where speed was the main factor, by age group (2007-2009) (Ministry of Transport NZ, 2010a).

The two most biggest causes of fatal crashes involving speeding are loss of control and head on crashes which account for over four-fifths of the fatal crashes involving excessive or inappropriate speeds for the conditions (Ministry of Transport NZ, 2010a). With an increase in speed there is an increase in stopping distances. Stopping distances depends on many factors such as the braking capability of your car, weather conditions and physiological factors such as alcohol, fatigue and drugs. All these factors are more prominent in young drivers due to their risk taking nature which could help explain their over representation in the crash statistics.

In 1987, the Graduate Driver Licensing (GDL) system was introduced to help reduce the crash rates. The essential elements for the GDL were a 6 month learner licence (supervised) followed by an 18 month restricted licence (unsupervised) with restrictions on night driving and carrying passengers. Several studies conducted showed that the crash rates among young drivers decreased with the introduction of the GDL and this system's impact has lasted (Begg & Stephenson, 2003; Langley, Wagenaar, & Begg, 1996). This system is not flawless, because the crash rates for young drivers are still much higher than any other age group which suggests that there must be other factors involved. These need to be investigated.

1.1.1. Why are young drivers so vulnerable to crashes?

Age is an important risk factor in young drivers but research suggests it disappears as a risk factor at the age of 25 years. Driving experience seems to be a more important risk factor than age and young drivers tend to lack this more than older drivers (Mayhew, Simpson, & Pak, 2003). They have not learned and experienced enough dangerous situations to make valid judgements when they encounter difficult scenarios on the road. Young drivers tend to overestimate their driving skills and underestimate the driving task and this is one of the reasons why they are so overrepresented in the crash statistics (Fuller, 2005).

Maturity is also an important risk factor for young drivers and there are many theories of why this is but it is clear that young people are not well equipped to weigh up risk and reward. They seem to be vulnerable to risk taking during the period in which their prefrontal lobe is still developing. Their ability to cognitively inhibit actions are not fully developed but the pleasure seeking area of the nucleus accumbus is fully matured (Casey, Getz, & Galvan, 2008). This causes young drivers to engage in thrill seeking behaviours without thinking of the consequences.

It is well known that males are more prone to risk taking than females and so their involvement in crashes is much higher (Ministry of Transport NZ, 2010b). There are many other compounding factors that contribute to risky driving which will not be looked at in this research. Peer pressure, fatigue, alcohol, distractions such as music, makeup and mobile phone use are all factors that influence a driver's ability to focus on the driving task. Individual differences such as sensation seeking, boredom, anger, competitiveness, impulsiveness, anxiety, conscientiousness, empathy concern and self esteem/driving confidence also play a part in young drivers decision making and cognitive abilities when driving.

1.1.2. Previous research on speed choice behaviour, hazard perception skills and individual differences.

Individual differences were often examined in previous research in regards to risky driving but not regarding hazard perception and speed choice. Dahlen, Martin, Ragan & Kuhlman (2005) examined the potential contribution of other individual differences such as sensation seeking, boredom proneness and impulsivity to driving anger in the prediction of unsafe driving using self report

measures. They found that the addition of these extra measures improved the prediction of unsafe driving behaviour beyond driving anger alone. This study had several limitations that will be rectified in this study. They only used self reported measures to predict unsafe driving and their sample consisted of 70% females with a median age of 19 which made the results less applicable to the general driving population. Since driving experience influences driving behaviour, a larger age range is needed so that individual differences in experience can be measured. Lastly, their sample was female dominated which did not provide an accurate reflection of the gender differences that might be more evident in a more balanced sample.

There seems to be a link between a driver's hazard perception and their speed choice. If a driver has good hazard perception skills, then they will have good speed choice skills (McKenna, Horswill, & Alexander, 2006; Renge, 1998). However there seems to be a lack of research in this area and will be investigated further in this research.

Most studies used self reported speed choice measures that which are not as reliable as the laboratory based speed choice task. The two laboratory tasks used in this research has both been used in previous research (*Hazard Perception Task* - Isler, Starkey, & Williamson, 2009) & (*Speed Choice Task* - Horswill & McKenna, 1999) but it has never been used to find individual differences. The speed choice task has been validated and it has good external and ecological validity which makes it a reliable laboratory task to use (Horswill & McKenna, 1999). Previous research based on the hazard perception dual task revealed significant differences between the hazard perception skills of young and experienced drivers which have been replicated by other studies (Isler, et al., 2009; McKenna, et al., 2006). These studies showed that the hazard perception dual task have good external and ecological validity.

In the current research we replicated the speed choice task (Horswill & McKenna, 1999) and the hazard perception dual task (Isler, et al., 2009) but in addition we included self report measures to test for individual differences. This research will first examine the speed choice behaviour across different road conditions and hazard perception skills of drivers in laboratory tasks using video simulations, with age, experience and gender as independent variables. In addition to this, the effects of attitudes, sensation seeking, boredom, anxiety, impulsivity, anger, conscientiousness, empathy concern, competitiveness, self esteem and self-confidence on the speed choice behaviour will be explored.

1.2. Literature Review

1.2.1. Age and experience, which is more important?

Age is a risk factor in crashes but only to the age of 25 year. Recent findings from developmental neuroscience may shed some light to why risk taking behaviours increases during adolescence and several theories has emerged to why adolescents are more prone to risk taking.

During puberty, pruning of neurons in the brain occurs and the proportion of white matter in the brain increases while the grey matter continues to decrease until the age of 30 years (Lenroot & Giedd, 2006; Sowell et al., 1999). The increase in white matter makes the sharing of information both within and between brain areas faster and more efficient particularly in the frontal lobes. Studies have shown that the prefrontal cortex of the brain is not fully developed until the third decade of life and its connections are extensively remodelled during adolescence (Casey, et al., 2008; Steinberg, 2008). The prefrontal lobe is thought to be involved in various goal directed behaviours, emotional processing, impulsive control and decision making (Spear, 2000). As this area is not fully developed during adolescence, the ability to cognitively inhibit actions is still developing while the pleasure seeking area of the nucleus accumbus (part of the basal ganglia) are already fully developed (Casey, et al., 2008). This leads to an adult size drive for pleasure without the adult size drive to cognitively inhibit these drives of sensation seeking. It is also evident that the connections between these areas are not fully developed in the adolescent brain which makes it even more difficult to control sensation seeking and risk taking urges (Casey, et al., 2008).

Another theory is that important developmental changes in the dopaminergic system take place during adolescence (Chambers, Taylor, & Potenza, 2003; Spear, 2000). This system plays a critical role in affective and motivational regulation and these changes are the main contributing factor to the socio-emotional development in adolescence. Importantly, among adolescents the areas of the prefrontal lobe that are activated during exposure to social stimuli overlap considerably with other parts of the brain also shown to be sensitive to reward stimuli (Galvan et al., 2005; May et al., 2004). In a recent study where adolescents engaged in a task where peer acceptance and rejection were

manipulated, it was found that there was greater activation of the prefrontal lobe when subjects were exposed to peer acceptance compared to peer rejection (Nelson et al., 2007). This indicates that peer acceptance may be processed in a similar way to non social rewards. As a result of this remodelling, dopaminergic activity in the prefrontal lobe increases during early adolescence. Because dopamine plays a critical role in the brain's reward circuitry, this increase during adolescence encourages attraction to novel and sensation seeking experiences (Steinberg, 2008).

The ability to delay gratification is an important aspect of self control and to inhibit impulsive drives. This common paradigm refers to the ability to resist the urge of an immediate smaller reward in order to receive a better reward later. According to Steinberg et al. (2009), the tendency to discount delayed rewards does not decline dramatically during adolescence which suggests that a higher level of brain maturation is needed in order to realise the true value of the delayed reward. So adolescents act impulsively and would prefer the immediate smaller rewards such as getting a thrill from speeding rather than thinking of the larger delayed reward such as arriving safely. But individual differences in previous experiences to learn how to control impulsive behaviour could help predict the improvements in the ability to delay gratification.

All of these theories are consistent with age being a risk factor in the crash statistics of young drivers, partly due to the prefrontal lobe being not yet fully developed. But experience seems to be more important than age when it comes to young drivers, because only 18% of full licensed drivers were involved in a crash compared to 44% of restricted licensed drivers between 2005 and 2007, when age was controlled for (Ministry of Transport NZ, 2010b).

One theory to support this is that control over risk taking can be learned and that the issue is not insufficient brain maturation but the lack of experience. McCartt, Shabanova & Leaf (2003) found that the first six months of driving during the adolescent years is the riskiest period, purely because of the lack of experience in driving. As Figure 1.3 showed, there is a sudden increase in the number of crashes when drivers graduate from their learners to solo driving and then it declines as the drivers gain experience in detecting hazards and driving to the road conditions (Lewis-Evans, 2010).

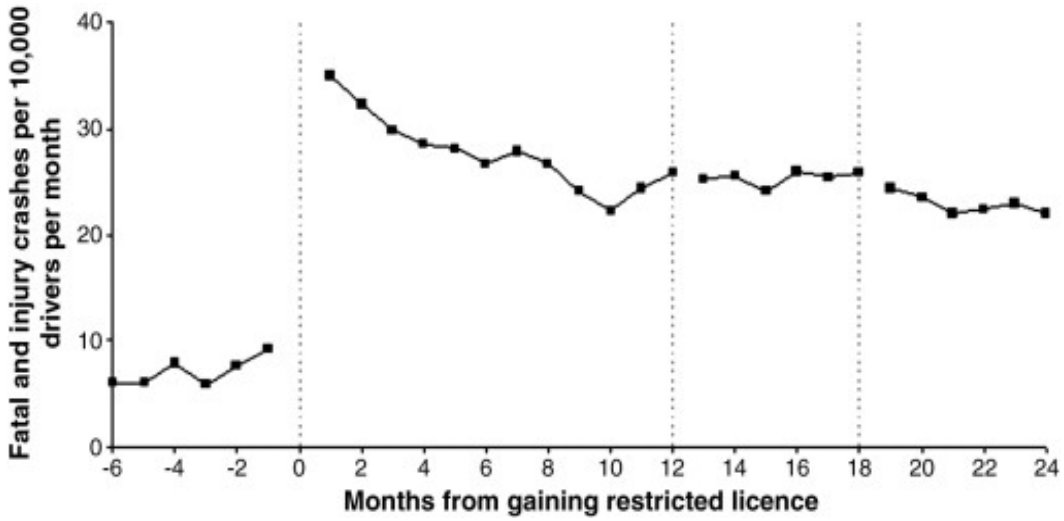


Figure 1.3: Crash rate profile of New Zealand novice drivers between 1999 and 2005 (Lewis-Evans, 2010).

It is evident that both age and experience contribute to crash risk and there is a continuous debate among researchers regarding which is more important. It is very difficult to separate these two factors, because they are confounded. As a driver gains experience, they also get older which means that these two factors are inter related and are hard to separate, however, a few studies have successfully done this.

Mayhew et al. (2003) suggested that age is an important risk factor but experience is more important than age. They found that 16-19 year old novice drivers had higher crash rates than novices age 20 years and older, given that the two groups had the same amount of experience. But regardless of age, crash rates of novice drivers decreased with an increase in length of time licensed. Lewis-Evans (2010) found similar results, that regardless of age, drivers who obtained their full drivers licence 12-18 months after their restricted licence had higher crash rates compared to those drivers who obtained their full licence after 18 months. In addition, he found that drivers aged 15.5 to 16.5 years had a 7.4 times increase in crash rates at the time of gaining their restricted drivers licence, which is significantly higher than any other age group. These studies clearly show that experience is more important, because regardless of age, crash rates decreased with increase in the length of time licensed. Age is also a factor, because young drivers have higher crash rates than older drivers but there is a bigger reduction in crash rates with increases in driving experience compared to older drivers.

A consequence of less experience is less opportunity for a driver to accurately identify hazardous events and situations. Isler et al. (2009) found that young inexperienced drivers detected and identified a smaller percentage of hazards compared to experienced drivers. It also took the young drivers significantly longer to detect the hazards compared to the experienced drivers. An older study found similar results in that drivers with a median age of 24 years old responded quicker in a hazard perception task if they had more than 40,000km of driving experience and more slowly if they had less than 10,000km driving experience. Both these groups were faster in detecting hazards than people of the same age who did not drive (Ahopalo, 1987). McKnight & McKnight (2003) analysed descriptions of more than 2000 accidents involving young drivers for behavioural contributors. They found that the great majority of non fatal crashes resulted from errors in attention, visual search, speed and hazard recognition. The differences in these types of errors by young drivers were relatively few and minor suggesting experience is an important aspect when it comes to driving. These studies clearly indicate that experience is most likely the key influence on detecting hazards, independent of age.

Speeding is the major cause of crashes and according to the Ministry of Transport (2010a), 74% of all young driver fatal crashes had inappropriately high speeds involved. Several studies have been conducted on the speed choice behaviour of drivers and they found that young and inexperienced drivers tend to prefer faster speeds than older drivers. Cantwell (2010) conducted a study on the speed preference of both young inexperienced and older experienced drivers. He found that the young inexperienced drivers preferred speeds close to the speed limit irrespective of different road environments. Older and more experienced drivers preferred slower speeds and adapted their speeds to the different road environments. All these studies clearly show that experience is more important than age when it comes to crashes, but age plays a role up to 25 years of age and this can clearly be seen in the crash statistics of young drivers.

1.2.2. Gender differences in young drivers risk taking

It is well known that men are more prone to risk taking than woman (e.g., Bergdahl, 2005; Evans & Wasielewski, 1983) and several studies have been conducted confirming this hypothesis. Bronson & Howard (2002) looked at the

self-reported measures of thrill seeking and risk taking. They found that overall, men were bigger risk takers than women, especially when it comes to driving. Men were much more likely to drive 40km/h over the speed limit than women and also more likely to drive a motorcycle, get into the car of a stranger and get on to the roof of a moving car. Wagner (2001) found similar results, men are more likely to engage in risky behaviours than women, such as reckless driving.

This increased risk taking by men appears to flow over into their driving, as evidenced by the road vehicle crash fatality rates being higher for males than females. Men are three times more likely to die behind the wheel than their female counterparts (Bergdahl & Norris, 2002). A study conducted in Sweden looked at the crash data for the period of 1988-2000 and they found that the crash incidence for men was nearly double that of women in all age groups. Also the crash morbidity rate for male drivers was 25-30% higher than for female drivers in the same age group (Monàrrez-Espino, Hasselberg, & Laflamme, 2006). Turner & McClure (2003) conducted a study in Australia looking at self reported accident rates. A random sample of 689 adults aged 17-88 selected within the Queensland state indicated that males were twice as likely to report at least one crash and nearly three times more likely to report two or more crashes than their female counterparts. Another study was conducted in New Zealand where the authors looked at a number of self reported risky driving behaviour and passenger behaviour and attitudes on young drivers with a mean age of 15.86 years. They found that young male drivers were significantly more likely to engage in unsafe driving such as speeding, drink driving and breaking curfew rules on a restricted drivers license compared to young female drivers (Harrè, Field, & Kirkwood, 1996). The Ministry of Transport (2010b) found similar results to the studies mentioned above in that of all young drivers involved in fatal crashes, 73% were male.

It has been suggested that the gender gap in the crash statistics may be due to men and women having different motivational factors and so they need to be trained differently (Hatakka, Keskinen, Gregersen, Glad, & Hernetkoski, 2002). They argued that male and female crashes have different characteristics and motives. For example, speeding while intoxicated is typical for male drivers but rare for female drivers. This is difficult to correct through driver training, because these behaviours are not directly linked with driving itself but rather to

the role of young males in society; their general risky behaviours and way of life (Laapotti & Keskinen, 1998).

Another reason why males are more prone to risk taking than females can be explained on the basis of the evolutionary theory. In all species, males operate in ways to attract females. They act fearlessly to demonstrate their capability to protect and compete with other males to gain access to mates (Nell, 2002). According to Constatinou et al. (2011) driving may be one of the few ways in some societies for males to show their masculinity and be competitive towards other drivers, especially other males.

However, it seems that young women's risky traffic related behaviours are catching up to those of men. In New Zealand, the percentage of females involved in fatal crashes has risen from 23.5% in 1990 to 31.5% in 2009 (Ministry of Transport NZ, 2010b). Several other studies found similar results (e.g., Moore, 1994). This rise in fatalities is not due to increased risk taking, but rather because a greater proportion of women are now licensed and driving more kilometres exposing them to more traffic crashes (Bergdahl & Norris, 2002). Nevertheless, there is a gender effect on driving risk that needs to be considered in the present study.

There seems to be a lack of research regarding gender differences when it comes to a laboratory setting. All the studies used only self-reported measures for risky driving and attitudes and no laboratory tasks looking at hazard perception skills and speed choice behaviour were ever used. Self-report of risk taking is less objective than a behavioural measure obtained from a laboratory task. To date, no research has focused on gender differences in hazard perception skills, comparisons have only been made between novice and experienced drivers. The current research will therefore examine the effect of gender on hazard perception skills and speed choice behaviour.

1.2.3. Lack of hazard perception skills in young drivers

One of the reasons why young drivers are at risk of having a crash is that their driving is not yet fully automated and so they use more of their attentional resources for the driving task such as steering, changing gears or a hill start, rather than looking for potential hazards (Annex, 2006). This lack of surveillance skills for potential hazards causes many crashes among young drivers and it is the fifth

most important cause of crashes in young drivers (Ministry of Transport NZ, 2010b). There are also other factors that cause young drivers to miss other vehicles or objects which include distractions such as passengers, music or makeup and inattention due to physiological factors such as fatigue or boredom, but these factors are beyond the scope of this research.

There is a plethora of evidence which confirms the hypothesis that young drivers lack good surveillance skills to detect other vehicles or objects while driving. One study looked at non-fatal police reported crashes involving newly licensed drivers to examine the circumstances and factors that led to the crashes. They found that three factors contributed equally to young drivers crashes; failing to detect another vehicle, speeding and loss of control. Most failures to detect another vehicle or object involved not looking properly, distraction and inattention (Braitman, et al., 2008). In another study, participants were shown traffic scene movies and they had to complete two consecutive tasks; press a button when they detected a hazard and watch the same movies again and classify them according to similarities in their hazardous situations. It was found that young inexperienced drivers classified the movies according to similarity of actual hazards whereas experienced drivers also considered potentially hazardous situations. This suggests that young inexperienced drivers experience difficulties in discerning potentially hazardous situations (Borowsky, Oron-Gilad, & Parmet, 2009).

Borowsky et al. (2010) conducted a study on hazard perception where participants viewed six hazard perception movies while being connected to an eye tracking system. The participants were required to identify hazardous situations. It was found that experienced drivers were proficient at hazard detection and potentially hazardous scenes such as approaching an intersection whereas young inexperienced drivers stopped reporting on hazards that followed highly hazardous situations. So it seems evident that young drivers still need to learn how to acquire the skills to drive so that more of their attentional resources can be used to detect potentially dangerous situations.

One major problem for young drivers is that they seem to experience difficulties seeing potential hazards and this could be due to them not scanning their surroundings properly for hazardous situations. There is some evidence which suggests that young drivers don’t scan the road properly and miss some of

the hazards, especially when it becomes a highly hazardous situation. Crundall & Underwood (1998) conducted a study examining the eye movements of participants while they were driving on various roads. The measures taken included fixation duration (time taken to assimilate fixated objects) and the variance of fixation (co ordinates to describe the spread in search on both horizontal and vertical axis). They found that inexperienced drivers' horizontal scanning was unchanged across the three different road types; rural, suburban and double lane motorway. The experienced drivers increased their horizontal scanning as the roads became more hazardous, especially on the two lane motorway where lanes were merging from right and left. Inexperienced drivers tended not to have such a widespread of fixations in the horizontal plane than experienced drivers and they tended to make more vertical fixations on the vertical plane. They also found that inexperienced drivers tended to focus longer on hazards than the experienced drivers. Similar results were found in another study where trained police drivers were found to show increased horizontal eye scanning, even when compared to the experienced drivers. This suggests that the driver's understanding of the task develops with experience. The roads that demand increased monitoring will receive more extensive scanning than roads that are simpler such as a quiet rural road. Inexperienced drivers did not show this sensitivity to road complexity which suggests that they failed to detect potential hazards (Underwood, 2007). According to Mayhew & Simpson (1995), inexperienced drivers display a smaller range of horizontal scannings on the road, look closer to the front of the vehicle, glance at objects less frequently, look in the mirrors less frequently and fixate on fewer hazards than experienced drivers. They also noted that inexperienced drivers fixate more on stationary objects whereas experienced drivers fixate more on moving objects.

Another problem is that young inexperienced drivers seem to lack situation awareness. They don't often seem to know what is happening around them and due to a lack of experience and inadequate surveillance skills, have difficulties to anticipate what other drivers might do next. Underwood et al. (2002) argued that it is not due to limited mental resources that young drivers miss hazards, but due to a lack of situation awareness. They conducted an experiment in a laboratory setting so that young driver's mental workload is not on driving but detecting hazards. Inexperienced and experienced drivers watched videos of a

car travelling along a road and their eye movements were recorded to determine the scanning patterns as they followed instructions to indicate hazards. They found that experienced drivers showed more extensive scanning of the demanding sections than inexperienced drivers, especially on the two lane motorways. This suggests that deficits in hazard detection in young inexperienced drivers are not due to the lack of mental capacity but instead may be due to a lack of situation awareness. Another study asked participants to look at movies while they were connected to an eye tracking system and they were requested to identify hazards in each video clip. The results showed that while approaching T intersections, experienced drivers fixated more towards the merging road on the right while young inexperienced drivers focus straight ahead, paying less attention to other vehicles on the merging road. This study suggests that driving experience improves situation awareness and guide a driver's eyes to the potential hazards (Borowsky, et al., 2010).

It is clearly evident that young inexperienced drivers lack the visual skills to detect potential hazards and with experience, these skills can be improved. However, the high crash statistics due to not detecting the hazards early enough still needs to be dealt with. Inexperienced drivers can't have training on the road, because it is too dangerous and if they fail to detect a hazard it could lead to fatal consequences. Instead, simulations can be set up to train young drivers without any risk to them or others. A couple of studies have shown that young inexperienced drivers can be trained to scan the road better and detect more potential hazards through commentary training. Isler et al. (2009) conducted a study where participants were shown video-based traffic scenarios and their primary task was to verbally identify the hazards while concurrently doing secondary tracking task. The secondary task was used to stimulate the steering of real driving. They found that young inexperienced drivers perceived fewer immediate hazards than the older more experienced drivers. However after the commentary training, the mean percentage of hazards detected by the young inexperienced drivers were at the level of the older more experienced drivers and were significantly higher than the same age and experience control group. In another study a computer based risk awareness and perception training program were used in which there was 10 traffic scenarios that helped inexperienced drivers identify where the potential hazards were located and which ones should

be attended to. The eye movements of the participants were recorded. They found that the trained inexperienced drivers were twice as likely as untrained inexperienced drivers to look at regions where potential hazards could appear or signs along the road that warned about potential hazards (Pollastek, Narayanaan, Pradhan, & Fisher, 2006).

This commentary training clearly shows that young inexperienced drivers can be trained before they start driving. This system is currently in use in the GDL system and is used in the full license test where the driver must maintain a running verbal commentary while driving, explaining to the instructor what potential hazards are on the road ahead. But according to the literature, this process would be better if it were included earlier in the licensing system.

One major disadvantage of this commentary training is that it could make the young drivers overconfident in their driving skills. They could overestimate their skills and underestimate the road conditions which could lead to more crashes. Other than a lack of hazard perception, speeding is also a big problem for young drivers.

1.2.4. Inappropriate speed choice in young drivers

As previously mentioned, excessive speed elevates both the risk and severity of having a crash (Elvik, et al., 2004; M. C. Taylor, Lynam, & Baruya, 2000). There is a distinct difference between excessive and inappropriate speed which will be explored in greater detail.

Driving above the speed limit is not a rare occurrence and many drivers do not perceive speeding as a serious offence (e.g., Campbell & Stradling, 2003; Quimby, Maycock, Palmer, & Buttress, 1999). Haglund & Åberg (2002) observed drivers at two locations along a route for two days in a row and found that in all cases, the mean speeds were above the posted speed limit. Speeding is seen to be the biggest antisocial behaviour by the public, especially on residential roads (Poulter & Mckenna, 2007). Although speeding above the posted speed limit has been identified across a wider population, it is particular frequent in younger drivers. One study looked at vehicle speeds on 13 different roads with a speed limit ranging between 65km/h and 90km/h. It was found that the speeders were younger, more likely to drive newer and sport utility vehicles and less likely to drive minivans (Williams, Kyrychenko, & Retting, 2006). Another study

conducted in New Zealand found that driving 20km/h above the speed limit was a stronger risk factor for young drivers (Blows, Ameratunga, Ivers, Lo, & Norton, 2005). Speeding is the most common kind of driving offence committed by young drivers (Clarke, Ward, & Truman, 2005).

Young drivers tend to choose inappropriate speeds when the road conditions change and this is one reason why they are so over represented in the crash statistics. Deery (1999) argued that in conditions different from well learned and expected, young inexperienced drivers may find it difficult to make the right decisions quickly and effectively. Several reasons and theories have been proposed to help explain why young drivers are so vulnerable when it comes to choosing the correct speed for the road conditions.

Fuller (2005) proposed the task-capability interface (TCI) model which describes the interaction between task difficulty and driver capability (see Figure 1.4). According to this model, drivers adjust their behaviour to maintain the current work load below their driver capability. When the driver's capabilities exceed the demands imposed by the road, then the driver will find the task easy. However, if the task demands exceed the driver's capabilities, then the driver will find the task too hard which could lead to a loss of control. If the task demands and the driver's capabilities are equal, then the driver will find the driving task hard but should still be able to keep control of the vehicle. Driving task demands are determined by the plethora of environmental and operational factors. On top of all of these elements of task demand, the driver has immediate and direct control over the speed of the vehicle. It is clearly evident that speed is the most significant factor, because the faster the vehicle is travelling, the less time there is to take information in, process and respond to it. Experienced drivers allow more time to take action if a mistake occurs than inexperienced drivers and so they can correct a mistake more easily (Brown & Groeger, 1988).

Driver capabilities can be affected by physiological factors such as fatigue, stress, knowledge of the road and information processing capacity. Young inexperienced drivers are more prone to be affected by these factors than older more experienced drivers. To counteract some of these factors, a driver will increase the task difficulty in order to reach their arousal level and this is generally done by increasing the speed, especially in young drivers (Brown, 1994). Motivation can also play an important part in the driver's capabilities,

because this contributes to the determination of resource allocation. As described earlier, young inexperienced drivers have plenty of motivation to engage in risky behaviours such as speeding. Driver experience is an important part in the TCI model and young drivers lack this which makes them more susceptible to task demands that are higher than their driving capabilities.

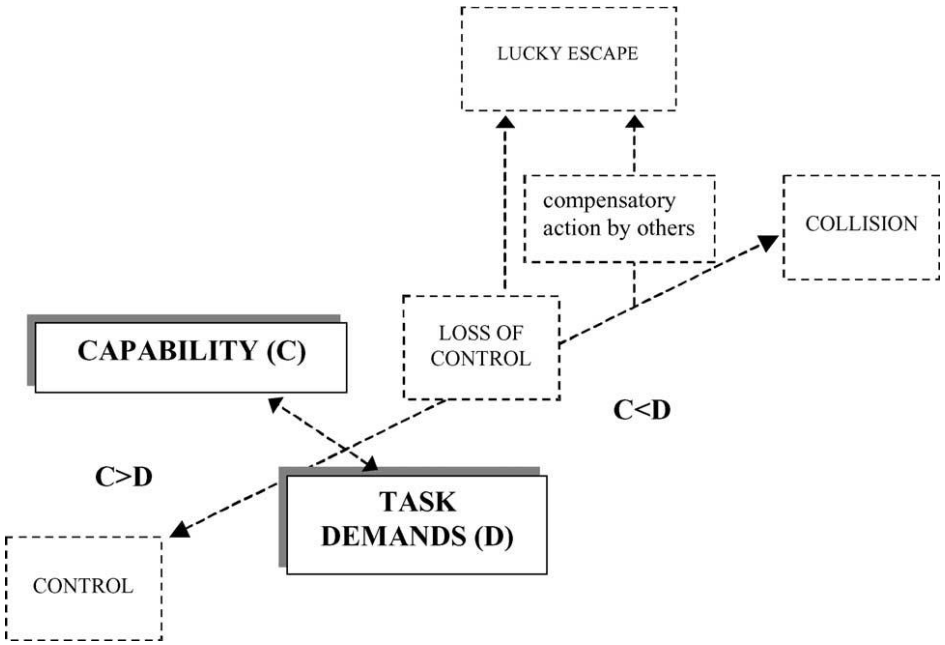


Figure 1.4: Outcomes of the dynamic interface between task demand and capability (Fuller, 2005).

Wilde (1982) proposed a theory called the risk homeostasis theory. It states that a driver has a specific level of risk (target risk) he or she is willing to accept. Whenever there is a discrepancy between the target risk and perceived risk, the driver will perform adjustment actions to minimise this discrepancy. When the perceived risk is higher than the target risk, the driver will drive safer to reduce the perceived risk. But when the perceived risk is lower than the target risk, the driver will engage in riskier driving in order to increase the perceived risk. A study was conducted in Munich where half of the taxi fleet was equipped with anti-lock brake system (ABS) and the other half had conventional brake systems. The crash rate was the same for both types of cabs, because the taxi drivers who had ABS was taking more risks and the taxi drivers with the conventional braking system drove more carefully (Wilde, 1994). Similar results

were found in Sweden when they changed from left to right hand driving in 1967. Following the change, crash rates decreased dramatically, but returned to normal within two years. Wilde argued that this change led to a sudden increase in perceived risk and so people drove more carefully. After some time, people discovered that the roads were less dangerous than thought and the perceived risk decreased causing an increase in riskier driving (Wilde, Robertson, & Pless, 2002). The same was found in Iceland in 1968. This theory is particular applicable to young inexperienced drivers, because they engage in more risky behaviours and so their target risk is higher than experienced drivers. Their target risk is sometimes higher than what is safe due to a lack of experience and they tend to drive too fast for the road conditions.

Solomon conducted a comprehensive study of more than 10,000 accident involved drivers and he found that the probability of being involved in a crash per vehicle-mile as a function of on-road vehicle speeds follows a U-shaped curve with speed values around the median speed having the lowest probability of being in a crash. This U-shaped curve is commonly known as the crash risk curve. This can be extrapolated to young inexperienced drivers, because they tend to choose higher speeds than older experienced drivers increasing their probability of being in a crash (Cantwell, 2010; Smeed, 1973). Young drivers see driving above the speed limit a test of their driving skills and it represents a mean of competing with other drivers and expressing one's own superiority and powerfulness while driving (Rolls & Ingham, 1992).

Excessive or inappropriate speed has been shown to be the biggest contributing factor for young drivers involved in fatal crashes. It causes over 40% of all fatal crashes involving young drivers (Ministry of Transport NZ, 2010b). There are other risky driving behaviours that are also contributing factors to the high crash rates of young drivers. Driving under the influence of drugs and alcohol, multi-tasking and distraction, driver fatigue, dangerous overtaking and following too closely are all contributing factors and they cause 35%, over 10%, 8%, 5% and 1% respectively of all crashes involving young drivers. These statistics are very alarming but since excessive or inappropriate speed is the primary cause of crashes in young drivers, this will be the focus of the current study.

Excessive or inappropriate speeds are so dangerous due to the effect it has on stopping distances and reaction times of the driver. The Transport Research Laboratory (2007) found that under dry conditions, a car travelling at 80km/h required 77.7m to fully stop where the reaction distance was 18.3m. At 120km/h the car required 107.5m to fully stop where the reaction distance was 22m. Under wet conditions the total stopping distance for a car travelling at 80km/h was 81.7m which is not a big difference but at 120km/h, the total stopping distance was 172.2m which is significantly more than under the dry conditions. This study found that if you double your speed, you quadruple your stopping distance. Many of the causes of crashes are due to a delayed reaction time by the driver and the lack of stopping distances to prevent crashes and injuries.

Young inexperienced drivers have poor calibration, because they overestimate their driving skills and underestimate the driving task (e.g. Deery, 1999; Delhomme, 2002). They have an unjustifiably high level of confidence in their driving abilities and so they engage in ignorance based risk taking behaviour. They also lack the ability to choose appropriate speeds for the road conditions. When young inexperienced drivers drive too fast, the task demands become higher than their capabilities without them realising it until it is too late. Also their target risk is higher than experienced drivers and due to a lack of experience; young inexperienced drivers tend to misjudge the perceived risk which leads to them driving too fast for the road conditions.

There is some evidence showing that incentives could help young inexperienced drivers drive under the speed limit. Five Dutch car insurance companies were involved in a study where young drivers could save money on their monthly insurance fee by keeping under the speed limit. It was found that this money incentive significantly reduced speeding violations of young drivers (Bolderdjik, Knockaert, Steg, & Verhoef, 2011).

1.2.5. Laboratory and self reported measures, which is better?

One major concern for researchers is the ecological validity and reliability of self-report measures and laboratory tasks. Self-report measures have been shown to have good test-retest reliability. Iverson (2004) administered two identical surveys to the same people 12 months apart and found that there was a good test-retest reliability between attitudes and driver behaviour. Ecological

validity is harder to achieve with self-report measures but some studies have successfully done this. Corbett (1999) found a moderately high correlation between subjective speed and observed speed. In a similar study it was found that self-reported social deviance, speed and carefulness corresponded well with observed driving behaviour (West, Elander, & French, 1993). All these studies used accident involvement to compare with self-report measures. Accident involvement is not a very good indicator of driving ability, because of its rare occurrence. Groeger & Grande (1996) conducted a study looking at this issue. They administered a self-reported questionnaire and then the same participants' actual driving skills were assessed by a driving instructor. There were no significant differences between the self-reported behaviour and actual observed driving behaviour.

Social desirability bias can be a big problem with self-reported questionnaires, because participants often answer in a way that might portray themselves better. Jonah & Dawson (1987) suggested that people under report negative driving behaviours and over report positive driving behaviours but self-report is nevertheless good for making comparisons between groups of driving behaviour. This problem is partially eliminated with the use of laboratory tasks to compare with self-reported measures.

One method of attempting to increase the ecological validity of self-reported measures while maintaining experimental control is to re-create some of the driving tasks in the laboratory using simulation. Participants can be exposed to more dangerous situations than would be possible in the real world and more diverse situations. McKenna and colleagues employed a video task that they had developed to determine whether speed preferences reflected risky driving attitudes. They found that higher speed preferences corresponded to riskier driving attitude indicating that laboratory tasks may provide an ecologically valid and more objective instrument to measure driver risk taking than the self-reported measures used (McKenna, et al., 2006). In the current study, two laboratory tasks will be used to assess risky driving behaviours and these will be compared to self-reported measures of risk taking.

The first laboratory task used in this research will be a hazard perception dual task (HPDT) which was developed by Isler, Starkey and Williamson (2009). It will require participants to search for immediate hazards in a driving scenario as

a primary task while doing a secondary tracking task at the same time. The second laboratory task used in this research will be the video speed choice task (VST) which was similar to the one developed by Horswill and McKenna (1999). It will require participants to watch a video sequence and estimate the vehicles speed as well as selecting an appropriate speed for the condition.

There seems to be a link between hazard perception skills and speed choice behaviour. Renge (1998) found a significant correlation between high hazard perception scores and lower speed choice. Another study showed that drivers who had learned to identify hazardous situations were choosing slower speeds when they had identified a more hazardous situation compared to a less hazardous situation. More experienced drivers tend to choose overall slower speeds than the inexperienced drivers (McKenna, et al., 2006). There is however, a lack of research to support this hypothesis and this will be investigated further in the current study.

1.2.6. Individual Differences in Young Drivers Risk Taking

It is widely recognised that driving is a complex behaviour and crashes have multiple determinants, however, potential predictors are generally studied by themselves and are rarely combined (e.g. Peck, 1993). The aim of the present study was to examine if self-reported measures relate to laboratory based driving behaviours.

This study will look at ten individual differences that could potentially influence young inexperienced drivers driving behaviour. These include; sensation seeking, anger, competitiveness, boredom, self esteem, confidence, conscientiousness, anxiety, empathy concern, impulsivity and attitudes toward speeding and general driving. Individual differences do not seem to predict crash risk directly but rather influences crash involvement indirectly through driver behaviour (Elander, West, & French, 1993).

According to Zuckerman (1979), sensation seeking is "a trait defined by the need for varied, novel and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experienced" (p. 10). Jonah (1997) conducted an intensive review of 40 studies and the vast majority showed a positive relationship between sensation seeking and risky driving. High sensation seeking participants were more likely to experience a

crash and traffic violations than low sensation seeking participants. Several studies have shown that sensation seeking is generally higher in men than in women (e.g., Zuckerman & Neeb, 1980). One study showed that young drivers with high sensation seeking were more likely to speed, report more aggressive driving habits and drive faster on wet roads (Jonah, Thiessen, & Au-Yeung, 2001). Arnett (1996) conducted a study looking at sensation seeking with high school and college students. He found sensation seeking was related to every type of reckless behaviour, including all types of risky behaviours in driving. Zuckerman (1994) suggested that sensation seeking is the most common purpose of risky driving in young drivers, especially aged 16-20 years.

According to Tasca (2000) aggressive driving is defined as "A driving behaviour is aggressive if it is deliberate, likely to increase the risk of collision and is motivated by impatience, annoyance, hostility and/or an attempt to save time" (p. 2). Driver anger and aggressive driving is a fairly common occurrence and it has been estimated that drivers may be subjected to hundreds of anger episodes and aggressive behaviours per year (Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000). Neighbors and colleagues found that participants reported being angered while on an average of 2-5 minutes per day and was on the increase (Neighbors, Vietor, & Knee, 2002). Parkinson (2001) found that anger is relatively more likely while driving than during other activities. Lajunen and colleagues found that young inexperienced drivers are more likely to exhibit driving anger than older more experienced males. They argued that older more experienced drivers may be better at tolerating frustrating driving situations and that they have learned to adjust their travel plans and expectations more realistically than young inexperienced drivers (Lajunen, Parker, & Stradling, 1998). Iversen & Rundmo (2002) found that drivers who scored high on driver anger and sensation seeking reported more risky driving. Begg & Langley (2004) found that aggressive behaviours at 18 years of age significantly predicted subsequent self reported speeding behaviour at both 21 and 26 years of age. Trait aggression has also been shown to significantly predict self-report drink driving (Begg & Langley, 2004; Gulliver & Begg, 2004).

According to Fernandes et al. (2007), competitiveness is "a trait to evaluate engaging in behaviour that is viewed as a contest with other people" (p. 60). While competitiveness should logically predict on road competitive driving,

there is little evidence to support the hypothesis that competitiveness is a contributing factor in risky driving. One study conducted in New Zealand showed that young drivers who report frequently racing their car were 2.4 times more likely to be involved in a crash (Blows, et al., 2005).

According to Fisher (1993) Boredom can be defined as "an unpleasant, transient affective state in which the individual feels a pervasive lack of interest in and difficulty concentrating on the current activity" (p. 396). Driver boredom has received limited attention from researchers. Harvey et al. (2011) administered a self-report questionnaire to UK drivers and they found that 31% reported being easily bored and therefore more likely to seek excitement by taking risks while driving. These thrill seekers were more prone to speeding and dangerous overtaking and these drivers were more likely to be young and inexperienced behind the wheel. They argued that when drivers become bored, they will increase their arousal levels so that their driver capabilities are the same as the task demands (see Fuller, 2005). As a result, bored drivers will engage in risky behaviours in order to make the on road experience more exciting, leading them to have one and a half times more crashes than other drivers. Dahlen et al. (2005) found that boredom proneness was related to driving anger and aggressive driving.

Rosenberg (1989) defined self esteem as a positive or negative orientation toward oneself; an overall evaluation of one's worth or value. Schreer (2002) showed that inflated self esteem is a better predictor of aggressive driving than low self esteem. Young drivers, especially males have higher self esteem than older more experienced drivers. He argued that people with high favourable views of the self that are undermined by another person, will be more prone to dangerous driving to defend their positive view of themselves (Baumeister, Bushman, & Campbell, 2000). This concept can't be "taught" and it is developed through an individual's life experiences, so it is a good reflection of a person's view of oneself.

Overconfidence is a major problem in young drivers, especially in males, because they are overconfident in their driving skills. Farrow & Brissing (1990) found that young males expressed more confidence than young females for driving situations perceived as hazardous; driving in a snowstorm, speeding, cool off after an argument and drink driving. Wieczorek and colleagues found that

young males are more likely than young females to feel comfortable in hazardous driving situations and also had less expectation of consequences attached to dangerous driving (Wieczorek, Mirand, & Callahan, 1994). Some vehicle handling training programs intended to increase young drivers' skills but have been found to increase their level of confidence rather than improving their driving skills (Nils. Petter. Gregersen, 1996).

Conscientiousness is one of the five traits in the "Big Five Model" of personality and it can be defined as a trait of being painstaking and careful. This includes elements such as self discipline, reliable and responsible. Arthur & Graziano (1996) found that conscientiousness and risky driving were negatively correlated. Participants who rated themselves as more conscientious were less likely to be involved in risky driving behaviours. However, more recent research has shown otherwise. Dahlen & White (2006) found that conscientiousness was not a predictor in unsafe driving and other studies found similar results (Schwebel, Severson, Ball, & Rizzo, 2006).

Anxiety is also one of the five traits in the "Big Five Model" of personality and it refers to a person's continual tendency to react with anxiety, because they're persistently expecting bad outcomes. Taylor & Paki (2008) conducted a study in New Zealand looking people's experiences of anxiety and fear related driving. They found that only 15% of sample experienced anxiety while driving which is small but significant. Women reported more driving anxiety, fear and avoidance than men. Similar results were found in a more recent study looking at older people (aged 55 to 70) (Taylor, Alpass, Stephens, & Towers, 2010).

Empathy Concern refers to an individual's understanding of another person's experience or the sensing of another person's emotions. Parkinson (2001) found that empathy showed no reliable correlations with the frequency of anger while driving. One study administered a personality questionnaire to older drivers and found that drivers who reported four or more driving errors had higher empathy scores. They argued that personality measures should be incorporated with future studies relating to driver behaviour (Owsley, McGwin, & McNeal, 2003). Ross & Antonowicz (2004) found that antisocial drivers lack empathy at both the emotional and cognitive level. They may be unable to feel what the other drivers are experiencing and may be unable to understand what the other drivers are feeling.

Impulsiveness is another component of risk taking that has received attention from researchers. It can be defined as an individual who initiate behaviour without any forethought of the consequences, relating to the saying "act for they think." Young drivers are more susceptible to this, because of their lack of the prefrontal lobe development (Steinberg, 2008). There is a distinct difference between sensation seeking and impulsiveness with sensation seeking referring to one's preference for novel experiences while impulsivity refers to self control exhibited over one's own actions (Dahlen, et al., 2005). Dahlen and colleagues found a significant positive correlation between impulsiveness and risky driving ($r=0.35$, $p<0.01$) and also a significant correlation between aggressive driving and impulsivity ($r=0.23$, $p<0.01$) (Dahlen, et al., 2005). One study examined the differences between young and adult drivers in relation to impulsivity, driving and risk attitudes. The results showed that young drivers displayed attitudes significantly more approving of risk taking and risky driving, had significantly higher impulsivity, and were much more inclined to committing future driving violations than older drivers (Moleni, 2010).

The theory of planned behaviour proposes that attitudes toward health and future relevant behaviours are key determinant of intentions to engage and perform the behaviour (Ajzen, 1985). Fernandes and colleagues argued on the basis of this theory that relevant attitudes arise from the beliefs about the outcomes of the behaviour coupled with the evaluation of those outcomes whether it is positive or negative (Fernandes, et al., 2007). For example, a belief that speeding will increase the chance of arriving on time coupled with a positive evaluation of arriving on time will amount to a positive attitude toward speeding. On the basis of this reasoning, several attitudinal measures will be used to assess and individual's attitude towards driving. Several studies have showed the importance of investigating driver attitudes and beliefs in relation to risky driving. For example, Iverson (2004) found that drivers with a more positive attitude toward driving violations engaged in more risky driving behaviours such as speeding. Young drivers showed more positive attitudes toward risky driving behaviours than older drivers.

In summary, young inexperienced drivers hold more lenient attitudes toward risky driving and have higher sensation seeking, impulsivity, self esteem and confidence than older more experienced drivers. Interestingly, young

inexperienced drivers also have a higher propensity to become angry or bored while driving than older more experienced drivers. Lastly, male drivers are less likely to be anxious behind the wheel and they show more confidence, sensation seeking and impulsive behaviours than their female counterparts.

1.3. The Current Study

This research will use the validated video speed choice task by Horswill and McKenna (1999) and the hazard perception dual task by Isler et al. (2009), adapted to different New Zealand road conditions. The speed choice behaviour and hazard perception skills of young inexperienced drivers will be compared to older experienced drivers. In addition, self-reported measures will be gathered from all participants in regards to sensation seeking, impulsiveness, aggressiveness, boredom, self esteem, competiveness, confidence, conscientiousness, anxiety, empathy concern and their attitudes and beliefs toward driving related behaviours. The aim of the current research is to build on previous findings and to further examine the link between hazard perception skills and speed choice behaviours using age, driving experience, gender and other individual differences as independent variables.

The specific research questions are:

1. *Do young inexperienced drivers choose different speeds than older experienced drivers? Is there a gender effect on the speed choice task? How do different road conditions affect the speed choice behaviour of the two groups?*

   The reviewed literature suggests that young inexperienced drivers will choose faster speeds than older more experienced drivers. In particular, young male drivers will choose faster speeds than their female counterparts. Young inexperienced drivers choose the same speed irrespective of the road conditions whereas older experienced drivers adapt their speed to the road conditions.

2. *Do hazard perception skills differ between the young inexperienced and older experienced drivers? Is there a gender effect on the hazard perception task?*

   The literature review suggests that young inexperienced drivers will detect fewer hazards than the older experienced drivers. The gender effect on the hazard perception task will be explored in this current research.

3. *Do the questionnaire measures and hazard perception times help characterize the drivers who consistently choose slower or higher speeds?*

The literature suggests that drivers who choose higher speeds are more likely to detect fewer hazards, because they lack the experience and so they engage in ignorance based risk taking behaviours. In addition, drivers who consistently choose higher speeds will score higher on the self-reported measures on driver risk taking. There seems to be a link between hazard perception skills and speed choice behaviour. If a driver has good hazard perception skills, then they will have good speed choice skills.

2. Method

2.1. Participants

A total of 120 drivers (61 males and 59 females) were recruited to participate in this study and they ranged in age from 15 to 73 years, with a mean age of 27.3 years (SD=13.5). While the majority of participants considered themselves as New Zealand European (N=94), there were also participants from other ethnic groups; New Zealand Maori (N=7), Asian (N=3), Other European (N=8), African (N=3), Kurdish (N=2), Indian (N=2) and Guyanese (N=1). Participants were required to hold a current New Zealand learner, restricted or full drivers licence in order to take part. The majority of participants had their driver's licence for more than six months (N=113) while the rest had their driver's licence for less than six months (N=7).

The first group, labelled as "Young Inexperienced Drivers", was composed of 81 drivers (41 males and 40 females) aged between 15 and 25 years, with a mean age of 19.6 years (SD=2.9). The mean age for the males was 18.95 years (SD=3.1) and for the females, was 20.95 years (SD=2.4). Sixteen of these drivers currently held a learner drivers licence, 24 had a restricted drivers licence and 41 had a full drivers licence. Most participants (N=74) had their drivers licence for more than six months while the rest (N=7) had their drivers licence for less than six months. The average driving experience for this group was 4.1 years (SD=2.8). The average driving experience for males was 3.57 years (SD=3.1) and for females was 4.69 (SD=2.4).

The second group, labelled as "Older Experienced Drivers", was composed of 39 drivers (20 males and 19 females) aged between 26 and 73 years, with a mean age of 42.5 years (SD=14.1). Two of these drivers currently held a restricted drivers licence and 37 had a full drivers licence. All 39 participants had their drivers licence for more than six months. The average driving experience for this group was 24.9 years (SD=13.6). This clearly showed that older experienced drivers had clearly more driving experience than the young inexperienced drivers.

2.2. Laboratory Based Measures

2.2.1. Video Speed Choice Task

A Video Speed Choice Task (VST) was used to examine and compare the speed choice behaviour of the participants in different road conditions and was similar to the one developed by Horswill and McKenna (1999). Participants were required to watch video clips recorded from the driver's perspective along different stretches of roads. This task was modified slightly to Horswill and McKenna (1999) in that after each video clip, the participant had to estimate the vehicle speed and then determine what would be the ideal speed for that particular road condition. The video task was designed to give a realistic impression of a driver's perspective travelling along different sections of roads.

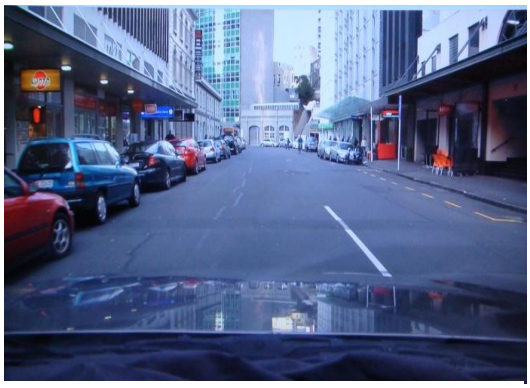
The videos used in the VST were selected according the criteria that Horswill and McKenna (1999) developed for their speed choice task ensuring that (a) the vehicle speed is constant across the video clip, (b) the road must be relatively clear ahead so that increasing the speed of the vehicle is possible, and (c) that there are no cues to what speed the vehicle in the video clip is travelling (e.g., speed signs, speedometer). As real world drivers rarely seem to consult their speedometers while engaging in speed related behaviour (Mourant & Rockwell, 1972), there was no speedometer supplied in the simulation as we tried to make this as close to the real world as possible. We also didn't want the participants to rely on other information they would not normally use while driving. The third criterion that Horswill and McKenna used was not applied in this study namely that; (c) the static cues within each video clip are kept to a minimum (e.g. parked cars, blind corners etc.). This ensured that the simulations were as real as possible, particularly for urban roads. With many parked cars on the side of the roads in the real world. Horswill and McKenna (1999) used only a limited number (seven) of scenes in their study whereas the present study used a larger variety of road scenes. The different road environments used in this experiment were representing what most motorists encounter regularly on New Zealand roads.

The two main types of roads were urban and rural.

Urban roads were defined as roads in the city/town with a speed limit of 50km/h and around schools this limit drops down to 40km/h (at specific times). These roads consist of more dense traffic (8,000-20,000 vehicles per day) and increased intersections compared to rural roads. An urban road generally has road markings on both the centre and shoulder of the road and has more hazards such as stationary hazards (e.g., parked cars) and moving hazards (e.g., pedestrians) (Cantwell, 2010; Davin & Olsen, 2011).

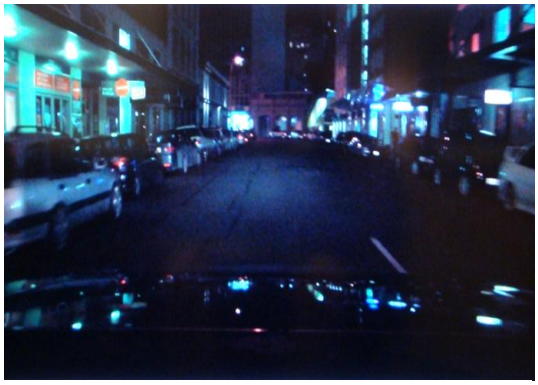
Rural roads were defined as two-lane open roads with a speed limit of 100km/h and these roads are located outside the city limits. These roads consist of less dense traffic (1,000-5,000 vehicles per day) and a low density of hazards (e.g., moving cars). A rural road has road markings on the centre of the road but not always on the shoulders. These roads are surrounded by pasture lands and forests whereas the urban roads are more surrounded by buildings and parks (Cantwell, 2010; Davin & Olsen, 2011).

According to the definitions of these two roads, eight different road conditions were filmed. The two urban roads (with and without shoulder lines) had a speed limit of 50km/h whereas the two rural roads (with or without shoulder lines) had a speed limit of 100km/h. The urban road conditions were filmed during the day and night and the rural road conditions were filmed during dry and wet conditions (see Figure 2.1).

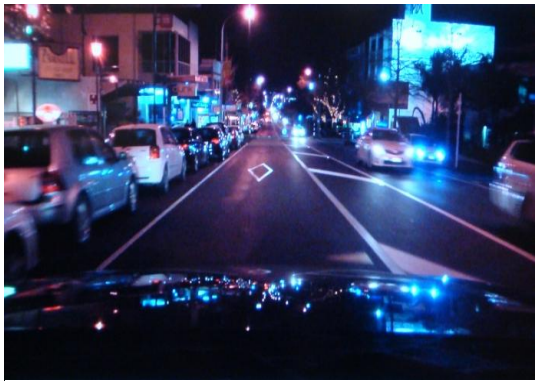


Urban day (no shoulder lines)

Urban day (shoulder lines)



Urban night (no shoulder lines)



Urban night (shoulder lines)

Rural dry (no shoulder lines)

Rural dry (shoulder lines)

Rural wet (no shoulder lines)

Rural wet (shoulder lines)

Figure 2.1: Video Speed Choice Task sample screenshots of the eight different road conditions used.

The video footage was collected with a camera-vehicle driven on several routes around the rural areas of Hamilton and the urban areas of Auckland. The footage was taken during the afternoon (3pm) for the day video clips and after sunset (10pm) for the night video clips. The recordings for both the wet and dry conditions were taken around the same time during the afternoon on different days.

The speed limit for the rural roads were 100km/h and the video clips were filmed at three different speeds; 100km/h, 70 km/h and 30km/h. This was done for both the wet and dry conditions. The speed limit for the urban roads were 50km/h and the video clips were filmed at three different speeds; 50km/h, 30km/h and 10km/h. This was done for both the day and night conditions. A deviance from the speed limit was chosen so that the participant was not inclined to select the speed limit each time but rather judge the speed in the video clip (i.e., participants should not select a speed close to the speed limit if the camera vehicle was travelling at 30km/h on a 100km/h speed limit road).

The video footage was recorded using a digital video camera mounted on a special bracket within a vehicle so that the footage would be static frame and no vibration of the vehicle would show. The recordings obtained the driver's perspective through the windscreen of the vehicle and it was recorded in high definition (HD) to make it as real as possible for the viewer. The camera focus was set on infinity (∞).

Once all the footage was obtained, it was transferred digitally onto a desktop computer and some editing was done. The video clips were selected according to Horswill and Mckenna (1999) criteria and this resulted in 24 short segments of the original clips. All the segments were the same length (six seconds) representing each of the road conditions described earlier. Four clips were repeated and selected at random to check for consistency and two practice trials were also included to make sure the participant understood the task at hand bringing the total to 30 video clips.

The clips were shown on a 42" Panasonic full high definition LCD TV (model number: TH-L42U30Z) with a screen resolution of 1920x1080 pixels (1080i). Also, the TV monitor was set to widescreen (16:9) and the frame rate of each video clip was 59.94 frames per second. A recliner chair was situated in front

of the TV monitor so that the participant was only one metre away from the screen giving a viewing angle of 53.9° (see Figure 2.2).

Figure 2.2: The experimental setup for the Video Speed Choice Task and Hazard Perception Dual Task.

Initially, the participant was presented with a clear screen and a mouse click on the button in the centre of the screen labelled *"Start Video*" started the task. A six second video was shown of a car travelling along a section of road without sound. After the video clip has finished, a screen appeared asking the participant to estimate the speed of the vehicle (i.e., *How fast do you think you were going?*). The counter was in the format of a speedometer (see Figure 2.3) and started on zero. Using the mouse, the participant could either drag the needle or click on the speed they want to select and the needle will automatically jump up to that position. Once the participant was happy with their selected speed, selecting "OK" opened the next screen (see Figure 2.4). This time, the participant was asked to select the speed that they felt comfortable driving in the road condition presented in the footage (i.e., *What do you think would be the ideal speed for this road condition?*). As in the previous screen, the participant was able to select the speed that they preferred driving in that road condition. The program

was designed so that the participant couldn't continue unless a speed was selected to ensure there were no missing values in the data.

Once participants had selected their estimated and preferred speeds, the original clear screen would appear and selecting "*Next Video*" began the countdown for the next video trial in the sequence. The process for each trial was the same and it was repeated until all video clips were shown (30 trials, 2 practice, and 4 repeated trials). Once all the trials were completed, the program ended.

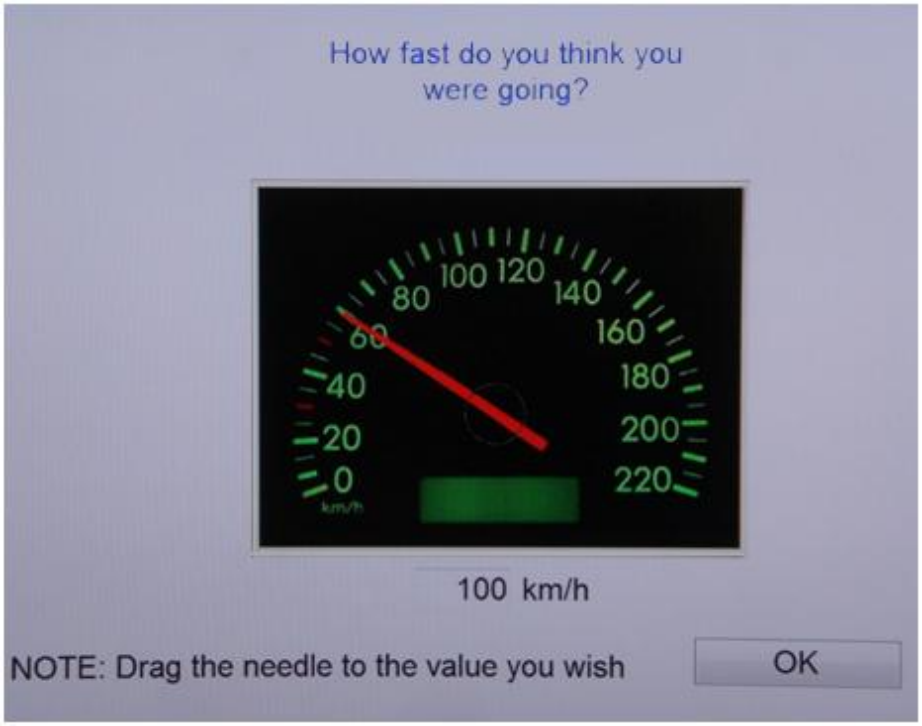


Figure 2.3: The first question asking participants their speed estimate of the video clip.

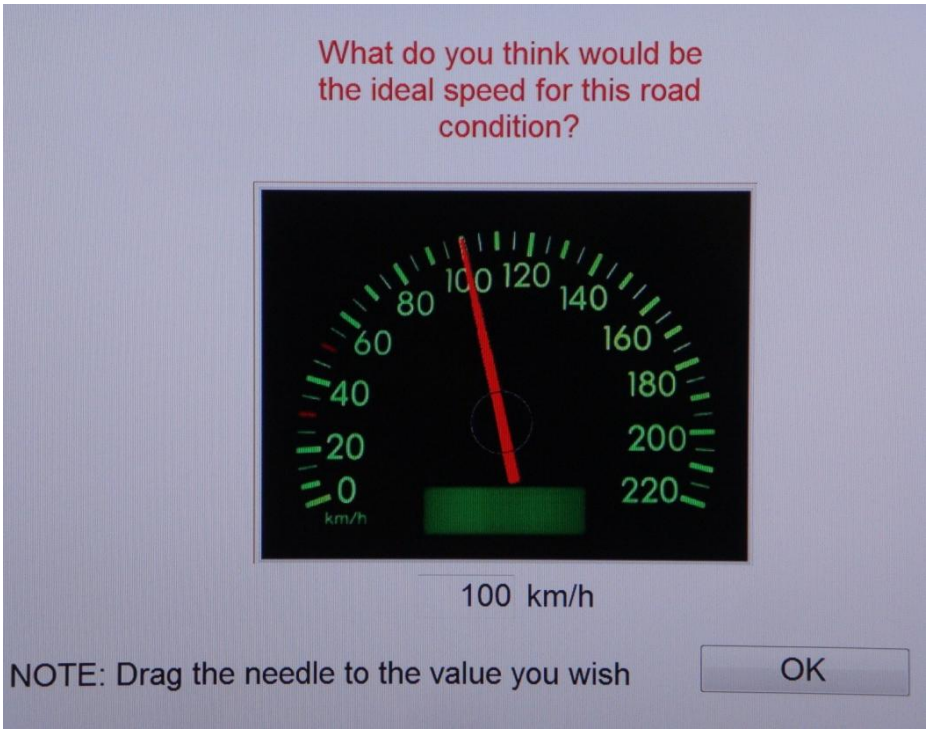


Figure 2.4: The second question asking participants their preferred speed of the video clip.

2.2.2. The Dependent Variables for the Video Speed Choice Task

The speed choice task provided two immediate dependent variables: the Estimated Speed (km/h) and the Chosen Speed (km/h). From these variables the following variables were calculated:

1) Standardised Estimated Speeds

This dependent variable was created by standardising the estimated speeds (z-scores) across all the road conditions. All these scores were added up to give the total standardised z-score for each participant. A higher value of this z-score indicated a higher estimated speed.

2) The Percentage Difference (%)

This variable was created by calculating the absolute percentage difference between the actual speed and estimated speed. The smaller value (%) indicated a higher accuracy of the speed estimation.

3) Standardised Chosen Speeds

This variable was created by standardising the chosen speeds (z-scores) across all the road conditions. All these scores were added up to give the total standardised z-score for each participant. A higher value of this z-score indicated a higher chosen speed.

4) Chosen Speeds in relation to the Speed Limit

This variable was created by calculating the difference between the chosen speeds and the speed limit for each road condition. A negative value indicated a chosen speed below the speed limit.

2.2.3. Hazard Perception Dual Task (HPDT)

A Hazard Perception Dual Task (HPDT) was used to assess the participants' ability to detect hazards in a driving scenario, similar to the one used by Isler, Starkey and Williamson (2009). It required them to search for immediate hazards in a driving scenario as a primary task while performing a secondary tracking task at the same time. An immediate hazard was defined as a hazard which could potentially get into the way of the driver so that a driving action would be required such as braking or steering away. Examples included braking cars, pedestrians, road workers, cyclists and pedestrians crossing the road. The video task was designed to give a realistic impression of a driver's perspective travelling along a section of road where hazards were present.

The video footage used in the HPDT was selected from the *eDrive* online interactive driver training (*www.edrive.co.nz*, Isler & Isler, 2011) program simulations were selected from around New Zealand with various lengths. Each simulation involved five immediate hazards. As this task was originally designed to give a realistic driving impression, the three rear view mirrors were included (see Figure 2.5).

Initially, the participant was presented with a clear screen and a mouse click on the button in the centre of the screen labelled "*Click here to Start Video*" started the task. The participant was required to click with the mouse as soon as they detected a hazard and verbally point it out. Each click was associated with a high pitch sound and recorded as a hazard detected by the participant. A voice recorder was used to record the participant's voice, so that the detected hazards in each simulation could be later matched up with what they verbally identified.

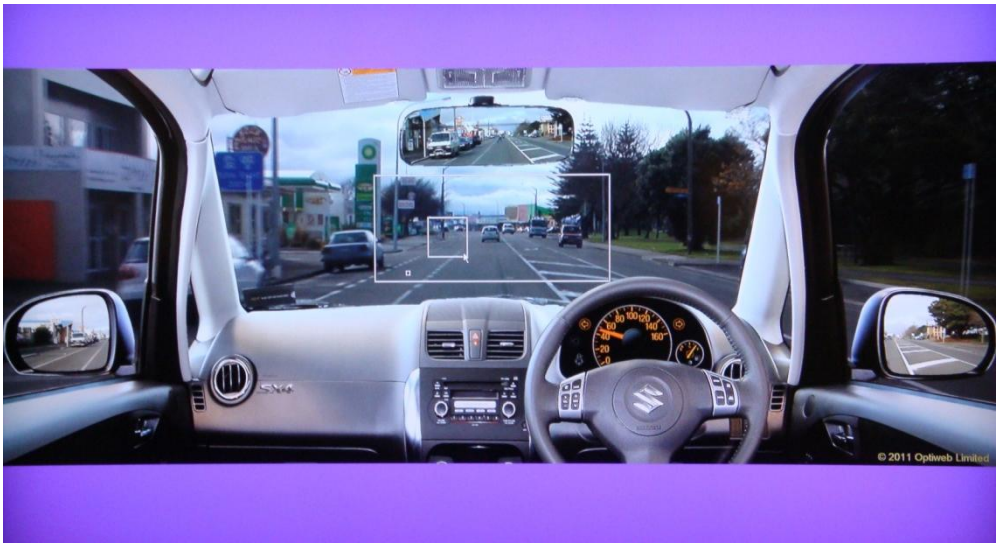


Figure 2.5: A screenshot of the Hazard Perception Dual Task with the secondary tracking task in the centre (see text for more info).

At the same time, the participant was required to perform a secondary tracking task which simulated the steering task in real driving and can be seen in Figure 2.5. A stationary large rectangle was superimposed over the traffic scene in the centre. The participant was required to keep the randomly moving dot within a square which was controlled by the mouse. The randomly moving dot was contained inside the large rectangle and bounced off the sides of the rectangle. If the moving dot went outside the square, a buzzing sound in conjunction with the background turning purple alerted the participant to the tracking error.

Once participants had completed a trial, the original clear screen appeared and selecting "*Click here to Start Video*" started the next video trial in the sequence. The process for each trial was identical and it was repeated until all eight video clips were shown. Once the eight trials were completed, the program exited.

2.2.4. The Dependent Variables for the Hazard Perception Dual Task

The hazard perception dual task recorded four immediate dependent variables: the number of tracking errors, the time mistracked, the total number of clicks and the time the clicks were made. From these variables the following variables were used:

1) Total Number of Tracking Errors

This variable was created by adding up all the number of times the participant made a tracking error across all the scenarios.

2) Number of Hazards Detected

For each hazard that appeared on the screen, there was a time window from when the hazard appeared until it disappeared. If the participant clicked within the time period allocated for a hazard, the hazard was counted as detected. There were five hazards in each of the eight scenarios and therefore a total of 40 hazards were to be detected.

3) Number of Clicks on Non Hazards

This variable was calculated by subtracting the number of hazards detected from the total number of mouse clicks.

4) Hazard Perception Time (sec)

The hazard perception time variable was calculated by taking the time from the time when the hazard appeared until the participant clicked the mouse button. If the participant failed to detect a hazard the total time during which the hazard was visible was recorded instead.

2.3. Questionnaire Measures

2.3.1. Demographic Questionnaire

The demographics questionnaire requested information regarding the participants' age, gender, ethnicity, marital status and type of licence (learners, restricted or full vehicle licence). Participants were asked to record their driving experience (months or years) and the average kilometres driven each week. Lastly, they were required to report all crashes and near misses in the last 12 months in which they were involved.

2.3.2. Driver Attitude Questionnaire

The Driver Attitude Questionnaire (DAQ, internal consistency α=0.78, Parker, Stradling, & Manstead, 1996) focuses on four factors that aim to measure respondent's attitudes towards major driving issues. This questionnaire consisted of 20 items (1 = strongly disagree, 5 = strongly agree). The four subscales were speeding (e.g., *Speed limits are often set too low, with the result that many drivers ignore them*), drink driving (e.g., *Even one drink makes you drive less safely*), close following (e.g., *Close following isn't really a serious problem at the moment*) and overtaking (e.g., *It is quite acceptable to take a slight risk when overtaking*). Two subscales had somewhat low reliabilities (drink driving α=0.47, overtaking α=0.48) and the other two had good reliabilities (speeding α=0.65, close following α=0.48). Participants had to indicate how much they agree or disagree with each statement about speeding, overtaking, drink driving and close following. Each statement was scored on a five-point Likert scale and some items were reversed scored so that higher scores consistently meant a less safe attitude towards driving.

2.3.3. Speeding Attitude Scale

The speeding attitude scale (SAS, α=0.87, Whissell & Bigelow, 2003) consisted of 14 questions (1 = strongly disagree, 7 = strongly agree) relating to driver's attitudes toward speeding. According to the authors, the questionnaire's has been correlated with Zuckerman's (1971) sensation seeking scale resulting in

a significant positive correlation ($r=0.40$, $p<0.05$). Specifically, a number of speeding tickets had a significant but low correlation with the SAS ($r=0.31$, $p<0.01$) and disrespect for the law had a very strong correlation with the SAS ($r=0.80$, $p<0.001$). Participants were required to select descriptor for each item which best describes them, using a seven-point Likert scale. The summation of the scores in the SAS for each individual yielded an overall score, with a higher score indicating a higher level of attitude for speeding.

2.3.4. Arnett Inventory of Sensation Seeking

The Arnett inventory of sensation seeking (AISS, $\alpha=0.70$, Arnett, 1994) consisted of 20 questions (1 = does not describe me very well, 4 = describes me very well) related to sensation seeking tendencies of individuals. The AISS has a good correlation with the Zuckerman's (1971) Sensation Seeking scale ($r=0.41$, $p<0.05$). The AISS was designed to assess the personality trait of sensation seeking, which is presumed to contribute to risk preferences, which is defined as a need for novel and intense stimulation (Zuckerman, 1979). Participants were instructed to rate the degree to which each item describes them on a four-point Likert. The AISS had two subscales; the novelty subscale (*odd number items*) and the intensity subscale (*even number items*). The two subscales had a strong positive correlation ($r=0.41$, $p<0.05$) and the intensity subscale was more strongly correlated with risk behaviour than the novelty subscale (Arnett, 1994) . Some items were reversed scored and the higher the score, the larger the sensation seeking tendency of that individual.

2.3.5. Boredom Proneness Scale

The short form of the Boredom Proneness Scale (BPS, Vodanovich, Wallace, & Kass, 2005) used was originally developed by Sundberg & Farmer (1986). This questionnaire measures the propensity of individuals to become bored and is closely related to thrill seeking behaviour. The BPS short form consisted of 12 questions (1 = strongly disagree, 7 = strongly agree) of the original 28 with six from each subscale; a lack of internal stimulation (e.g., *I find it easy to entertain myself*) and a lack of external stimulation (e.g., *It would be very hard for me to find a job that is exciting enough*). The internal consistencies

for the two subscales were high at α=0.86 (internal stimulation) and α=0.89 (external stimulation). Participants were asked to what extent do they agree or disagree with the statements about their level of boredom, indicating on a seven-point Likert scale. The original scale used a Guttman close scale (true/false) but this study used the Likert scale to make it more sensitive. The summation of the two subscale scores yielded an overall score, with higher scores indicating a higher level of boredom.

2.3.6. Rosenberg Self Esteem Scale

The Rosenberg Self Esteem Scale (RES, Morris Rosenberg, 1965) measures the overall evaluation of one's self worth or value. Participants were required to respond to statements that described general feelings of themselves. The RES was scored on a four-point Likert scale and consisted of 10 questions (1 = strongly agree, 4 = strongly disagree). Some items were reversed scored and the total score ranged from 10-40 with 40 indicating the highest score possible. Scores between 20 and 30 are within the normal range and scores below 20 suggest low self esteem. The RES has a good internal consistency (α=0.77-0.88) and good test-retest correlations (r=0.82-0.88) (Blascovich & Tomaka, 1993; Morris Rosenberg, 1986).

2.3.7. Driving Anger Scale (DAS)

The propensity to become angry when driving was assessed using the 14 item short form (1 = not at all, 5 = very much) from the Driving Anger Scale (DAS, α=0.80, Deffenbacher, Oetting, & Lynch, 1994). Cluster analysis of the original version (33 items) revealed six reliable subscales including hostile gestures, illegal driving, police presence, slow driving, discourtesy and traffic obstructions. The short form was developed by selecting item scores that were highly correlated with the long form scores (r=0.95). The DAS has been validated in a number of studies (e.g., Deffenbacher, et al., 2000). Participants had to rate each statement to the degree to which each situation would anger them using a five-point Likert scale. A summation of all four subscales yielded and overall score, with higher scores indicating higher levels of anger while driving.

2.3.8. Conscientiousness, Anxiety and Empathy Concern

The conscientiousness and anxiety scales were originally developed by Costa & McCrae (1992). The conscientiousness scale gives an indication of an individual's level of self discipline, their ability to act dutifully and aim for achievement. These behaviours are generally planned rather than spontaneous. The anxiety scale gives an indication of a person's level of anxiousness. The internal consistencies for these two scales are very good; conscientiousness (α=0.81) and anxiety (α=0.83). The empathy concern scale was originally developed by Barchard (2001) and it refers to an individual's understanding of another person's experience or the sensing of another person's emotions. This scale had a good internal consistency (α=0.73). All three scales were sourced from the International Personality Item Pool (Goldberg et al., 2006). Participants were asked to select how accurate each of the statements described them on a five-point Likert scale ranging from 1(*very inaccurate*) to 5(*very accurate*). As each scale measured a different construct, they were scored independently and higher scores indicated a higher level of that personality trait.

2.3.9. Self-Assessment of Driving Ability

The Self-Assessment of Driving Ability (SADA) questionnaire was developed by Tronsmoen (2008) but is based on two other instruments aimed at measuring self-assessment of driving ability (Gregersen & Nyberg, 2002; Spolander, 1983). It consisted of 22 questions (1 = completely correct, 5 = completely wrong) with four subscales which were the following: general driving ability, safety orientation, the body dimension and specific task skills. General driving ability refers to the driver's skills such as driving fast, driving in slippery conditions and driving in the dark. Safety orientation refers to a driver's judgement in relation to risk, danger and safe driving. The body dimension refers to the unity between what the driver feels and the car and lastly, specific skills which refers to judgement of specific skills such as reversing and parallel parking. The internal consistencies for the four subscales were very good; general driving capability (α=0.85), safety orientation (α=0.70), the body dimension (α=0.79) and specific task skills (α=0.76). Participants were required to select how accurate each of the statement was for them on a five-point Likert scale. The statements of

the four subscales were mixed and a summation of the four subscale scores indicated how well a person believed he or she could drive.

2.3.10. Competitive Attitude Toward Driving

The Competitive Attitude Toward Driving (AT, α=0.81, Donovan, 1993)was a five item measure (1 = strongly disagree, 4 = strongly agree). Items included: *It's fun to beat other drivers when the lights changes; it's really satisfying to pass other cars on the highway; it's a thrill to out manoeuvre other drivers; it's fun to weave through slower traffic and taking risks in traffic makes driving more fun*. One item were rephrased to make it more appropriate to the sample (i.e., motorway was used instead of highway). This scale was preferred over the Hypercompetitive attitude scale, because its statements are more related to driving and its good internal consistency. Participants had to indicate how much they agree or disagree with each of the statements and they responded on a four-point Likert scale. The final score was calculated by averaging across reverse coded items so that a higher score represented a more competitive attitude toward driving.

2.3.11. Self Evaluation Questionnaire

The Self Evaluation Questionnaire was used to assess a participant's driving ability and was developed by Horswill, Waylen & Tofield (2004). There were four self evaluation questions and each one addresses a different area and is used individually so no internal reliability data were available. The first statement related to accident concern ("*I sometimes feel worried that I will be involved in an accident*") and was rated on a scale from 1 (strongly disagree) to 9 (strongly agree). The same rating scale was applied to the second statement relating to thrill seeking from driving ("*I often get a thrill from driving*"). The third statement related to driving ability ("*How likely are you to be involved in accidents in the future compared to the average driver?*") and was rated on a scale from 1 (much less likely) to 9 (much more likely). The fourth statement also related to driving ability ("*How skilful do you think you are compared with the average driver?*") and was rated on a scale from 1 (much less skilful) to 9 (much more skilful).

2.3.12. Driver Confidence Questionnaire (DCQ)

The Driver Confidence Questionnaire (DCQ, Bergdahl, 2005) consisted of 13 questions (1 = very safe, 5 = very unsafe) and measured how safe an individual felt driving in various driving situations such as drink driving and driving at 100 km/h. While the original version contained 13 questions, seven were omitted from the reproduction used in this study, because they were not of any value in this study. There was no internal reliability available in the original study for this questionnaire and there is also no report of retest reliability data in subsequent studies where it was used. Participants were required to indicate how safe they would feel in each of the driving scenarios and each question was scored on a five-point scale. A higher score indicated higher confidence in an individual's driving ability.

2.3.13. Barratt Impulsivity Scale – Short Form

The short form of the Barrat Impulsivity Scale (BIS-15, α=0.79, Spinella, 2007) was originally developed by (Patton, Stanford, & Barratt, 1995) which consisted of 15 statements (1 = rarely/never, 4 = almost always/always) relating to a person's impulsivity. This scale consisted of three subscales including non-planning (e.g., *I plan tasks carefully*), attention impulsivity (e.g., *I am restless at lectures or talks*) and motor impulsivity (e.g., *I buy things on impulse*). Some of the items were worded negatively to prevent affirmation bias (DeVellis, 1991). All the items that were worded negatively were reversed scored. Participants had to select the response that best described them by indicating it on a four-point Likert scale. The summation of the scores in the BIS-15 yielded an overall score with higher scores indicating a stronger degree of impulsivity on all three components. Each subscale can be looked at separately, by adding their scores separately, higher scores in each component indicated greater impulsivity in that subscale.

2.3.14. Reliability Analysis of the Questionnaire Measures

Reliability analysis was conducted on all the items on each questionnaire measure to see whether the level of internal consistency was acceptable compared to previous research. There was no reliability analysis for the self evaluation questionnaire, because each question on that questionnaire measure different constructs. The reliability analysis revealed similar internal consistencies for most self reported measures compared to previous research. Interestingly, the BPS had a poor level of internal reliability for the current research and removing items did not increase the level of reliability to an acceptable level.

Table 1

Reliability Analysis for the Questionnaire Measures

Questionnaire measures:	Current Research	Previous Research
Driver Attitude Questionnaire (DAQ)	0.74	0.78
Speeding Attitude Scale (SAS)	0.85	0.87
Arnett Inventory of Sensation Seeking (AISS)	0.67	0.70
Boredom Proneness Scale (BPS)	0.39	0.87
Rosenberg Self Esteem Scale (RES)	0.87	0.83
Driving Anger Scale (DAS)	0.85	0.80
Conscientiousness, Anxiety & Empathy Concern	0.75	0.81
Self Assessment on Driving Ability (SADA)	0.87	0.78
Competitive Attitude Toward Driving (AT)	0.88	0.81
Self Evaluation	N/A	N/A
Driving Confidence Questionnaire (DCQ)	0.76	N/A
Barratt Impulsivity Scale (BIS-15)	0.81	0.79

2.4. Procedure

After ethics approval was obtained from the School of Psychology Ethics Committee of the University of Waikato, the participants were recruited through advertising on posters on the research notice boards around the Hamilton campus, local newspapers (Te Awamutu Courier & Waikato Times), Boys High School and through word of mouth. Each participant was also given a flyer and was asked to promote the experiment to friends and family. This method was highly effective; all the participants were recruited and tested within an eight week period.

The participants who signed up for the experiment were contacted via email and 1 ½ hour individual appointments were arranged. An information sheet was attached to the email and they were asked to read this before coming to the experiment. After arriving at the laboratory room, information about the experiment was given to read again if they had not done so prior. The consent form was signed upon agreement of the terms stated on the form; they had received adequate information and time to ask any questions they might have and that they had the right to withdraw from the experiment at anytime with no questions asked. A participant number was used instead of their real names in order to presume confidentiality.

The participants were tested individually and they were alternated in starting between the questionnaire measures and the video based tasks. If the participant's number started with an even number, they started with the questionnaire measures and if their number started with an odd number, they started with the video based tasks.

The questionnaire measures were administered on a desktop computer in the following order; Demographics, Driver Attitude Scale, Speeding Attitude Scale, Arnett Sensation Seeking Scale, Boredom Proneness Scale, Self Esteem Scale, Anger Scale, CEAC Questionnaire, Self assessment on driving, Competitive Attitude Scale, Self Evaluation, Driver Confidence and Barrat Impulsivity Scale. Online survey software called *Qualtrics* was used to administer these measures which gave an output of all participants' responses (see *www.qualtrics.com* for further details). Participants were asked to read the instructions of all the scales and answer all the questions.

The Hazard Perception Dual Task was then performed by participants seated in the lazy boy chair in front of the television screen. This task was explained to the participant and a practice trial was presented. This trial could be repeated until the participant felt comfortable doing both tasks. After the practice trial, eight video clips were shown to the participant where they had to identify all hazards by clicking the mouse button and verbally say it out loud. At the same time, they had to do the secondary tracking task.

The Video Speed Choice Task was then completed by the participants in the same chair and television screen. Participants received an explanation of the task and they then completed two practice trials to ensure they understood the task at hand. After the two trials, 28 video clips, of six seconds each were shown to the participant and after each one they had to answer the two questions (mentioned earlier) using their mouse. Between the two video clips, there was a three second countdown to help prepare the participant for the next trial. The process was identical for all the trials.

Once all tasks were completed, an informal discussion (e.g., *Do you feel the speed choice task reflected real driving experiences?*) was conducted and they were asked if they had made any other observations or any comments or questions. They were then debriefed on the experiment and thanked for their time. First year psychology students received a 2% course-credit for their participation and all other participants received a $10MTA voucher. Finally, they were asked whether or not they wanted a copy of the summary results which would be send to them via email once the study was completed.

3. Results

All the 120 participants completed both laboratory tasks and the self reported measures. Therefore, data from 81 young inexperienced drivers (41 males and 40 females) and from the 39 older experienced drivers (20 males and 19 females) was analysed. Individual data points were excluded if they were over three standard deviations away from the mean. The following section will report the main results in order of the research questions.

3.1 Do young inexperienced drivers choose different speeds than older experienced drivers? Is there a gender effect on the speed choice? How do different road conditions affect the speed choice behaviour of the two groups?

3.1.1 Estimated and Chosen Speeds across all road conditions.

The speed choice task provided two immediate dependent measures: The Estimated and the Chosen Speeds. The variable Estimated Speeds was first standardised over all road conditions using the total z-scores for the participants (section 2.2.2) and then they were graphed as group means (and 95% confidence intervals) in Figure 3.1. Second, Estimated Speeds were also analysed for accuracy using the variable absolute percentage difference (between estimated and actual speed, see 2.2.2). This variable was also graphed as group means (and 95% confidence intervals) in Figure 3.2.

Figure 3.1 first indicates that the young inexperienced drivers clearly estimated the speeds as slower than the older experienced drivers. They young inexperienced male driver group also consistently estimated slower speeds than their female counterparts and older experienced drivers.

A 2 (driver groups) x 2 (gender) ANOVA on the standardised estimated speeds confirmed that there were significant main effects for driver groups, $F(1,116) = 19.38$, $p < 0.01$ and gender, $F(1, 116) = 6.24$, $p < 0.05$. There was also a significant interaction between driver groups and gender, $F(1,116) = 9.87$, $p < 0.05$. Even though t-tests increase the likelihood of making a Type 1 error, they were used over the post-hoc tests, because there were only to groups. An independent t-test confirmed that young inexperienced male drivers estimated the speeds as significantly slower than their female counterparts, $t(79) = 5.07$, $p < 0.01$, and also compared to the older experienced male drivers, $t(59) = 4.68$, $p < 0.01$. This confirmed, as Figure 3.1 already indicated, that overall, the young inexperienced male drivers estimated the speeds as significantly slower than any other groups.

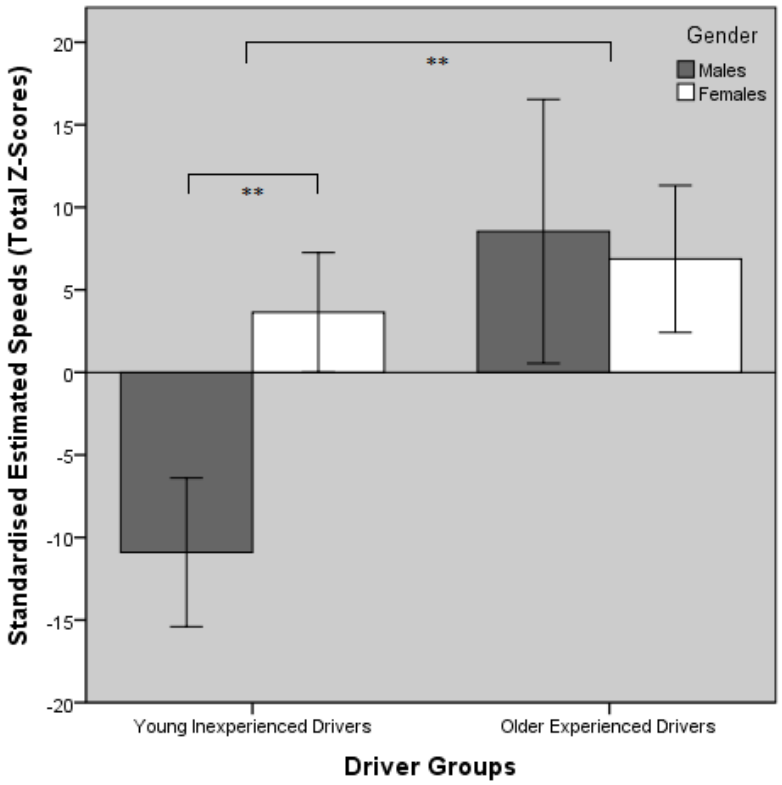


Figure 3.1: Mean standardised Estimated Speeds for all road conditions, by driver groups and gender. The bars indicate 95% confidence intervals (** = $p < 0.01$).

Figure 3.2 shows that young inexperienced drivers had smaller absolute percentage differences (between the actual speeds and the estimated speeds) indicating that their speed estimates were more accurate than their female counterparts and also compared to the older experienced drivers.

A 2 (driver groups) x 2 (gender) ANOVA on the percentage difference confirmed that there was a significant main effect for driver groups, $F(1,116) = 10.35$ $p < 0.01$ but not for gender. There was, however, a significant interaction between driver groups and gender, $F(1,116) = 5.73$, $p < 0.05$. Independent t-tests revealed that the young inexperienced male driver group had significantly smaller absolute percentage differences of estimated speeds and therefore their speed estimates were significantly more accurate compared to their female counterparts, $t(79) = 3.73$, $p < 0.01$, and also compared to the older experienced male drivers, $t(59) = 3.65$, $p < 0.01$. This confirmed, as Figure already 3.2 indicated, that overall, the young inexperienced male drivers estimated the speeds as significantly more accurate and closer to the actual speed than any of the other drivers.

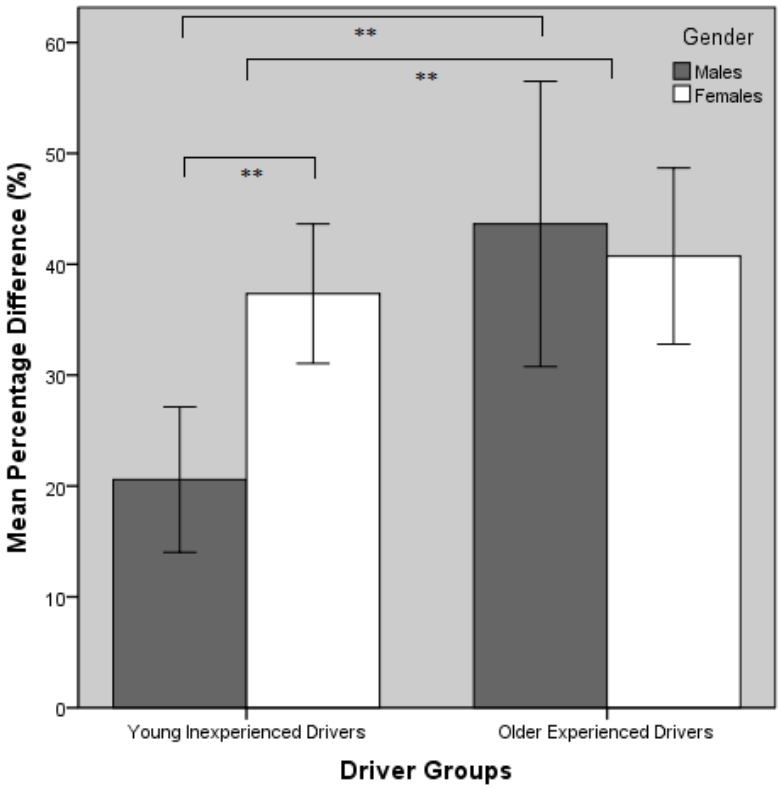


Figure 3.2: Mean Percentage Difference (between actual speeds and the estimated speeds) over all road conditions, by driver groups and gender. The bars indicate 95% confidence intervals (** = $p < 0.01$).

The variable Chosen Speeds was first standardised over all road conditions using the total z-scores for the participants (section 2.2.2) and then they were graphed as group means (and 95% confidence intervals) in Figure 3.3. This figure indicates that the young inexperienced male drivers clearly chose slower speeds than their female counterparts and older experienced drivers.

A 2 (driver groups) x 2 (gender) ANOVA on the standardised chosen speeds confirmed that there were no significant main effects for driver groups or gender. There was, however, a significant interaction between driver groups and gender, $F(1,116) = 4.32$, $p < 0.05$. An independent t-test confirmed that young inexperienced male drivers chose significantly slower speeds than their female counterparts, $t(79) = 2.42$, $p < 0.05$. While for the older experienced drivers, the male drivers chose higher speeds than their female counterparts. This confirmed, as Figure 3.3 already indicated, that overall, the young inexperienced male drivers chose significantly slower than any of the other drivers.

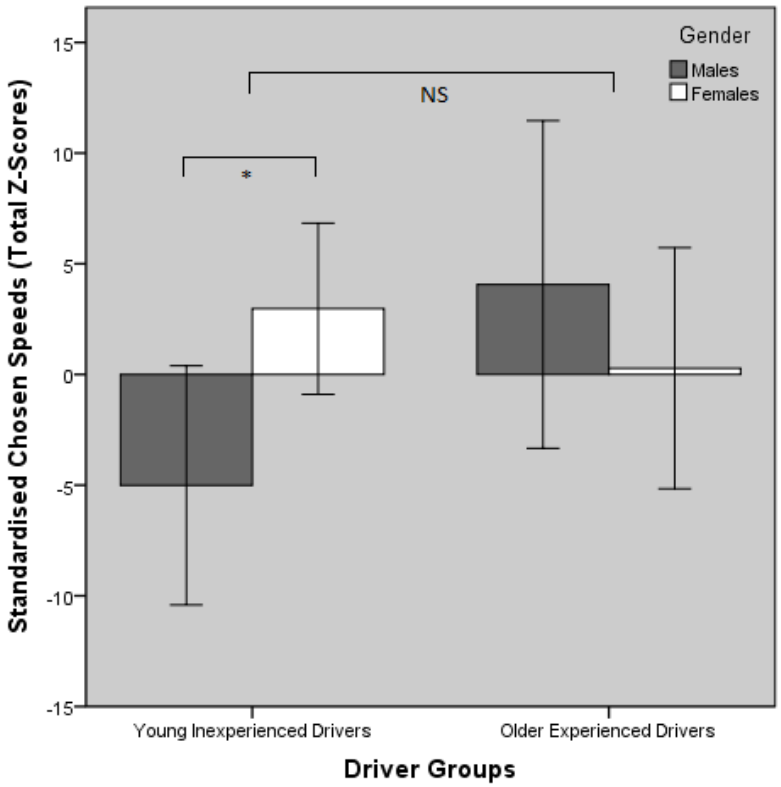


Figure 3.3: Mean standardised Chosen Speeds for all road conditions, by driver groups and gender. The bars indicate 95% confidence intervals (* = $p < 0.05$, NS = not significant).

In summary, the young inexperienced driver group estimated the speeds as slower than the older experienced driver group. In addition, the young inexperienced drivers estimated speeds closer to the actual speed compared to the older experienced drivers. Interestingly, the young inexperienced male drivers estimated the slowest speeds and closer to the actual speeds than any of the other groups. The young inexperienced male drivers also consistently chose slower speeds over all conditions than any of the other drivers.

3.1.2 Chosen Speeds in relation to the speed limits of the different road conditions.

The next analysis examined the chosen speeds separately for the different road conditions. The Chosen Speeds were first analysed using the day and night road conditions for the urban roads in relation to the speed limit for each participant (see 2.2.2) and then they were graphed as group means (and 95% confidence intervals) in Figure 3.4. Second, the Chosen Speeds were also analysed for the wet and dry road conditions for the rural roads in relation to the speed limit for each participant (see 2.2.2). This variable was also graphed as group means (and 95% confidence intervals) in Figure 3.5. The results for each road condition are presented below.

Urban Roads

Figure 3.4 displays the chosen speeds in relation to the speed limits for the urban road conditions. This figure indicates that there was a marginal difference in the chosen speeds between the young inexperienced drivers and older experienced drivers. Young inexperienced drivers chose slightly slower speeds (M=43.32km/h, SD=5.78) than the older more experienced drivers (M=43.62km/h, SD=5.08) for the urban roads. There was however, a difference between the day and night road conditions with participants choosing higher speeds during daytime driving compared to night time driving.

A 2 (driver groups) x 2 (day vs. night) x 2 (gender) ANOVA on the chosen speeds in relation to the speed limit confirmed that there was a main effect for day and night road conditions, $F(1,116) = 5.43$, $p < 0.05$. There were no main effects for driver groups and gender, however, there was an interaction effect between driver groups and gender, $F(1,116) = 8.06$, $p < 0.01$. The two road conditions for the urban roads were analysed separately using gender as an independent variable.

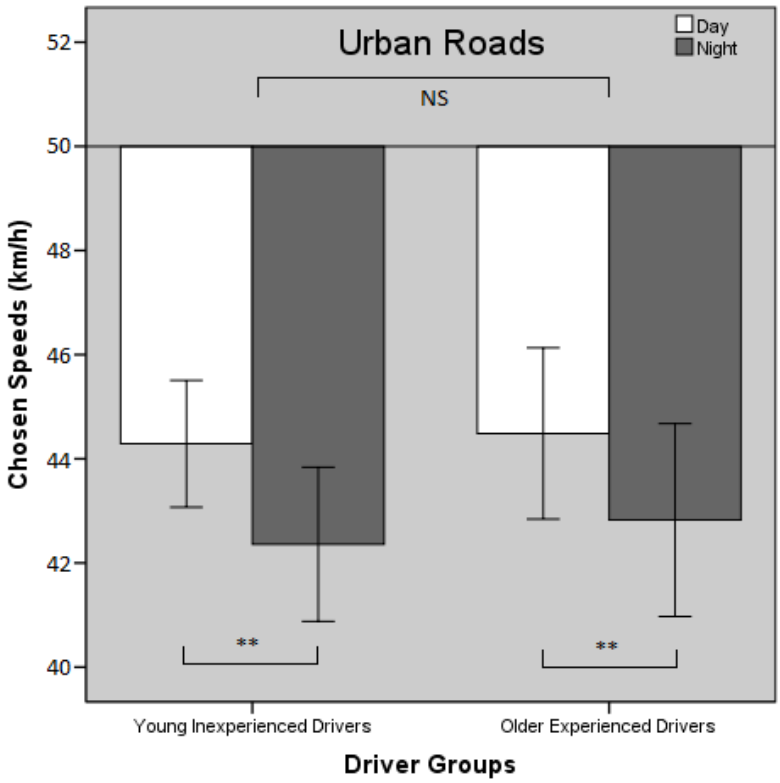


Figure 3.4: Mean Chosen Speeds in relation to the speed limit (50km/h) for day and night, by driver groups. The bars indicate 95% confidence intervals (** $p < 0.01$, NS = not significant).

Day

Young inexperienced males chose slower speeds than the older experienced males during daytime on urban roads but this was the opposite for females, they chose higher speeds than their older counterparts. Overall, males chose slower speeds (M=43.59km/h, SD=5.68) than females (M=45.14km/h, SD=4.90) during daytime driving. A two-way ANOVA showed no that there were no main effects for driver groups and gender. There was however, a significant interaction between these two variables, $F(1,116) = 4.42$, $p < 0.05$. An independent t-test revealed that the young inexperienced male drivers chose significantly slower speeds than their female counterparts, $t(79) = 2.45$, $p < 0.05$.

Night

Young inexperienced males chose slower speeds than the older experienced males during night time driving on urban roads. Again, similar to the daytime condition, young inexperienced female drivers chose higher speeds than their older female counterparts. Overall, males chose slower speeds (M=41.30km/h, SD=6.95) than females (M=43.77km/h, SD=5.49) during night time driving. A two-way ANOVA showed that there were no main effects for driver groups and gender. There was no interaction between the two variables. An independent t-test revealed that the young inexperienced male drivers choose significantly slower speeds than their female counterparts, $t(79) = 2.79$, $p < 0.01$.

Rural Roads

Figure 3.5 displays the chosen speeds in relation to the speed limits for the rural road conditions. This figure indicates that the young inexperienced drivers chose slower speeds (M=83.85km/h, SD=9.73) than the older experienced drivers (M=86.70km/h, SD=8.52) for the rural roads. There was also a difference between the wet and dry road conditions with participants choosing much higher speeds during dry conditions compared to wet conditions.

A 2 (driver group) x 2 (dry vs. wet) x 2 (gender) ANOVA on the chosen speeds in relation to the speed limit confirmed that there were main effects for driver groups, $F(1,116) = 4.30$, $p < 0.05$ and dry and wet road conditions, $F(1,116) = 119.80$, $p < 0.01$. There was no main effect for gender and no interaction between gender and driving groups and therefore no further analyses were performed.

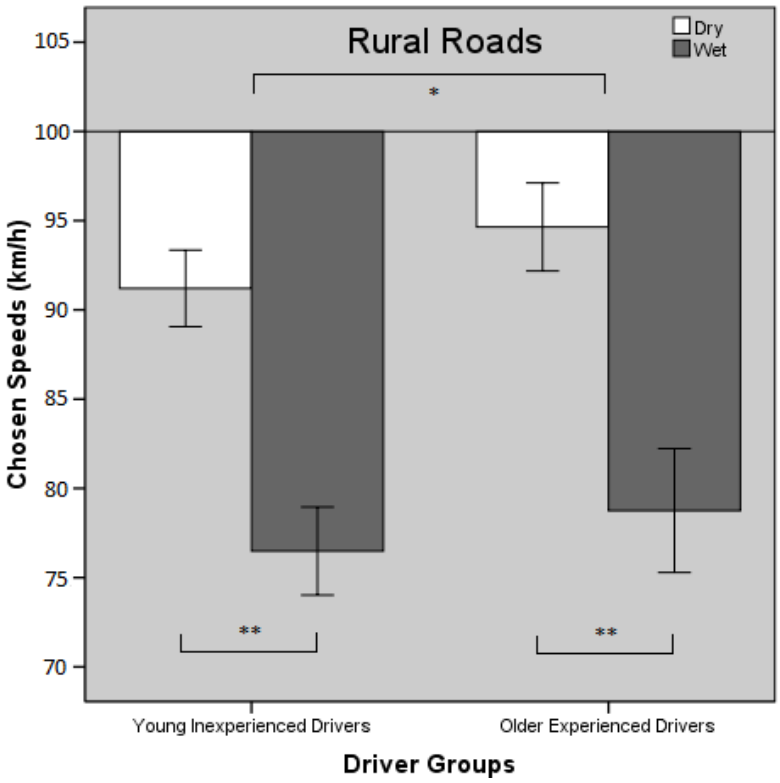


Figure 3.5: Mean Chosen Speeds in relation to the speed limit (100km/h) for dry and wet, by driver groups. The bars indicate 95% confidence intervals (**= $p < 0.01$, * = $p < 0.05$).

In summary, all drivers chose slower speeds during night time driving compared to daytime driving on urban roads. For the rural roads, drivers consistently chose slower speeds during the wet conditions compared to dry conditions. In addition, there was a gender effect for the urban roads with the young inexperienced male drivers choosing slower speeds at night compared to their female counterparts and the older experienced drivers. This effect was not observed on rural roads.

3.2 Do hazard perception skills differ between the young inexperienced and older experienced drivers? Is there a gender effect on the hazard perception task?

The hazard perception task provided main four dependent measures: Number of Tracking Errors, Number of Hazards Detected, Number of Clicks on Non Hazards and Hazard Perception Time (see the operational definitions for these measures in the method section 2.2.2).

3.2.1 Number of Tracking Errors

The total number of tracking errors were analysed using the total number of times the randomly moving dot went outside the square for each participant (see 2.2.4) and then graphed as group means (and 95% confidence intervals) in Figure 3.6. This figure indicates that young inexperienced drivers made fewer tracking errors (M=1.98, ranging between 0.01 and 8.63, SD=1.38) than the older experienced drivers (M=2.80, ranging between 0.63 and 8.63, SD=2.03). In addition, the young inexperienced male drivers made the lowest number of tracking errors.

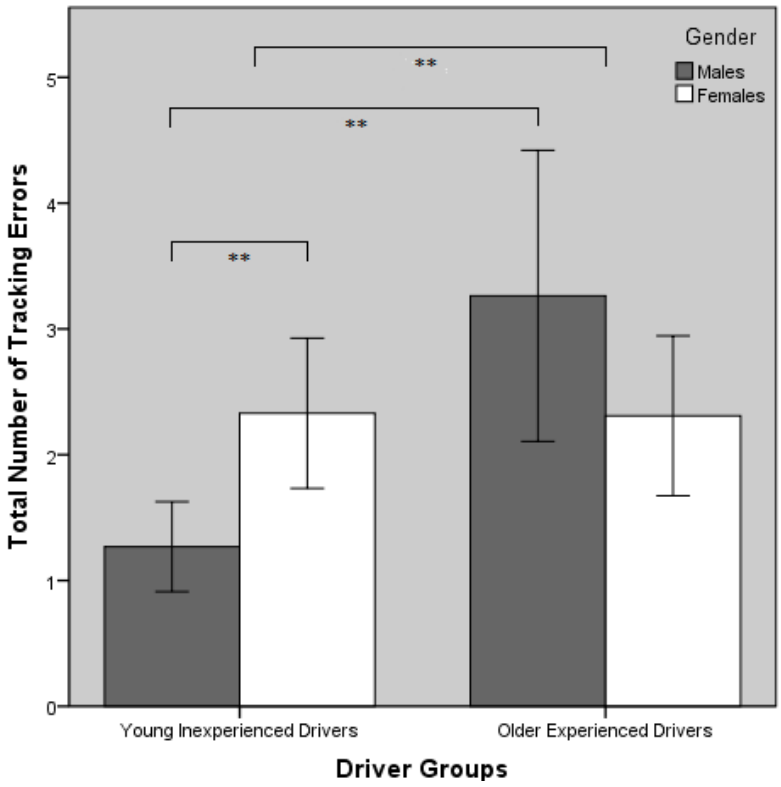


Figure 3.6: Mean Total Number of Tracking Errors, by driver groups and gender. The bars indicate 95% confidence intervals (NS = not significant).

A 2 (driver groups) x 2 (gender) ANOVA on the mean total number of tracking errors confirmed there were main effects for driver groups, $F(1,115) = 8.84$, $p < 0.01$ but not for gender. There was, however, a significant interaction between driver groups and gender, $F(1,115) = 9.21$, $p < 0.01$. An independent t-test confirmed young inexperienced male drivers made significantly less tracking errors than their female counterparts, $t(78) = 3.01$, $p < 0.01$, and also compared to the older experienced male drivers, $t(58) = 4.32$, $p < 0.01$. This confirmed, as Figure 3.6 already indicated, that overall, the young inexperienced male drivers made less tracking errors than any other groups.

3.2.2 Number of Hazards Detected

The total number of hazards detected was defined as the total number of times the participant clicked within the time period when a hazard was present (see 2.2.4) and then graphed as group means (and 95% confidence intervals) in Figure 3.7. This figure indicates that young inexperienced male drivers detected fewer hazards than the older experienced male drivers. The young inexperienced female drivers detected slightly more hazards than their older counterparts. Overall, the young inexperienced group (M=24.63, SD=7.12) detected fewer hazards than the older experienced group (M=26.00, SD=5.05).

A 2 (driver groups) x 2 (gender) ANOVA on the mean total number of hazards detected confirmed that there was a main effect for gender, $F(1,116) = 4.95$, $p < 0.05$. There was no main effect for driver groups and no interaction between the two variables. An independent t-test revealed that the mean total number of hazards detected was significantly different with young inexperienced male drivers detecting fewer hazards than their female counterparts, $t(79) = 5.07$, $p < 0.01$. This confirmed, as Figure 3.7 already indicated, that overall, the young inexperienced male drivers detected fewer hazards than any of the other groups.

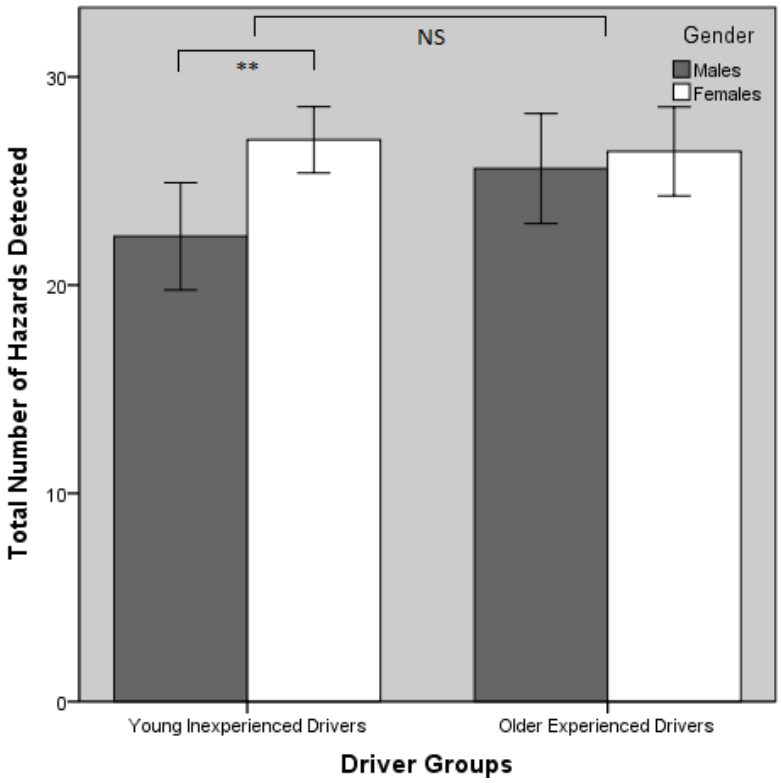


Figure 3.7: Mean Total Number of Hazards Detected, by driver groups and gender. The bars indicate 95% confidence intervals (** = $p < 0.01$, NS = not significant).

3.2.3 Number of Clicks on Non Hazards

The total number of clicks on non hazards were analysed using the total number of times the participant clicked within the time period minus the number of real hazards detected (see 2.2.4). This variable was graphed as group means (and 95% confidence intervals) in Figure 3.8. This figure indicates that the young inexperienced male drivers clearly made fewer clicks on non hazards than their female counterparts and than older experienced male drivers. This was the same for the female drivers, but to a less extent. Overall, the young inexperienced group (M=14.60, SD=12.10) made fewer clicks on non hazards compared to the older experienced drivers (M=14.97, SD=8.58).

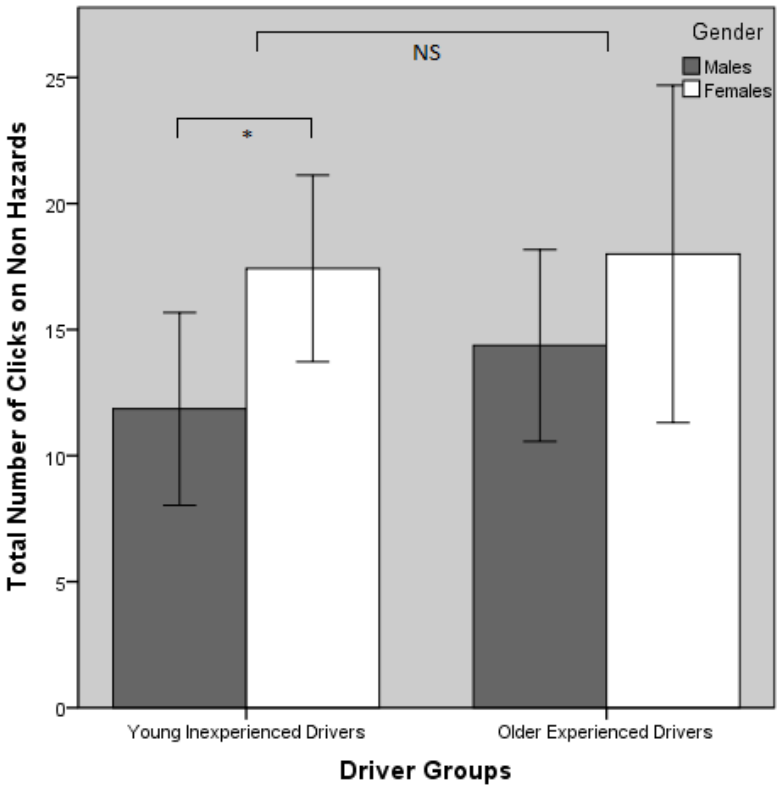


Figure 3.8: Mean Total Number of Clicks on Non Hazards, by driver groups and gender. The bars indicate 95% confidence intervals (* = $p < 0.05$, NS = not significant).

A 2 (driver groups) x 2 (gender) ANOVA on the number of clicks on non hazards confirmed that there was a main effect for gender, $F(1,115) = 4.02$, $p < 0.05$. There was no main effect for driver groups and no interaction between the two variables. An independent t-test revealed that the mean total number of clicks on non hazards was significantly different with young inexperienced male drivers clicking less on non hazards than their female counterparts, $t(79) = 2.17$, $p < 0.05$. This confirmed, as Figure 3.8 already indicated, that overall, the young inexperienced male drivers clicked on fewer non hazards than any other drivers.

3.2.4 Hazard Perception Time

The hazard perception times (see 2.2.4) for all scenarios were averaged for all participants. These means were then further analysed for each of the groups to get the grand means (and 95% confidence intervals), graphed in Figure 3.9. This figure indicates that the young inexperienced male drivers had longer hazard perception times than the older more experienced male drivers. This was similar for females; the young inexperienced female drivers had slightly longer hazard perception times than their older counterparts. Overall, the young inexperienced drivers had longer hazard perception times (M=3.68 seconds, ranging between 1.81 and 5.67, SD=0.88) than the older experienced drivers (M=3.42 seconds, ranging between 2.15 and 5.52, SD=0.71).

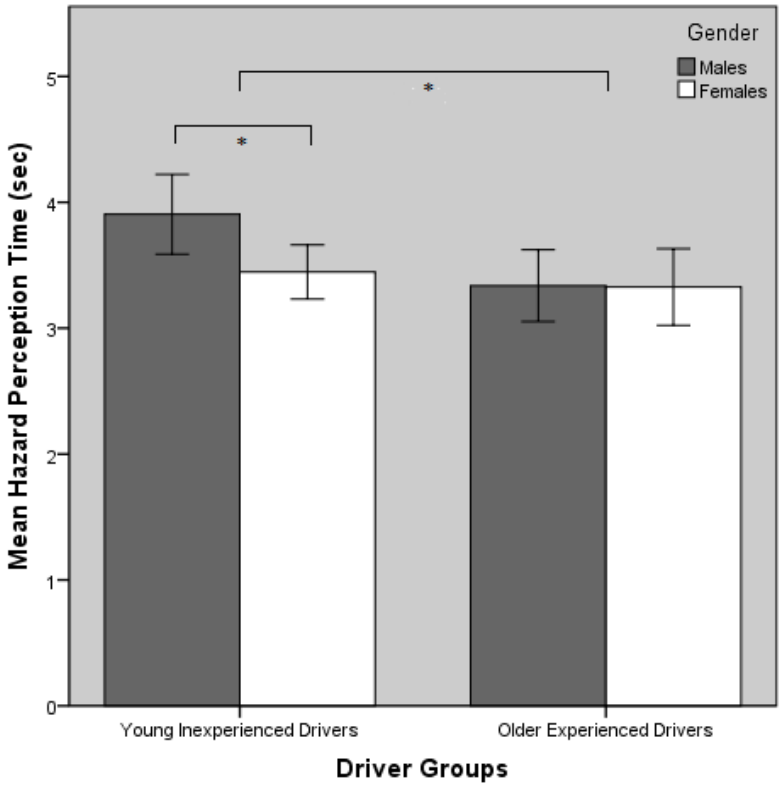


Figure 3.9: Grand mean Hazard Perception Time across all hazards, by driver groups and gender. The bars indicate 95% confidence intervals (* = $p < 0.05$, NS = not significant).

A 2 (driver group) x 2 (gender) ANOVA on the mean hazard perception times confirmed that there was a main effects for driver groups, $F(1,115) = 4.85$, $p < 0.05$. There was no main effect for gender and no interaction between the two variables An independent t-test revealed that the mean hazard perception times were significantly longer for the young inexperienced male drivers compared to their female counterparts, $t(79) = 2.41$, $p < 0.05$. This confirmed, as Figure 3.9 already indicated, that overall, the young inexperienced male drivers had longer hazard perception times than any other drivers.

In summary, the young inexperienced drivers made less tracking errors than the older experienced drivers but the young inexperienced males detected fewer hazards than any of the other drivers. Interestingly, the young inexperienced female drivers detected the same amount of hazards than the older experienced group even though they made less tracking errors. There was only a gender difference between the two groups when it came to the number of clicks on non hazards. Lastly, the young inexperienced drivers had longer hazard perception times than the older experienced drives. In addition, the young inexperienced male drivers had the longest hazard perception times.

3.3 Do the questionnaire measures and hazard perception times help characterize the drivers who consistently choose slower or higher speeds?

In order to answer this question, two new groups were created who either choose consistently slower or higher speeds. The standardised chosen speeds were assigned to three groups. The first group (N=40, "low speed choice group" choose consistently the lowest speeds in the sample (they had the lowest standardised z-scores), while the second group (N=40, "high speed choice group" choose the highest speeds (they had the highest standardised scores). The data of the remaining participants in a third group was not used in the following analysis. A paired samples t-test confirmed that the two selected groups indeed differed significantly in their speed choice behaviour, $t(79) = 10.26$, $p < 0.01$. The low speed choice group consisted 27 (33.3%) young inexperienced drivers and 13 (33.3%) older experienced drivers with an average age of 26.70 years (SD=14.16). This group consisted of 21 males and 19 females. The high speed choice group consisted of 23 (28.4%) young inexperienced drivers and 17 (43.6%) older experienced drivers with an average age of 29.80 years (SD=14.95).

A series of separate one-way ANOVAs was conducted with the two speed choice groups as an independent variable and all the questionnaire measures as independent variables. The results can be seen in Table 3.1. There was a significant difference between the two speed choice groups in regards to the attitude measures of driving (DAQ) indicating that participants who chose higher speeds showed unsafer attitudes toward driving. Furthermore, the speeding and the drink driving subscales indicated that participants who chose higher speeds also showed unsafer attitudes toward speeding and drink driving. There was a significant difference between the two speed choice groups in regards to the propensity to become angry while driving (DAS) indicating that participants who chose higher speeds were more likely to become angry while driving. Furthermore, the discourtesy, traffic obstructions, slow driving and police present subscales indicated that participants who chose higher speeds are more likely to become angry if other drivers showed discourtesy, obstructing traffic, driving slowly and when police were present.

Lastly, there was a significant difference between the two speed choice groups in regards to driver confidence indicating that participants who chose higher speeds were less confident in their driving abilities.

Interestingly, there were no significant differences between the two groups in regards to the sensation seeking and impulsivity measures. Participants who chose slower speeds had higher sensation seeking but this effect was the opposite for impulsivity. Participants who chose higher speeds showed more impulsive behaviours. Also the questionnaire measures for boredom, self esteem, conscientiousness, anxiety, empathy concern and competitiveness did not help to characterise the two groups.

Table 2

One way ANOVA on Speed Choice Groups using all the Questionnaire Measures

Questionnaire Measures	Low Speed Choice Group		High Speed Choice Group			
	M	SD	M	SD	F Ratio	P, Sig
Driver Attitude Questionnaire(DAQ)	48.95	7.756	53.95	9.758	6.436	**.013***
-Speeding	13.65	3.620	15.30	3.603	4.174	**.044***
-Drink Driving	11.03	3.393	13.15	3.302	8.059	**.006***
-Close Following	12.28	1.783	12.95	2.541	1.891	.173
-Overtaking	12.00	3.397	12.55	3.358	0.530	.469
Speeding Attitude Scale (SAS)	46.50	14.300	51.60	14.120	2.579	.112
Arnett Inventory of Sensation Seeking (AISS)	55.00	7.452	53.63	6.923	0.731	.395
-Novelty	26.60	4.738	26.78	3.683	0.034	.854
-Intensity	28.40	4.573	26.85	4.435	2.368	.128
Boredom Proneness Scale (BPS)	51.28	6.385	53.20	6.595	1.759	.189
-Internal Simulation	30.35	3.355	31.23	3.408	1.339	.251
-External Simulation	20.93	5.916	21.98	5.731	0.650	.423
Rosenberg Self Esteem (RES)	31.90	4.727	31.13	5.110	0.496	.483
Driving Anger Scale (DAS)	37.10	7.441	42.33	10.830	6.324	**.014***
-Discourtesy	9.700	2.420	10.98	2.869	4.616	**.035***
-Traffic Obstructions	6.300	2.028	7.790	2.759	4.127	**.049***
-Hostile Gestures	6.130	2.002	6.300	2.503	0.119	.731
-Slow Driving	5.200	1.742	6.250	1.891	6.669	**.012***
-Police Present	3.680	1.655	4.880	2.564	6.186	**.015***
-Illegal Driving	6.100	2.216	6.600	1.919	1.163	.284
Conscientiousness	37.20	6.626	37.20	4.392	0.000	1.00
Anxiety	26.88	7.750	29.23	6.542	2.148	.147
Empathy Concern	33.15	6.347	33.95	5.013	0.391	.533
Self Assessment of Driving Ability (SADA)	73.18	11.230	75.93	10.090	1.328	.253
-General Driving Ability	25.65	4.764	27.13	4.115	2.196	.142
-Safety Orientation	21.93	2.795	22.53	2.160	1.154	.286
-The Body Dimension	16.20	3.943	16.93	3.125	0.831	.365
-Specific Task Skills	9.400	2.520	9.350	2.797	0.007	.933
Competitive Attitude Toward Driving (AT)	1.850	0.651	2.070	0.650	2.284	.135
Self Evaluation - Accident Concern	5.750	1.891	5.730	1.935	0.003	.954
Self Evaluation - Thrill Seeking	4.880	2.040	5.180	2.111	0.418	.520
Self Evaluation - Driving Ability 1	3.850	1.406	4.080	1.403	0.513	.476
Self Evaluation - Driving Ability 2	5.830	1.196	6.280	1.358	2.473	.120
Driver Confidence Questionnaire (DCQ)	16.23	3.813	14.05	3.194	7.648	**.007****
Barrat Impulsivity Scale (BIS-15)	30.25	6.172	30.28	5.228	0.000	.984
-Attention Impulsivity	9.880	2.366	9.950	2.511	0.019	.891
-Motor Impulsivity	10.00	2.837	10.18	2.480	0.086	.770
-Non Planning	10.38	2.976	10.15	2.637	0.128	.721

Note: * = $p < 0.05$, ** = $p < 0.01$.

Finally, it was examined if the hazard perception times from the HPDT help to characterise the two speed choice groups. Figure 3.10 displays the mean hazard perception times (and 95% confidence intervals) for the two groups and indicates that the low speed choice group had longer hazard perception times than the high speed choice group.

A one-way ANOVA on the two speed choice groups confirmed a significant difference between the hazard perception time and the two speed choice groups, $F(1, 79) = 4.93$, $p < 0.05$. The low speed choice group ($M=3.89$, $SD=0.90$) had a higher hazard perception time than high speed choice group ($M=3.47$, $SD=0.75$).

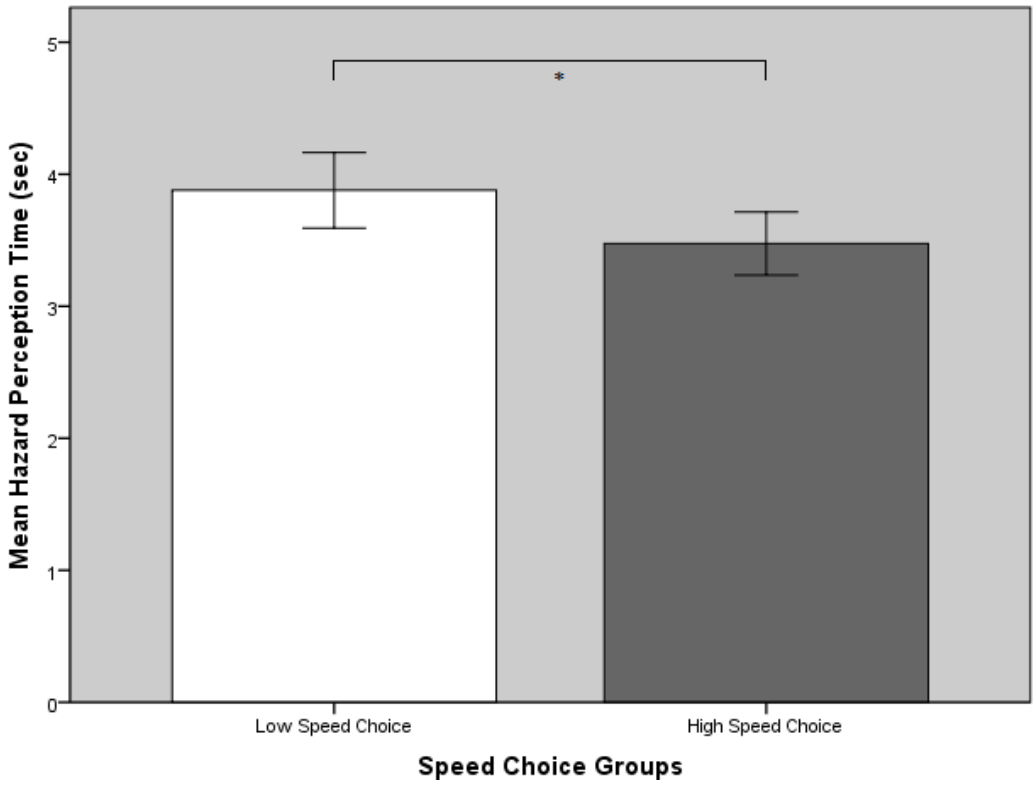


Figure 3.10: Grand mean Hazard Perception Times across all hazards, by speed choice groups. The bars indicate 95% confidence intervals (* = $p < 0.05$).

4. Discussion

The general purpose of this research was to examine how young inexperienced drivers and older experienced drivers differ in their hazard perception skills and speed choice behaviour, as measured by a hazard perception dual task and a video speed choice task, respectively. In addition, this research also examined how the speed choice task measures related to attitudes, beliefs and individual differences of the participants. Gender differences were also explored.

This section will put the findings of the current study in context of the reviewed literature. The discussion will be structured so that the research questions raised at the end of the introduction section will be answered in the order they were presented.

The results from the video speed choice task revealed that young inexperienced male drivers were better at estimating the vehicle speeds and estimated the speeds as slower than any of the other drivers. In addition, the young inexperienced male drivers chose slower speeds across all the road conditions.

These results were not anticipated from the literature review, which suggested that young inexperienced drivers would more likely choose faster speeds than the older experienced drivers (e.g., Blows, et al., 2005; Renge, 1998). Cantwell (2010) found that young inexperienced drivers preferred faster speeds and chose speeds closer to the speed limit than the older experienced drivers. As young inexperienced drivers engage in more risky driving behaviours (e.g., Harrè, et al., 1996), their target risk should be higher than older experienced drivers. Due to a lack of experience, young inexperienced drivers' target risk could actually be higher than their driver capabilities and cause them to drive too fast for the conditions (Wilde, 1994). These results were not found in the current study and several reasons have emerged to why this might be.

One reason for these results could be that the video speed choice task was not a valid measure for estimating and choosing vehicle speeds even though previous research has used this particular measure and found that young inexperienced drivers chose higher speeds than older experienced drivers across different road conditions (Cantwell, 2010; Horswill & McKenna, 1999). It could also be that when young inexperienced drivers drive, they don't actually think about the speed they are going due to other factors such as distractions, peer pressure or fatigue. When they are focused on driving, their speed choice and knowledge about how fast they should be going is actually quite good and so perhaps they are just not good at putting what they know into practice. According to the task capability interface model (TCI), drivers adjust their driver behaviour to maintain their current workload below their driver capabilities (Fuller, 2005). In the video speed choice task, there was no steering task which allowed the drivers to use more attentional resources on judging the speed of the vehicle and so they chose slower speeds.

In addition, the literature review suggest that young inexperienced male drivers chose faster speeds than their female counterparts (e.g., Bronson & Howard, 2002). Harrè et al. (1996) found that young male drivers were

significantly more likely to engage in unsafe driving such as speeding, drink driving and breaking curfew rules on a restricted license than young female drivers. One reason for this inconsistency between the current research and previous findings could be due to how the participants were recruited. Many of the male learner and restricted licensed drivers were recruited from Hamilton Boys High School. This is a good school where the students receive driver education as part of their curriculum and so they would have discussed issues around driving prior to doing the experiment. In addition, it could have been that only the top students in the class got the opportunity to participate in the current research as a reward and so this was not a representative sample of the driver population. Another reason could be that young inexperienced male drivers were not necessarily better at estimating the vehicle speeds but rather that the other groups' inaccurate estimated higher speeds were due to a lack of experience in simulator tasks. It has been shown that young males tend to play more video games during adolescence than females which could help them to estimate the vehicle speeds more accurately and in turn, chose slower speeds (e.g., Lucas & Sherry, 2004). Lastly, it could be that the young inexperienced male drivers chose slower speeds due to the experimental setup. The experimenter was present in the room while the participants performed the video speed choice task which could have biased their responses, due to demand characteristics.

When the individual road conditions were explored in greater detail, it was found that participants chose slower speeds during the night time condition compared to the daytime condition on the urban roads. In particular, young inexperienced male drivers chose slower speeds for both day and night time driving conditions compared to any other drivers. In addition, participants chose slower speeds during the wet conditions compared to the dry conditions on the rural roads. In particular, young inexperienced drivers chose slower speeds on both road conditions than the older experienced drivers. Overall, the young inexperienced male drivers chose slower speeds than any of the other drivers across all the road conditions. These results suggest that drivers take road conditions certainly into account when driving and that they adjust their speed accordingly to the road conditions. Drivers seem to reduce their speeds when the road conditions deteriorate which is consistent with the task capability interface model (Fuller, 2005). According to this model, as the task demands increase,

drivers have to readjust their capabilities in order to maintain their current workload below the task demands and so they chose slower speeds as the road conditions deteriorated.

Interestingly, the young inexperienced drivers chose slower speeds on the rural roads compared to the older experienced drivers suggesting that young inexperienced drivers perceived the rural road conditions as more dangerous. The author was not able to find any comparable research in the literature and therefore more research is needed to validate this finding.

The results from the hazard perception dual task revealed that young inexperienced male drivers detected fewer hazards, took longer to detect the hazards, made less tracking errors and clicked less frequent on non hazards compared to any of the drivers. As a group, including the female drivers, the young inexperienced drivers took longer to detect hazards and made less tracking errors compared to the older experienced drivers.

These results were anticipated from the reviewed literature, which suggested that young inexperienced drivers lack hazard perception skills (e.g., Borowsky, et al., 2009; Borowsky, et al., 2010). Isler et al. (2009) found that young inexperienced drivers detected and identified a smaller percentage of hazards than the older experienced drivers. They also found that young inexperienced drivers took longer to detect the hazards compared to the older experienced drivers. Mayhew & Simpson (1995) also found that young inexperienced drives fixate on fewer hazards compared to the older experienced drivers.

The results of the current study could be explained on the basis of the task capability interface model (TCI) (Fuller, 2005). The task demands of detecting hazards while driving are higher than the driver capabilities of the young inexperienced drivers, because they still need to use the majority of their mental workload to focus on the driving task in order to complete it successfully without making any mistakes. This causes the young inexperienced drivers to miss hazards when driving and takes them longer to detect the hazards compared to older experienced drivers.

Another reason why young inexperienced drivers lack the ability to detect hazards could be that they lack situation awareness. Young inexperienced drivers

tend to focus their visual search more on areas which provide information relevant to the steering task and less to detecting hazards. Several studies have found that young inexperienced drivers horizontal scanning remained unchanged across different road environments whereas older experienced drivers increased their horizontal scannings as the road environments became more hazardous. In addition, young inexperienced drivers tend not to have such a widespread of fixations in the horizontal plane than older experienced drivers and they tend to fixate on hazards longer (Crundall & Underwood, 1998; Mayhew & Simpson, 1995; Underwood, 2007).

The young inexperienced drivers made overall fewer tracking errors than the older experienced drivers which is consistent with research by Isler et al. (2009). The better performance of the young inexperienced drivers on the secondary task could be due to the fact that they may have assigned fewer attentional resources to the primary task of detecting hazards than the older experienced group. This means that the two groups might have prioritised their mental workload differently in the hazard perception dual task. The young inexperienced drivers might have focused more on the secondary tracking task whereas the older experienced drivers could have focused more on detecting hazards. One reason for this could be that the secondary tracking task gave an audio and visual cue whereas when a hazard was missed, no cues were given which could have signalled to the young inexperienced drivers that the secondary task required more attention than the primary task. When translated into real world driving, young inexperienced drivers' skills are not yet fully automated and so they need to contribute more of their attentional resources to the steering task and less to detecting hazards (Annex, 2006).

Interestingly, the young inexperienced female drivers made fewer errors on the tracking task but detected more hazards than the older experienced drivers. This indicates that the young inexperienced female drivers were the best at detecting hazards while performing the secondary task. As hazard perception skills directly relate to crash risk (e.g., Braitman, et al., 2008), this is not consistent with the literature, because, although young inexperienced female drivers experience fewer crashes than their male counterparts, they still have more crashes than the older experienced drivers (Ministry of Transport NZ, 2010b). One reason could be the inconsistency between the young inexperienced male and

female driver group. The young inexperienced female drivers were on average two years older and had one year more driving experience than the inexperienced male drivers. Another reason could be that young inexperienced male and female drivers were recruited from different sources. Most young male drivers were still at school whereas the young female drivers were at university. As age and experience is very important factors in young drivers, this could be the reason why females performed better in the hazard perception dual task than their male counterparts.

Since experience plays a vital part in the ability to detect hazards, there is much evidence to support the theory that once the driving task become automated in young inexperienced drivers, attentional resources will be freed up and drivers will be able to reinvest these into the appropriate areas of hazard detection.

The results for the two speed choice groups in regards to questionnaire measures revealed some interesting results. Firstly, participants who chose higher speeds were more likely to show unsafer attitudes toward driving, especially speeding and drink driving. There was a significant difference between the two speed choice groups in regards to the propensity to become angry while driving. This indicated that drivers who chose higher speeds were more likely to become angry while driving. In addition, there was a significant difference between the two speed choice groups in regards to the discourtesy, slow driving, traffic obstructions and police present subscales. This indicated that participants who chose higher speeds were more likely to become angry when other drivers showed discourtesy, block traffic, drive slowly and when police were present.

These results were consistent with previous findings. For example, Iverson & Rundmo (2002) found that drivers who scored high on driver anger were more likely to engage in risky driving. In a longitudinal review, Begg & Langley (2004) found that aggressive behaviours at 18 years of age significantly predicted subsequent self reported speeding behaviour at both 21 and 26 years of age. Trait aggression has also been shown to significantly predict self reported drink driving and speeding (Begg & Langley, 2004; Gulliver & Begg, 2004). This clearly supports the findings of the current research that drivers who chose higher speeds were more likely to engage in risky behaviours such as speeding and drink driving. These drivers were also more likely to be aggressive towards other

drivers while driving. The results of the current research therefore indicated that the Driving Attitude Questionnaire and the Driving Anger Scale are valid measures to help explain speed choice behaviour of drivers in the laboratory setting.

Interestingly, driver confidence was a significant factor separating the two speed choice groups, but not the way it was expected. Drivers who chose higher speeds were less confident in their driving abilities. These results were not supported in the literature review. For example, Farrow & Brissing (1990) found that young males expressed more confidence than young females for driving situations perceived as hazardous; driving in a snowstorm, speeding, cool off after an argument and drink driving. One reason for the unexpected finding could be that drivers who lack confidence in their driving abilities might choose to drive faster in order to gain more experience in such situations and in turn gain more confidence in their driving abilities. Another reason could be that drivers who were more confident in their driving abilities might have a greater understanding of the risk associated with speeding and therefore chose slower speeds. But this needs further investigation.

Another interesting finding was that the two speed choice groups did not significantly differ in regards to their sensation seeking and impulsivity scores. Drivers who chose higher speeds reported lower sensation seeking scores. According to the reviewed literature, sensation seeking and is related to risky driving. For example, Jonah (1997) conducted an intensive review of 40 studies and the vast majority showed a positive relationship between sensation seeking and risky driving. Another study showed that young drivers with high sensation seeking were more likely to speed, report more aggressive driving habits and drive faster on wet roads (Jonah, et al., 2001). Iversen & Rundmo (2002) found that drivers who scored high on driver anger and sensation seeking reported more risky driving. These previous findings clearly indicate that sensation seeking is related to risky driving behaviours such as speeding.

However, drivers who chose higher speeds reported higher impulsivity scores. Dahlen et al. (2005) found a significant positive correlation between impulsiveness and risky driving, indicating that drivers who had higher impulsiveness were more likely to engage in risky driving behaviours such as speeding. Lastly Moleni (2010) found that drivers who had higher impulsivity

displayed attitudes significantly more approving of risky driving. All these results indicated that impulsivity are related to risky driving behaviours such as speeding but in the current research it was not found to be significantly different between the two speed choice groups. The findings of the current research are at odds with all of the previous research which indicated that sensation seeking and impulsivity are related to risky driving behaviours and therefore this needs to be investigated further.

There were no significant differences between the two speed choice groups in regards to the self-reported measures such as boredom, competitiveness, anxiety, conscientiousness, empathy concern and self esteem. According to previous research, only boredom, competitiveness and self esteem are related to risky driving behaviours (e.g., Blows, et al., 2005; Harvey, et al., 2011; Schreer, 2002). Conscientiousness seemed to be negatively related to risky driving behaviours indicating that drivers who were more conscientious were less likely to engage in risky driving behaviours (Arthur & Graziano, 1996). The current study did not confirm these findings. Lastly, the author was not able to find any comparable research in the literature to suggest that anxiety and empathy concern were related to risky driving behaviours and similar results were found in the current research. Perhaps the sample size of drivers in the current study was too small and not powerful enough to reveal any effects on these self-reported measures and this study needs to be replicated first with a larger sample size.

Lastly, there seemed to be a link between the hazard perception and speed choice task, because there was a significant difference between the two speed choice groups in regards to the hazard perception times. The drivers who were faster at detecting hazards chose higher speeds. The results of the current study were not consistent with the reviewed literature. For example, Renge (1998) found a significant correlation between high hazard perception scores and lower speed choice ($r=0.27$). Similarly, McKenna et al. (2006) showed that drivers who had learned to identify hazardous situations, were choosing slower speeds when they had identified a more hazardous situation compared to a less hazardous situation. One reason why drivers who chose faster speeds detected hazards faster could be that the drivers were perhaps confident that they can detect the hazards easily and therefore thought they could drive faster. In order to validate this finding, further research is needed.

This study had two main strengths which should be mentioned. Firstly, objective laboratory based tasks were used which have been validated in other studies (e.g., Horswill & McKenna, 1999; Isler, et al., 2009). Secondly, this study tested a lot of participants for an experimental study. Having many participants increases the power of the statistics to reveal any effects and also decreases the variability of the data.

5. Limitations

A number of limitations were identified in the current study which will be addressed in this section.

5.1. External validity

Generalising the results of an experimental design to an external environment is usually a limitation in experimental research. For the video speed choice task, no audio or tactile cues were used which could limit the external validity of this laboratory task. It could be that drivers would have used these cues to help them judge the speed of the vehicle and therefore might have created a more realistic driving experience. In addition, the camera angle used did not provide any peripheral information such as side and mirror views which literature suggest could influence how drivers make speed judgements (e.g., Palmer, n.d.). For the hazard perception dual task, the number of hazards detected and hazard perception times were used as measures of hazard perception abilities. In real world driving, identifying potential and actual hazards is much more complex, because many other factors such as distractions and fatigue could contribute to how well drivers can detect these hazards. All these issues mentioned could limit the external validity of the laboratory tasks.

5.2. Social desirability

Some participants might have answered the self report questionnaire items in such a way that seemed more socially acceptable, rather than answering them honestly. In the current study, no social desirability scales were incorporated to test for this issue and so we cannot determine how this might have influenced the findings. This was less of a concern for the two laboratory tasks. In the hazard perception dual task this issue was somewhat limited, because of the complex nature of the task. But the video speed choice task was more vulnerable to demand characteristics, because participants could have easily selected slower speeds in order to appear as responsible drivers. Additionally, the experimenter was present during the experiment in order to assist and explain the tasks which

could have made the participants responding in ways that were more socially acceptable, because perhaps they didn't want to come across as risky drivers. It was attempted to minimise this issue by ensuring the participants, that their results were confidential and that they could not be identified.

5.3. Sample size

The sample size in the current research was relatively small for self-reported measures and the participants in the two groups were unequally represented in the current study. The mean age and number of years of driving experience between inexperienced male and female drivers were also different. Larger sample sizes are generally more reliable and usually have less variability in the data which makes the inferential statistics more powerful in detecting any effects. Additionally, the sample was mostly composed of students who may have different characteristics than the general population in the propensity to engage in risky and unsafe driving behaviours. Increasing the sample size and the range of methods used to recruit participants to a more general population could help address this issue.

5.4. Confounding variables

The last limitation concerns the confounding variables of age and experience. They are common confounding variables in the area of young driver research which makes it difficult to assess whether driver behaviour is the result of age or level of experience, because as young drivers are getting older, they tend to gain driver experience at the same time. Although age is an important factor to consider in young drivers, Mayhew et al. (2003) showed that regardless of age, crash rates of novice drivers decreased with an increase in the length of time licensed.

5.5. Test-retest reliability

The last limitation of this study was that it had no test, retest reliability. The participants in this study completed the experiment only once and therefore it is not known how reliable their responses were.

6. Conclusions and Future Research

This final section will report the conclusions of this study and any potential future research. This research was based upon the ongoing debate in the area of young driver research that focuses on whether the high crash rates of young drivers are due to inexperience or intentional risk taking. The findings of the current study suggest that young inexperienced male drivers estimated and preferred lower speeds across all the road conditions compared to any of the other groups. In addition, they performed better on the secondary tracking task of the hazard perception dual task and detected fewer hazards than any of the other groups. There seemed to be a relationship between some of the questionnaire, hazard perception and speed choice measures. Interestingly, there seemed to be a link between hazard perception and speed choice. Lastly, participants who preferred higher speeds were more likely to engage in speeding, drink driving, become angry when other drivers show discourtesy, drive slowly, block traffic and when police are present. Interestingly, participants who preferred higher speeds had lower confidence in their driving abilities. One notable finding was that the young inexperienced female drivers performed similarly in the two laboratory tasks as the older more experienced group.

The video speed choice task appeared to have good external validity and was an easy method to investigate how drivers estimate and prefer speeds across different road conditions. Although more research is needed upon the findings of the current study, there is a potential for including other cues to assist the participant in judging speeds more successfully. Other cues could include audio cues such as the vehicle's engine noise and tactical cues such as the vibration of the vehicle. Although there is a lot of variability between different vehicles when it comes to other cues such as the ones mentioned, it would be interesting whether or not the estimated and preferred speeds of the drivers would change when these cues are present. The video speed choice task should be validated against a driver's real driving behaviour by using a gps recorder. This would properly validate the video speed choice task and show if it relates to on-road driving behaviour.

This current research recruited 120 participants who completed both the laboratory and self reported measures. It would be interesting to replicate the current study with a larger sample size, because the larger the sample size, the more closely it will represent the population. This study had no female drivers on a learners licence and therefore the age and experience between the young inexperienced female and male drivers were different. Future research can include this group of drivers and examine whether or not this made a difference to the results found in this research. As this study only tested the participants on one occasion, a longitudinal study would be interesting to see whether or not their responses remained the same and test for test-retest reliability.

Lastly, it is clearly evident from the current research that drivers are inaccurate when perceiving speeds. Further research may expand on the current study to examine countermeasures to influence drivers' speed choice behaviour. Such interventions could be to help train drivers on perceiving speeds better and act accordingly. Drivers can be asked to judge vehicle speeds and get commentary training on the actual speed of the vehicle. When they meet a certain criteria after the commentary training, it would be interesting to compare the trained group with an untrained group and see whether the commentary training is an effective program in helping drivers perceive vehicle speeds better.

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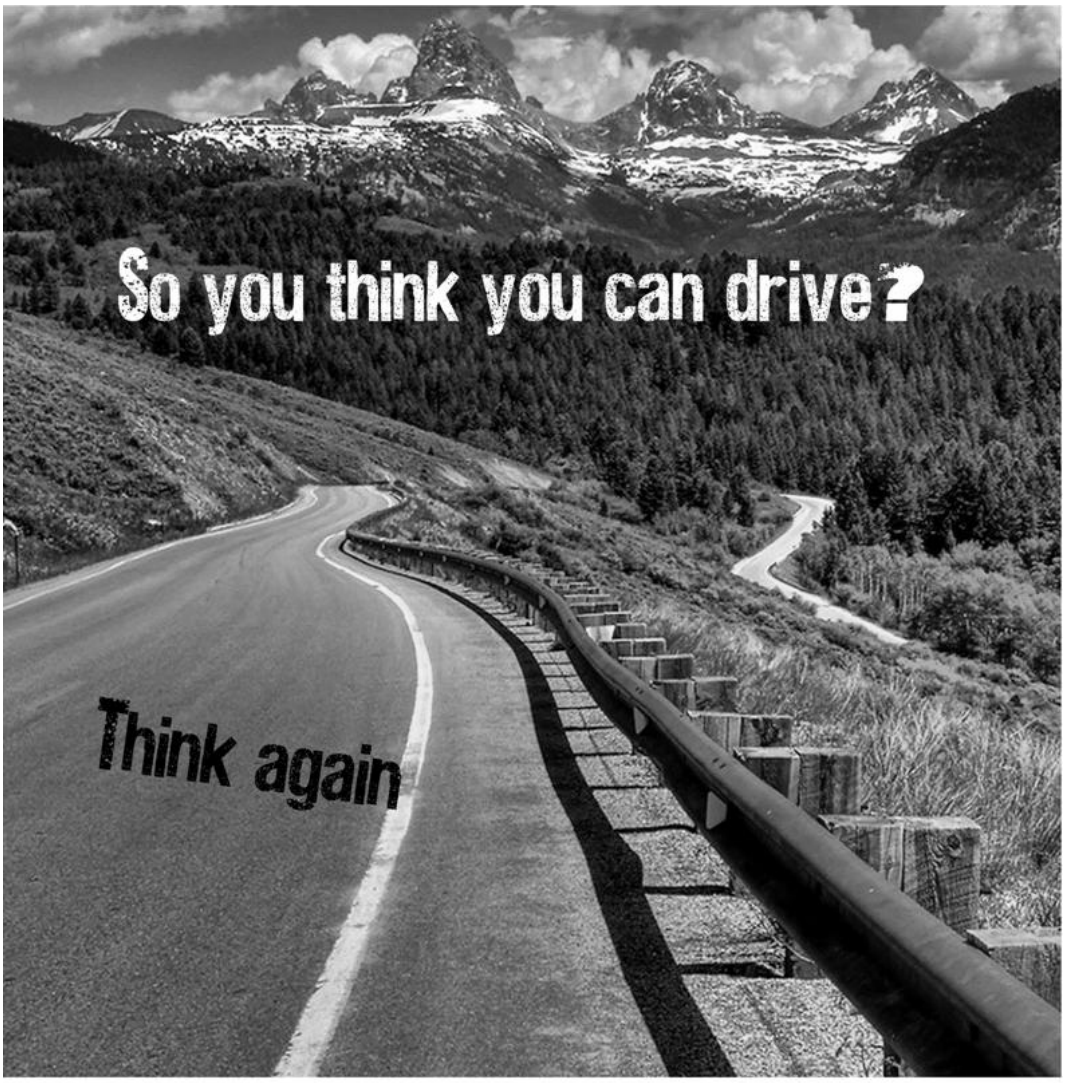
8. Appendices

8.1. Participant Information

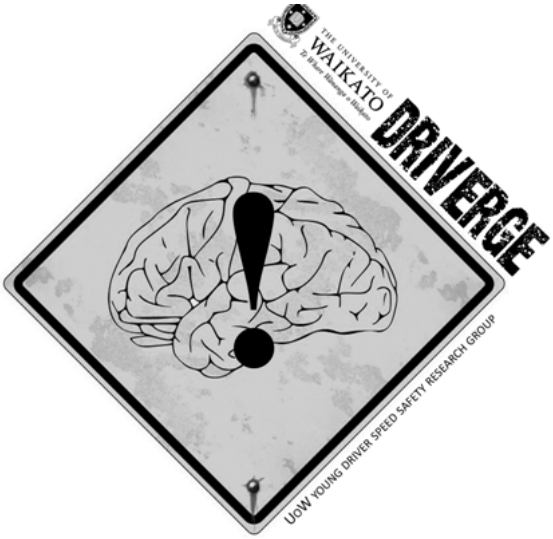
8.1.1. Participant Advertisements



Participants needed to reshape the way we know the road

DRIVERGE

UoW YOUNG DRIVER SPEED SAFETY RESEARCH GROUP



Participants Wanted

Our research team is interested in the relationship between hazard awareness, speed choice, and personality and individual differences.

If you are 16 years or older and have a current NZ learner, restricted or a full driver license, we want to hear from you!

The experiment will take approximately 60-90 minutes to complete, and involves a number of computer based and questionnaire tasks. Participants will receive either 1% course credit (for first year students enrolled PSYC102-11A) or a $10 MTA voucher. For more information contact:

DRIVERGE participation
For more information email:
scant@waikato.ac.nz

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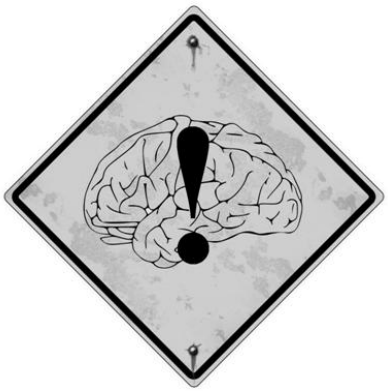

DRIVERGE

UoW YOUNG DRIVER SPEED SAFETY RESEARCH GROUP

Participant Information

What is this study about?

You are being invited to participate in a research project that examines the way the factors age and experience influences driver behaviour. We are primarily focused on the way drivers perceive hazards on the road; choose appropriate speeds, and how this relates to attitudes and beliefs about road usage.

This research will be conducted by the DRIVERGE research team from the University of Waikato, and it is hoped that the findings from this research will greatly benefit all New Zealanders, and hopefully lead to future crash interventions and improvements to driver training.

Am I eligible to take part?

You are eligible to take part in this study if you hold a New Zealand learner, restricted or full drivers licence and are 15 years or older.

What am I being asked to do?

If you agree to take part in this study, it will involve one session of approximately 90 minutes. There will be a number of tasks involving hazard perception and speed selection carried using a computer, and also some questionnaires. There will also be several questionnaires related to your personal driving behaviour and demographic information (age, gender, etc.) For this, you will need to arrange transport to be at the University of Waikato to meet with a researcher at a pre-arranged time. To show our appreciation for your involvement in this research, you will receive either 2% course credit (if you are enrolled as a first year psychology student, the experiment will be a useful learning experience) or a $10 MTA fuel voucher.

What will happen to my information?

All information received from you will remain strictly confidential, and will not be made available to anyone in a way that will identify you. Your information will be immediately stored on a computer using an anonymous identification number, so even the researchers will not be able to connect your data with your identity. After data collection from all participants, the research team will conduct the analysis of the data and an electronic summary will be sent to those participants who had indicated that they would like to see it.

What can I expect from the researchers?

If you decide to participate in this project, the researchers will respect your right to:

- Ask any questions of the researchers about the study at any time during participation;
- Decline to answer any particular questions or carry out any of the tasks;
- Withdraw from the study at any stage and request your data be excluded or destroyed;
- Provide information on the understanding that it is completely confidential to the researchers. All forms are identified by a code number, and are only seen by the researchers. It will not be possible to identify you in any articles produced from the study;
- Be provided with an electronic summary of the findings if you would like;
- Be kept aware of future publications, newspaper or journal articles related to our research.

Who can I speak with about my participation in this project?

If you, or anyone you know is interested in taking part in this research please contact either:

Driverge.waikato@gmail.com

This research has been approved by the School of Psychology Research and Ethics committee. If you have any concerns about the experiment please contact the convenor: Dr Lewis Bizo (email lbizo@waikato.ac.nz).

University of Waikato
School of Psychology

CONSENT FORM

PARTICIPANT'S COPY

Research Project: DRIVERGE (Young drivers and speed choice)

Name of Researcher:

Name of Supervisor (if applicable): Dr Robert Isler

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee (Dr Lewis Bizo, phone: 838 4466 ext. 6402 or 856 0095, e-mail lbizo@waikato.ac.nz)

Participant's Name:_____Signature:_____Date:_____

==========

University of Waikato
School of Psychology

CONSENT FORM

RESEARCHER'S COPY

Research Project: DRIVERGE (Young Drivers and Speed choice)

Name of Researcher:

Name of Supervisor (if applicable): Dr Robert Isler

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee.

Participant's Name: _____Signature:_____ Date:_____

8.2. Self Reported Questionnaires

8.2.1. Demographics Questionnaire

1. Age (years)

How old are you? ☐

2. Gender

- ☐ Male
- ☐ Female

3. Please indicate which best describes your ethnic background:

- ☐ New Zealand European
- ☐ New Zealand Maori
- ☐ Asian
- ☐ Pacific Islander
- ☐ Other European
- ☐ Other, please specify_____

4. Are you currently:

- ☐ Single
- ☐ In a relationship
- ☐ Married/Civil Union
- ☐ Divorced
- ☐ Widowed

5. What type of licence do you hold?

- ☐ Learners for car
- ☐ Restricted for car
- ☐ Full for car

6. How long have you had your licence?

- ☐ Less than six months
- ☐ More than six months

7. How many years or months driving experience do you have?

Years

Months

8. How many kilometres do you drive in a usual week?

9. In the last twelve months, how many crashes have you been involved in?

A *crash* is any collision that occurred *on the public roads* (but not private property), while you were the driver of the vehicle and irrespective of who was at fault.

10. In the last twelve months, how many near misses have you experienced?

A *near miss* is when you narrowly avoided being in a crash *on public roads* (but not private property), while you were the driver of the vehicle and irrespective of who was at fault.

8.2.2. Driver Attitude Questionnaire (DAQ)

Instructions:
To what extent do you agree or disagree with each of the following statements? Please read each statement carefully, and then select the option that best corresponds to you.

Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**
1	**2**	**3**	**4**	**5**

1.	Some people can drive perfectly safely after drinking three or four pints of beer.	1	2	3	4	5
2.	People stopped by the police for close following are unlucky, because lots of people do it.	1	2	3	4	5
3.	I would welcome further use of double yellow line to let me know when it is unsafe to overtake.	1	2	3	4	5
4.	Speed limits are often set too low, with the result that many drivers ignore them.	1	2	3	4	5
5.	I think the police should start breathalysing a lot more drivers around pub closing times.	1	2	3	4	5
6.	It is quite acceptable to take a slight risk when overtaking.	1	2	3	4	5
7.	Close following isn't really a serious problem at the moment.	1	2	3	4	5
8.	I know exactly how fast I can drive and still drive safely.	1	2	3	4	5
9.	Some drivers can be perfectly safe overtaking in situations which would be risky for others.	1	2	3	4	5
10.	Even one drink makes you drive less safely.	1	2	3	4	5
11.	I would favour stricter enforcement of the speed limit on 50km/h roads.	1	2	3	4	5
12.	Some people can drive perfectly safely even when they only leave a small gap behind the vehicle in front.	1	2	3	4	5
13.	The aim of the police should be to stop as many people as possible overtaking in risky circumstances.	1	2	3	4	5
14.	Even driving slightly faster than the speed limit makes you less safe as a driver.	1	2	3	4	5
15.	It’s hard to have a good time if everyone else is drinking but you have to limit yourself, because you're driving.	1	2	3	4	5
16.	I would be happier if close following regulations were more strictly applied.	1	2	3	4	5
17.	Stricter enforcement of speed limit on 50km/h roads would be effective in reducing the occurrence of road accidents.	1	2	3	4	5

18.	Even driving slightly too close to the car in front makes you less safe as a driver.	1	2	3	4	5
19.	I think it is O.K. to overtake in risky circumstances as long as you drive within your own capabilities.	1	2	3	4	5
20.	The law should be changed so that drivers aren't allowed to drink any alcohol.	1	2	3	4	5

8.2.3. Speeding Attitude Scale (SAS)

Instructions:
To what extent do you agree or disagree with each of the following statements? Please read each statement carefully, and select the option that best corresponds to you.

Strongly Disagree	Disagree	Mildly Disagree	Neutral	Mildly Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

1.	I have found out how my car performs at speeds well above the speed limit.	1	2	3	4	5	6	7
2.	I have raced other drivers for the sheer thrill of it.	1	2	3	4	5	6	7
3.	Fast cars are fun to drive.	1	2	3	4	5	6	7
4.	Sometimes, when I am upset, I rev the engine higher than normal.	1	2	3	4	5	6	7
5.	Drag racing on an abandoned road can be fun to watch.	1	2	3	4	5	6	7
6.	I like the feeling of accelerating.	1	2	3	4	5	6	7
7.	It is nice to get ahead of a parade of cars all travelling the same speed.	1	2	3	4	5	6	7
8.	Just following the flow of traffic justifies driving at high speeds.	1	2	3	4	5	6	7
9.	Driving tricks, such as "four wheel Skids" and "laying rubber" are fun.	1	2	3	4	5	6	7
10.	I have put the "pedal-to-the-metal" on a deserted road just to see what it feels like.	1	2	3	4	5	6	7
11.	I have chased another motorist with my car.	1	2	3	4	5	6	7
12.	After an argument, I might drive faster than I should.	1	2	3	4	5	6	7
13.	I have occasionally made a "U" turn when it was not allowed, because I would otherwise have to drive for some distance to turn around.	1	2	3	4	5	6	7
14.	On a four-lane highway with a traffic jam, I try to get into the lane that is moving the fastest.	1	2	3	4	5	6	7

8.2.4. Arnett Inventory of Sensation Seeking (AISS)

Instructions:
To what extent do the following statements describe you?
Please read each statement carefully, and select the option that best corresponds to you.

Describes me very well	**Describes me somewhat**	**Does not describe me very well**	**Does not describe me at all**
1	**2**	**3**	**4**

1.	I can see how it would be interesting to marry someone from a foreign country.	1	2	3	4
2.	When the water is very cold, I prefer not to swim even if it is a hot day.	1	2	3	4
3.	If I have to wait in a long line, I'm usually patient about it.	1	2	3	4
4.	When I listen to music, I like it to be loud.	1	2	3	4
5.	When taking a trip, I think it is best to make as few plans as possible and just take it as it comes.	1	2	3	4
6.	I stay away from movies that are said to be frightening or highly suspenseful.	1	2	3	4
7.	I think it's fun and exciting to perform or speak before a group.	1	2	3	4
8.	If I were to go to an amusement park, I would prefer to ride the rollercoaster or other fast rides.	1	2	3	4
9.	I would like to travel to places that are strange and far away.	1	2	3	4
10.	I would never like to gamble with money, even if I could afford it.	1	2	3	4
11.	I would have enjoyed being one of the first explorers of an unknown land.	1	2	3	4
12.	I like a movie where there are a lot of explosions and car chases.	1	2	3	4
13.	I don't like extremely hot and spicy foods.	1	2	3	4
14.	In general, I work better when I'm under pressure.	1	2	3	4
15.	I often like to have the radio or TV on while I'm doing something else, such as reading or cleaning up.	1	2	3	4
16.	It would be interesting to see a car accident happen.	1	2	3	4
17.	I think it's best to order something familiar when eating in a restaurant.	1	2	3	4
18.	I like the feeling of standing next to the edge on a high place and looking down.	1	2	3	4

19.	If it were possible to visit another planet or the moon for free, I would be among the first in line to sign up.	1	2	3	4
20.	I can see how it must be exciting to be in a battle during a war.	1	2	3	4

8.2.5. Boredom Proneness Scale (BPS)

Instructions:
To what extent do you agree or disagree with each of the following statements? Please read each statement carefully, and select the option that best corresponds to you**.**

Strongly Disagree	**Disagree**	**Mildly Disagree**	**Neutral**	**Mildly Agree**	**Agree**	**Strongly Agree**
1	**2**	**3**	**4**	**5**	**6**	**7**

1.	It is easy for me to concentrate on my activities.	1	2	3	4	5	6	7
2.	Having to look at someone's home movies or travel slides bores me tremendously.	1	2	3	4	5	6	7
3.	I find it easy to entertain myself.	1	2	3	4	5	6	7
4.	Many things I have to do are repetitive and monotonous.	1	2	3	4	5	6	7
5.	I get a kick out of most things I do.	1	2	3	4	5	6	7
6.	In any situation I can usually find something to do or see to keep me interested.	1	2	3	4	5	6	7
7.	It would be very hard for me to find a job that is exciting enough.	1	2	3	4	5	6	7
8.	Many people would say that I am a creative or imaginative person.	1	2	3	4	5	6	7
9.	Among my friends, I am the one who keeps doing something the longest.	1	2	3	4	5	6	7
10.	Unless I am doing something exciting, even dangerous, I feel half-dead and dull.	1	2	3	4	5	6	7
11.	It seems that the same things are on television or the movies all the time, it's getting old.	1	2	3	4	5	6	7
12.	When I was young, I was often in monotonous and tiresome situations.	1	2	3	4	5	6	7

8.2.6. Rosenberg Self-Esteem Scale (RES)

Instructions:
Below is a list of statements dealing with your general feelings about yourself. Please read each statement carefully, and select the option that best corresponds to you.

Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**
1	**2**	**3**	**4**

1.	On the whole, I am satisfied with myself.	1	2	3	4
2.	At times, I think I am no good at all.	1	2	3	4
3.	I feel that I have a number of good qualities.	1	2	3	4
4.	I am able to do things as well as most other people.	1	2	3	4
5.	I feel I do not have much to be proud of.	1	2	3	4
6.	I certainly feel useless at times.	1	2	3	4
7.	I feel that I'm a person of worth, at least on an equal plane with others.	1	2	3	4
8.	I wish I could have more respect for myself.	1	2	3	4
9.	All in all, I am inclined to feel that I am a failure.	1	2	3	4
10.	I take a positive attitude toward myself.	1	2	3	4

8.2.7. Deffenbacher Driving Anger Scale (DAS)

Instructions:
Imagine that each situation described below was actually happening to you and rate the amount of anger that would be provoked.
Please read each statement carefully, and select the option that best corresponds to you.

None at all	**A little**	**Some**	**Much**	**Very much**
1	**2**	**3**	**4**	**5**

1.	Someone is weaving in and out of traffic.	1	2	3	4	5
2.	A slow vehicle on a mountain road will not pull over and let people by.	1	2	3	4	5
3.	Someone backs right out in front of you without looking.	1	2	3	4	5
4.	Someone runs a red light or stop sign.	1	2	3	4	5
5.	You pass a radar speed trap.	1	2	3	4	5
6.	Someone speeds up when your try to pass him/her.	1	2	3	4	5
7.	Someone is slow in parking and is holding up traffic.	1	2	3	4	5
8.	You are stuck in a traffic jam.	1	2	3	4	5
9.	Someone makes an obscene gesture toward you about your driving.	1	2	3	4	5
10.	Someone honks at you about your driving.	1	2	3	4	5
11.	A bicyclist is riding in the middle of the lane and is slowing traffic.	1	2	3	4	5
12.	A police officer pulls you over.	1	2	3	4	5
13.	A truck kicks up sand or gravel on the car you are driving.	1	2	3	4	5
14.	You are driving behind a large truck and you cannot see around it.	1	2	3	4	5

8.2.8. Conscientiousness, Anxiety, Empathic Concern (CAEC)

Instructions:
How accurate are the following statements for you?
Please read each statement carefully, and select the option that best corresponds to you.

Very Inaccurate	Moderately Inaccurate	Neither inaccurate nor accurate	Moderately Accurate	Very Accurate
1	2	3	4	5

1.	I worry about things.	1	2	3	4	5
2.	I waste my time.	1	2	3	4	5
3.	I am concerned about others.	1	2	3	4	5
4.	I am not easily bothered by things.	1	2	3	4	5
5.	I am always prepared.	1	2	3	4	5
6.	I feel little concern for others.	1	2	3	4	5
7.	I fear for the worst.	1	2	3	4	5
8.	I find it difficult to get down to work.	1	2	3	4	5
9.	I feel sympathy for those who are worse off than me.	1	2	3	4	5
10.	I am relaxed most of the time.	1	2	3	4	5
11.	I pay attention to details.	1	2	3	4	5
12.	I have no sympathy for criminals.	1	2	3	4	5
13.	I am afraid of many things.	1	2	3	4	5
14.	I do just enough work to get by.	1	2	3	4	5
15.	I sympathize with the homeless.	1	2	3	4	5
16.	I am not easily disturbed by events.	1	2	3	4	5
17.	I get chores done right away.	1	2	3	4	5
18.	I look down on any weakness.	1	2	3	4	5
19.	I get stressed out easily.	1	2	3	4	5
20.	I don't see things through.	1	2	3	4	5
21.	I believe that criminals should receive help rather than punishment.	1	2	3	4	5
22.	I don't worry about things that have already happened.	1	2	3	4	5
23.	I carry out my plans.	1	2	3	4	5
24.	I don't like to get involved in other people's problems.	1	2	3	4	5
25.	I get caught up in my problems.	1	2	3	4	5
26.	I avoid my duties.	1	2	3	4	5
27.	I believe that the poor deserve our sympathy.	1	2	3	4	5
28.	I adapt easily to new situations.	1	2	3	4	5
29.	I make plans and stick to them.	1	2	3	4	5
30.	I have little sympathy for the unemployed.	1	2	3	4	5

8.2.9. Self Assessment on Driving Ability (SADA)

Instructions:
How correct is each of the following statements for you?
Please read each statement carefully, and select the option that best corresponds to you.

Completely Wrong	**Mostly Wrong**	**Neither-Nor**	**Mostly Correct**	**Completely Correct**
1	**2**	**3**	**4**	**5**

1.	I am a champion on slippery conditions.	1	2	3	4	5
2.	Dangerous situations rarely occur abruptly for me.	1	2	3	4	5
3.	I have the feeling of direct contact with the road surface.	1	2	3	4	5
4.	I am able to reverse fast and precise into a garage.	1	2	3	4	5
5.	I am well skilled to drive fast if necessary.	1	2	3	4	5
6.	I have a driving style avoiding dangerous situations.	1	2	3	4	5
7.	The car and I are united.	1	2	3	4	5
8.	I am able to reverse easily by using rear-view mirrors.	1	2	3	4	5
9.	I drive effectively under high traffic density conditions.	1	2	3	4	5
10.	I am pretty good at driving safely.	1	2	3	4	5
11.	I know immediately if my car fits into a narrow passage.	1	2	3	4	5
12.	I am well skilled in fast and precise parallel parking.	1	2	3	4	5
13.	I am well skilled to anticipate.	1	2	3	4	5
14.	I recognise dangerous situations.	1	2	3	4	5
15.	I know exactly the position of the car.	1	2	3	4	5
16.	I always judge gaps in traffic flow correctly.	1	2	3	4	5
17.	I feel confident to cope with unexpected situations.	1	2	3	4	5
18.	I know the exact stopping distance needed for maximum braking.	1	2	3	4	5
19.	I have excellent driving skills.	1	2	3	4	5
20.	I have lower crash risk than the average driver.	1	2	3	4	5
21.	I am well skilled in dark driving.	1	2	3	4	5
22.	I know exactly how to turn the wheel when skidding.	1	2	3	4	5

8.2.10. Competitive Attitude Toward Driving (AT)

Instructions:
To what extent do you agree or disagree with each of the following statements? Please read each statement carefully, and select the option that best corresponds to you.

Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**
1	**2**	**3**	**4**

1.	It's fun to beat other drivers when the light changes.	1	2	3	4
2.	It's really satisfying to pass other cars on the motorway.	1	2	3	4
3.	It's a thrill to out manoeuvre other drivers.	1	2	3	4
4.	It's fun to weave through slower traffic.	1	2	3	4
5.	Taking risks in traffic makes driving more fun.	1	2	3	4

8.2.11. Driver Confidence Questionnaire (DCQ)

Instructions:
We would like to know how you feel about driving in different circumstances. Please read each of the following statements below and indicate how safe you would feel driving in that situation.

Very Safe	**Safe**	**Neither**	**Unsafe**	**Very Unsafe**
1	**2**	**3**	**4**	**5**

1.	At night?	1	2	3	4	5
2.	After drinking?	1	2	3	4	5
3.	At 100 km/ph?	1	2	3	4	5
4.	At 110 km/ph?	1	2	3	4	5
5.	At 120 km/ph?	1	2	3	4	5

8.2.12. Self Evaluation Questionnaire

Instructions:
To what extent do you agree or disagree with each of the following statements? Please read each statement carefully, and select the option that best corresponds to you.

1. I sometimes feel worried that I will be involved in a crash.

1	2	3	4	5	6	7	8	9
Strongly Disagree				Neither Agree/ Disagree				Strongly Agree

2. I often get a thrill from driving.

1	2	3	4	5	6	7	8	9
Strongly Disagree				Neither Agree/ Disagree				Strongly Agree

3. How likely are you to be involved in crashes in the future compared to the average driver?

1	2	3	4	5	6	7	8	9
Much less likely				About the same				Much more likely

4. How skilful do you think you are compared with the average driver?

1	2	3	4	5	6	7	8	9
Much less skilful				About the same				Much more skilful

8.2.13. Barrat Impulsivity Scale (BIS-15)

Instructions:
We all act and think differently in day to day situations.
Please read each statement and select the answer that best describes the way you act and think.
Do not spend too much time on any one statement.
Answer quickly and honestly.

Rarely/Never	**Occasionally**	**Often**	**Almost always/Always**
1	**2**	**3**	**4**

1.	I plan tasks carefully	1	2	3	4
2.	I do things without thinking	1	2	3	4
3.	I concentrate easily	1	2	3	4
4.	I save regularly	1	2	3	4
5.	I am a careful thinker	1	2	3	4
6.	I say things without thinking	1	2	3	4
7.	I act on impulse	1	2	3	4
8.	I get easily bored when solving thought problems	1	2	3	4
9.	I buy things on impulse	1	2	3	4
10.	I am restless at lectures or talks	1	2	3	4
11.	I plan for the future	1	2	3	4
12.	I squirm at plays or lectures	1	2	3	4
13.	I act on the spur of the moment	1	2	3	4
14.	I don’t pay attention	1	2	3	4
15.	I plan for job security	1	2	3	4