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Exploring the Factors which underpin Young Drivers' Over-Representation in Road Traffic Collisions

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Exploring the Factors which underpin Young Drivers' Over-Representation in Road Traffic Collisions

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Abstract

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Lauren Weston

Worldwide, young drivers are involved in more road traffic collisions than any other age group (Taubman & Katz, 2012). Comprehensive driver training and various forms of pre- and- post-test road safety interventions (RSIs) are in place, but young drivers continue to be involved in more at-fault, fatal collisions than older, newly qualified drivers (e.g. Emmerson, 2008; Braitman et al, 2008; Clarke et al, 2010). The evidence base to date is mixed regarding why young drivers are at a heightened risk of collision and so this thesis aims to provide further understanding about the factors underpinning young drivers' engagement in risky driving.

An evaluation of a young driver RSI, found that young males were less likely than young females to report safer attitudes and intentions after attending the RSI. We considered that this may be due to young males' behaviour being motivated by a desire to seek rewards (e.g. the thrill of risky driving) rather than a fear of punishment which forms the basis of traditional RSIs. Two subsequent studies were conducted to ascertain whether a heightened sensitivity to reward might underpin the risk-taking behaviour of those most at risk. We found that young males and females scoring high on reward sensitivity reported engaging in more road traffic violations and displayed slower reaction times on a driving game; suggesting that young people may have a heightened sensitivity to reward, in general, and concurrently tend to accept a higher degree of risk than other drivers. We also found that reward sensitive young drivers rated road safety messages framed in terms of financial gains as most effective, suggesting that financial incentives may be a potential route to engage young drivers in the future. The findings from another study provided insight into the precise mechanisms at play in the relationship between young drivers and their peer passengers, and the evaluation of the pilot peer-to-peer RSI showed how it might be possible to improve young drivers' intentions to drive safely by modifying the norm that risky driving is an appropriate way to attain social prestige within a peer group.

The thesis offers a significant contribution to the literature by establishing empirically the effect of reward sensitivity on young drivers' engagement in risky driving and suggesting multiple ways to better improve young drivers' safety in the future.

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Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Sub-Committee. Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at the University of Plymouth or at another establishment. The studies presented within this thesis all received independent ethical approval from the University of Plymouth, Faculty of Science Human Ethics Committee and were carried out under full compliance with the British Psychological Society's ethical guidelines.

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Chapter One

Introduction

Road traffic collisions are the leading cause of death for adolescents (Curry et al, 2011) and worldwide, young drivers – aged 25 years or less - are involved in collisions more than any other age group (Taubman & Katz, 2012). In the UK, one in five newly qualified drivers are involved in a collision within 6 months of passing their test (DfT, 2008a); and drivers aged 16-19 are more than twice as likely to die in a collision as drivers aged 40-49 (DfT, 2015). Not only this, young drivers are also more likely to be classed at fault for a collision as well, for example Clarke et al. (2010) examined police reports of collisions in the UK involving 1 or more fatalities. They found that drivers below the age of 20 were 12 times more likely to have caused a fatal collision than drivers of any other age. Thus the evidence suggests that there are three key elements to young drivers' heightened collision risk compared to the general population: their collisions are more frequent, more likely to involve fatalities and are more often the fault of the young driver. From here on in the term 'collision' risk will be used to refer to all 3 elements.

There are multiple proposed risk factors that contribute to young drivers' high collision risk. These tend to be considered broadly as:

a) skill-based deficits due to driving inexperience, such as poorly developed hazard perception
b) age-related personality factors such as sensation seeking
c) increased risk-taking behaviour such as speeding

Researchers have gathered evidence about some of the risk factors associated with young drivers, but it is still unclear why they are at such an increased risk compared to their older driver counterparts and how this risk can be effectively reduced. The literature review detailed

below provides a summary of the evidence to date regarding the contributory factors associated with young drivers' increased risk of a collision, and considers gaps in the knowledge base that still need to be filled.

1.1 Skills Deficits

The US Department of Transportation Federal Highway Administration have identified several driving skill characteristics considered to be fundamental for safe driving that young drivers are proposed to be deficient in (Husband, 2010). These are: visual search, automaticity and vehicle control, and hazard perception. One possibility is that these skill deficits are a result of the lack of driving experience young drivers have been able to acquire, and it is this lack of experience that can be directly related to young drivers' over-representation in collisions. If this is true, it is logical to assume that once these deficiencies are addressed, the numbers of collisions young drivers are involved in and responsible for, will reduce. However the evidence is thus far inconclusive, with researchers finding evidence from various sources that both support and oppose the idea that young novice drivers are at risk because of skill deficits. Summarised below is the evidence concerning each of the skill areas young drivers are suggested to be under-developed in, and their relative role in collision rates involving young drivers.

1.1.1 Visual Search

Failing to attend to appropriate areas of the visual scene at the relevant time is considered to be a major contributing factor toward young novice drivers' collision risk (Pollatsek, Fisher & Pradhan, 2006). For example, Lestina and Miller (1994) identified that failing to search the road adequately was the single most frequent factor associated with collisions involving specifically young drivers. Similarly in a review of nearly 1,000 non-fatal collisions involving 16- and 17-year-old drivers, McKnight and McKnight (2003) found that failures to search ahead, to the side, and to the rear were together the cause of 42.7% of the collisions.

As a result of findings such as these that implicate visual search errors in the number of collisions experienced by young drivers, researchers have been interested in examining the differences in roadway observation patterns of drivers with varying degrees of experience. Typically, eye movements of experienced and novice drivers are compared whilst they watch film clips recorded from a car as it travels along different road types, in order to observe differences in visual scanning behaviours. Using this procedure Underwood et al. (2002) found that as roadways become more complex the visual search behaviour of novice and experienced drivers differed. Whereas experienced drivers tended to increase their amount of visual scanning when viewing dual carriageways as opposed to rural roads, novices performed a similar degree of visual scanning on both the simple roads and the more complex ones.

Underwood et al. (2003) investigated this further, recording driver's eye fixations while they drove along three different types of road (rural, suburban and dual-carriageway). It was found that in undemanding situations, such as on rural roads, where the presence of pedestrians, parked cars and other potential hazardous sources on the roadway were unlikely, all drivers, irrespective of experience level, tended to look straight ahead at the position in the road where their vehicle would be in the next few seconds (Underwood et al, 2003). As the focus of expansion is generally in line with the direction of the vehicle it appears to make sense that this gaze direction has been found to be the most common scanning strategy used by experienced and novice drivers alike. However as the number of potential hazards increase in the visual environment the scanning strategies of experienced and novice drivers diverged. In more demanding roadway situations, such as on a dual-carriageway, experienced drivers tended to direct the majority of their fixations to the left and right of the focus of expansion, along the horizontal plane (Underwood et al, 2003). This suggests that experienced drivers are more likely than novices to vary their gaze in response to the increased likelihood of hazard occurrence, for example to search for developing hazards associated with dual-carriageway road conditions such as traffic merging from slip-roads and lane-changes (Underwood et al, 2003). By contrast, novice drivers tended to make more fixations in the vertical plane and much fewer, less

widespread fixations along the horizontal plane, suggesting that the horizontal bias may be learned with experience as the driver's anticipation of potential hazardous circumstances improves (Mourant & Rockwell, 1972, Crundall & Underwood, 1998).

More recently driving simulators have been used to examine where drivers tend to direct their eye movements when faced with 'risky scenarios'. Pradhan et al. (2005) found that young inexperienced drivers tended to fixate on target regions in the virtual world containing information about potential risks much less frequently than more experienced drivers, and accordingly tended to respond by stopping much less quickly. Similarly Alberti, Shahar and Crundall (2014) explored how wide versus narrow fields of view affected novice and experienced drivers' identification of hazards in a simulator. They found that experienced drivers made use of the wide field view much more than novice drivers and maintained lower speeds when approaching hazards, particularly when they had access to a wide field of view. Novice drivers on the other hand displayed a less cautious approach when advancing towards hazards, they did not make use of the increased field of view, and were more likely to miss hazards and have a collision as a result. Underwood (2007) also found that novice drivers were much less likely to anticipate potential hazards. In a review on visual attention patterns, he found that experienced drivers were more likely than novices to fixate areas of the road where road users may cross paths, thus anticipating hazards and being able to respond more quickly (Underwood, 2007).

Research has since been conducted to understand why it is that novice drivers do not look around them at the precise point in time that it is important to do so. Two prominent explanations have been proposed. The first refers to a problem with situational awareness, whereby young drivers may have an incomplete mental model of the potential risks that can be present on different road types. A mental model is a well-defined set of knowledge structures that are relevant for task performance in any given domain (Scialfa et al, 2012). With regards to young drivers it might be that their limited experience of various roadway environments means

that they have not yet experienced all situations that carry risk (Gugerty, 1997; Horswill & McKenna, 2004). In this way, novice drivers may simply not be aware of the dangers associated with more complex roads, such as other vehicles changing lanes or merging from slip-roads, and the increased potential for a collision as a result (Underwood, 2007).

The alternative explanation is that novice drivers may not have had sufficient practice to automate the mechanical skills of driving such as steering and clutch control, to allow for spare cognitive capacity to be directed toward navigation and road situation awareness in more complex roadways (Underwood, 2007). As novices may still be devoting a large proportion of their attention to the mechanical skills of driving, they would have fewer cognitive resources left to allocate to attending the roadway at crucial times, therefore potentially missing important information about dangerous roadway situations (Pollatsek, Fisher & Pradhan, 2006). For example in one study of driver's eye fixations, the amount of visual scanning behaviour exhibited by drivers was found to decrease after a secondary task was introduced that increased cognitive workload (Recarte & Nunes, 2003 as cited in Underwood, 2007). Therefore a general lack of driving skills and cognitive overload may explain novices' reduced visual scanning behaviour in roadway environments of a greater complexity, as the mechanical driving skills not yet automated would be requiring the majority of their cognitive capacity (Underwood, 2007).

Studies that remove the need for drivers to actually control a vehicle whilst undertaking visual scanning are useful for comparing the validity of each of these explanations. If novices show less visual scanning because their cognitive resources are being used for vehicle control, then by removing this aspect of the task the amount of visual search they display should increase to a comparable level as shown by experienced drivers. On the other hand if they do not engage with much visual scanning because they are not know aware of the hazards they may face, as a result of an underdeveloped mental model, then removing the task of driving should not have much of an effect on the degree of visual scanning they display (Underwood, 2007). Underwood's findings indicate that the latter explanation might be most likely. They found that novice drivers

displayed a similar level of visual scanning regardless of the road complexity. This might suggest that inexperienced drivers have an incomplete mental model not informing them of the potential hazards associated with complex road types, and thus did not engage in more widespread scanning because they simply did not know they had to. Therefore from the results of this study it was suggested that it may not be the act of controlling the vehicle itself per se that results in novices not responding appropriately to road conditions, but that they simply do not have the same degree of situational awareness as do experienced drivers (Underwood, 2007).

In addition to this, the influence of social factors should not be considered in isolation from aspects of driving skill. Recently Pradhan et al. (2014) found that the visual scanning undertaken by young male drivers in a simulated driving study was much narrower, both horizontally and vertically when in the presence of a peer passenger compared to when alone. The authors suggested this could be due to the additional cognitive load experienced by the driver, or the perceived influence of the passenger on the drivers' behaviour. Either way, the young drivers' visual scanning was much more extensive when driving alone, suggesting they do have the ability to scan appropriately, but this may be affected at times by social and temporal influences.

The contrasting findings that support different explanations of why novice and experienced drivers differ in their scanning strategies shows that researchers have yet to fully explain the origins of such differences. However researchers have often failed to take into account the confounding presence of age and inexperience. They tend to focus on the visual search skills of specifically young novice drivers, failing to consider how older novice drivers may compare. For example Underwood et al.'s (2003) sample used two groups of participants; the 'novice' group had a mean age of 19.9 years, whilst the 'experienced' group had a mean age of 27.7 years. Similarly the two groups in Alberti et al.'s (2014) study had mean ages of 22.4 years (novices) and 28.6 years (experienced drivers). These studies confound age and inexperience

because there is no way of knowing whether older novice drivers would display similar visual search strategies to the younger novices and so we cannot infer that this risk is specific to young novice drivers.

A more recent study has attempted to explore age and inexperience differences in drivers' search strategies. Scott et al. (2013) assessed drivers' gaze transitions in simulated junction scenarios, using three groups of participants: young novices (mean age = 20.6 years), young experienced (mean age = 23.8 years) and older experienced (mean age = 66.4 years) drivers. They found that young novices and older experienced drivers (defined as 'high risk' in this study) displayed less even gaze transitions than the young experienced drivers, who tended to distribute their gaze across all areas of the scene. Similarly Pradhan et al. (2005) also addressed the issue of age and inexperience using three groups of participants: young and inexperienced, young and experienced, and older and experienced. Their results indicated that there were much bigger differences in the visual search patterns of older and younger participants, rather than between experienced and inexperienced drivers. This indicates that age-related factors may be key in explaining the risk faced by young drivers, rather than their lack of driving experience in general. However these studies still tended to recruit "high risk" drivers i.e. very young and very old individuals. How the visual scanning behaviour of a middle-aged novice driver in comparison to a young novice driver, has still yet to be considered.

Most studies have shown that young, novice drivers do show limited visual search skills, putting them at an increased risk of collision as it limits their awareness of emerging hazards in various situations (Underwood, 2007). However the research also suggests that this "skill deficit" is actually confounded by other social and environmental factors affecting their cognitive load. Young, inexperienced drivers do display limited search strategies, but whether age or inexperience plays a bigger role is as yet unidentified.

1.1.2 Automaticity and Vehicle Control

The term automaticity refers to instances when an individual performs an action without conscious awareness of doing so; usually as a result of learning, repetition and practice through which the action has become proceduralised (Bargh & Chartrand, 1999). Many aspects of driving have been found to become automated with practice (Ranney, 1994) but the exact amount of driving experience required for this to occur varies from person to person. Rasmussen's (1987) model of human control and behaviour (the skill-rule-knowledge based framework) suggests that during training, in this instance driving, control moves from the rule-based level to the skill-based level, reducing the amount of cognitive workload required to carry out the driving tasks and thereby enabling a larger amount of the cognitive resources available to be engaged elsewhere.

To investigate the notion of driving automaticity researchers tend to measure the degree of 'spare mental capacity' available to experienced versus novice drivers, as they perform a secondary task whilst driving. The extent to which they display safe driving skills whilst completing the secondary task is taken as evidence of the process of driving having become automated or not (Patten et al, 2006). For example, Lansdown (2002) found that novice drivers made much fewer verbal reports regarding road signs, vehicle operations etc, than more experienced drivers, whilst simultaneously driving in a fixed base driving simulator. He suggested that this may be due to the fact that novices had not yet automated the mechanical aspects of driving and were thus using their attention capacity to focus on their driving skills with only a limited amount left to dedicate to the secondary task of verbal reporting. The experienced drivers on the other hand had perhaps automated the mechanical skills of driving and were therefore not reliant on using their declarative, procedural-based memory to drive, so had much more available cognitive capacity to attend to the secondary task (Lansdown, 2002).

Various sources provide additional evidence in support of the notion that experienced and novice drivers differ in the extent to which their driving skills are automated. Chapman and

Underwood (1998) recorded driver's eye movements as they viewed scenes of roads of varying complexity. They found that young novice drivers tended to display longer duration fixations compared to their more experienced (and older) counterparts. They suggested that this represents a longer amount of time spent processing hazard-related information in the road, indicative of effortful and conscious processing (as opposed to automatic and unconscious). Similarly, the novice drivers in Chapman and Underwood's (1998) study were found to fail to respond appropriately to the increased complexity of certain road types, suggesting perhaps that the more complex roads (such as dual carriageways) required more cognitive resources than the novices had spare, as the vehicle control aspects of driving were using up the majority of their attention capacity.

It is suggested that the lack of automaticity in the driving skills of young novices may be a factor in the increased collision rate experienced by this age group of drivers (Lerner, 2001). It is argued that they are unable to switch quickly and efficiently between tasks in emergency situations because they are preoccupied with carrying out the appropriate vehicle control aspect of driving. Whilst their attention is directed to controlling the vehicle they neglect to search and respond to hazards with enough speed, and are thus more likely to be at risk of collision (Lerner, 2001).

McGwin and Brown (1999) compared characteristics of collisions to show how drivers of different ages are involved in different types of collisions. They found that when the driver was responsible for the collision, the most common primary contributing factor amongst young drivers was a lack of control over the vehicle (16.4%). Similarly Clarke et al. (2006) analysed more than 3000 collisions to identify trends within and between different age groups. They found that young drivers were particularly at risk from loss of control collisions on curves and in darkness.

Braitman et al. (2008) examined who was to blame in a sample of collisions and found that young drivers were at fault in 75% of the collisions they experienced. The primary factors involved in such collisions were found to be failures of detection, speeding and a loss of control of the vehicle. This is a finding echoed by many past researchers (e.g. Jonah, 1986; Michiels & Schneider, 1984; Trankle et al, 1990) that young drivers are particularly at risk from collisions resulting from a loss of control of their vehicle, likely to be due, at least in part, to the effortful recall needed of the skills required to avoid a collision and the lack of time available to do this and perform the manoeuvres safely.

However it is argued that loss of vehicle control may not be adequate as the main explanation for young driver's collision risk, and it might be that when young drivers do lose control this is due to circumstantial driver error, such as distraction, speeding etc. For example in one study, factors behind young (18-21 years old) males' and females' fatal loss-of-control collisions were examined, and compared to collisions in which no loss of control occurred (Laapotti & Keskinen, 1998). Male drivers were more likely to lose control during evening and night-time hours and whilst also engaging in other risky driving behaviours such as speeding and drunk driving. These factors were not evident when females lost control of the car, where a slippery road condition was the most frequently cited factor, and so these findings support the idea that risky driving behaviours may play a substantial role in specifically young males' collision rates. A deficit in vehicle handling skills leading to a collision may only really apply to female drivers (Laapotti & Keskinen, 1998). Horswill and McKenna (1999) stated that whilst young drivers are less good at staying alive in their vehicle once they have passed their driving test, they would have been relatively efficient in learning how to control the vehicle itself otherwise they would not have passed the test. Thus there appears to be other social factors influencing young drivers' loss of control, rather than a skill deficit in controlling a vehicle per se.

1.1.3 Hazard Perception

Hazard perception is operationally defined here as 'objective' as opposed to 'subjective', and refers to the driver's ability to identify potentially dangerous traffic situations (McKenna & Crick, 1994); being aware of any aspect of the road environment that increases the possibility of a collision (Mills et al, 1998). Conversely, risk perception is subjective, and is reliant on drivers' own evaluations of how hazardous a given situation may be (Von Benda & Hoyos, 1983). An individual's risk perception will determine the level of danger they are willing to accept, before they change their course of action to reduce the risk (Finn & Bragg, 1986). As risk perception is subject to individual differences and is related to personality rather than skill, it will be discussed in full later. This section refers to the objective matter of hazard perception, which is a skill and learnt through driver training.

Identifying and responding to hazards quickly and accurately is considered to be one of the most critical perceptual and cognitive skills required for safe driving (Scialfa et al, 2011).This is of particular concern for young novice drivers as it is also one of the key skills they appear to be underdeveloped in (McKnight & McKnight, 2003). Although having an awareness of hazards aids protection against collision when learning to drive, newly qualified drivers have been found to be less able to identify and respond to them (McKenna & Crick, 1994; Pollatsek et al, 2006). Furthermore even when novices do respond to hazards their response times are much slower when compared to more experienced drivers (Smith et al, 2009; Scialfa et al, 2011) and they tend not to adjust their visual scanning strategies according to the complexity of the road type they are on (Crundall & Underwood, 1998).

The evidence presented earlier regarding visual scanning suggests that novices do not scan the road and surrounding areas efficiently (Chapman et al, 2002; Pradhan et al, 2005) and thus may fail to notice many critical hazards that could result in a collision. One explanation as to why novice drivers are lacking in their hazard perception skill is because of their limited experience and thus limited driving skill. Groeger (2000) suggested that each hazard encountered by a

driver is encoded as a separate memory trace. Future accurate response to the same hazard is affected by how fast they remember previous encounters. The more experience they have, the stronger the memory trace. On this basis it is argued that as novices have had less driving experience they do not have a complete database of all the hazards they might encounter. Therefore because of this underdeveloped database of encounters, they are slower to search and respond to hazards than more experienced drivers (Scialfa et al, 2012).

The finding that novices identify and respond to hazards slower than more experienced drivers has been replicated both in the laboratory and on the road. For example Scialfa et al. (2011) presented short video clips of roadway scenes to novice and experienced drivers of a similar age, and asked them to indicate when they observed traffic conflicts that might lead to a collision. They found that novices responded much slower when faced with a perceived hazard. A similar finding was observed when using static images of roadway scenes in place of video clips (Scialfa et al, 2012). Not only did they replicate the finding that novices were much slower at responding to hazards, but they also found that novices had a tendency to rate the traffic conflicts as less hazardous in general.

It has also been proposed that novices' poor hazard perception skill may be due to an impoverished mental model of the hazards that are present in the driving environment (Horswill & McKenna, 2004). Because they may not have experienced the full range of driving situations, their situational awareness capacity particularly on complex roads, may be under-developed (Endsley, 1995, Horswill & McKenna, 2004). Underwood (2007) used Endsley's (1995) three-level model of situational awareness to describe how the difference in scanning strategies used by novice and experienced drivers may explain novice's apparent hazard perception skill deficits. At the third and highest level of situation awareness the driver would be able to predict the behaviour of other road users and anticipate how the current situation may develop as other vehicles manoeuvre around. An impoverished mental model, particularly at the third level of situation awareness, may be responsible for novice drivers' deficits in hazard perception

(Underwood, 2007). A recent study conducted by Crundall (2015) supports this idea, wherein young experienced drivers were found to outperform young novices' ability to predict the onset of various hazards from video clips varying in length and different situational contexts. However the evidence is not conclusive as Wallis and Horswill (2007) found that novice and experienced drivers did not differ in the number of hazards they predicted to occur at specific points on static images of traffic scenes.

It should be noted that what constitutes being a 'novice' driver differs considerably between studies. For example whilst Wallis and Horswill (2007) classified a novice as someone who had had their driving license for 4 years or less, Crundall's (2015) novices had less than 3 years experience and De Craen et al. (2011) used novice drivers with only 2 weeks post-license experience. Bearing in mind that the collision rate for novice drivers decreases considerably during the first 6 months post-licensure (Mayhew, Simpson & Pak, 2003) it is important to consider the substantial within-group differences that may result from having such a widespread classification of 'novice'.

1.1.4 Conclusion

The evidence presented above appears to suggest that young, inexperienced drivers may be at an increased risk of having a collision because of their underdeveloped driving skills. However the confounding factor is that age and inexperience are inextricably linked within this assumption. As mentioned earlier, many studies fail to consider this when making assertions about 'young, inexperienced drivers' (e.g. Underwood et al, 2003; Alberti et al, 2014) and there is evidence to suggest that newly qualified drivers are more at risk regardless of their age. Figure 1.1 shows the risk of collision risk for new drivers of different ages. The data was collected by Wells et al. (2008, as in cited in Emmerson, 2008), based on more than 42,000 responses from newly qualified drivers in the UK. They asked participants about their driving experience, collisions, offences and attitudes at several different times points: the week they took their driving test, and then at intervals of 6, 12, 24 and 36 months after passing their test.

Figure 1.1 illustrates that whilst all newly qualified drivers had a heightened collision risk immediately upon passing their test; the risk was highest for the youngest novice drivers. The individuals who learned to drive at age 17 had a collision involvement rate upon passing their test almost 50% higher than those who learnt to drive at age 25, and were in almost double the number of collisions than those who had learned to drive at age 60. This means that a) all newly qualified drivers are involved in more collisions than experienced drivers, but that b) young new drivers are much more likely to be in a collision than older new drivers, which suggests that there is another unidentified factor, other than experience, that makes young novice drivers more at risk than older new drivers. Determining what it is about young novice drivers that puts them at the most risk will direct the types of intervention measures needed to be employed to reduce collision rates, and is thus critical to inform action.

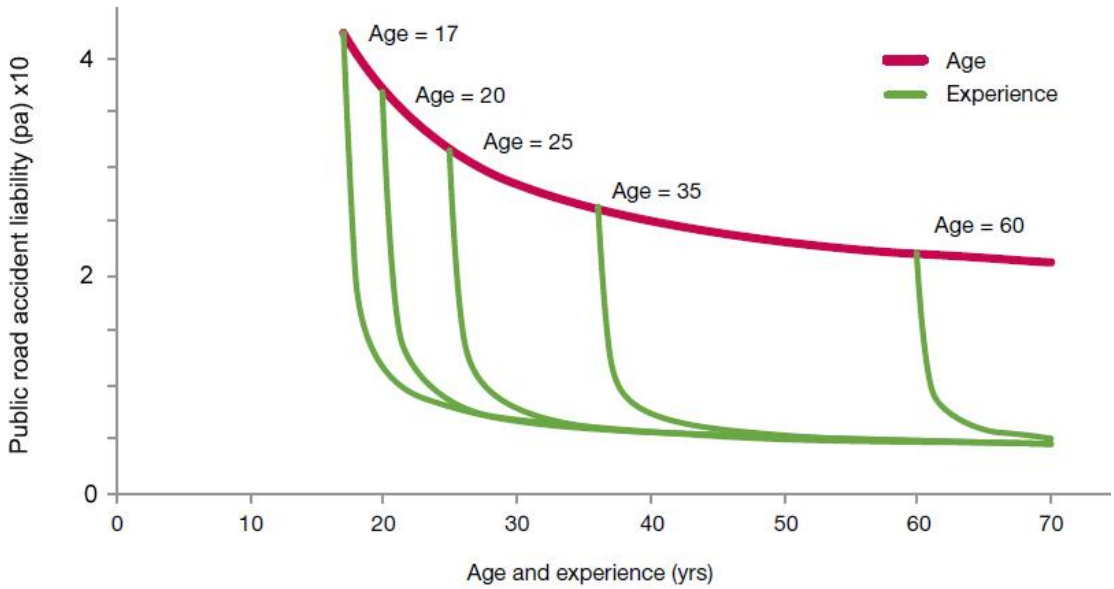


Figure 1.1. The effect of age (at passing test) and experience on collision involvement (Emmerson, 2008).

There appears to be a wealth of evidence supporting the idea that a lack of experience and thus underdeveloped driving skills in general, is a contributing factor to young driver's over-involvement in collisions. However it has also been shown that inexperience cannot explain young drivers' risk on its own (e.g. Figure 1.1). There is a vast amount of research suggesting

that age-related factors associated with ‘adolescence’ may be better predictors of young driver’s collision risk, such as personality traits and risky driving behaviours. If this is the case it might be that young drivers’ inexperience may not be the leading cause of their high risk. Instead it could be that age-related characteristics that influence young drivers’ behaviour may result in their increased likelihood of a collision. This would have implications for the age at which full driving licenses should become available to young people and for how to target interventions designed to reduce their risk.

Understanding the specific risky behaviours young drivers are more likely to engage in is critical in order to try and address the problems. Thus the next part of this review details some of the most common risky behaviours that young drivers tend to engage in, to a greater extent than older drivers, which put them at more risk. These include speeding, alcohol use, the tendency not to wear a seatbelt, driving at night, at the weekend, with peers, and being distracted. Further to this, certain personality characteristics have been found to be particularly evident among young adults that may contribute to risky behaviours, for example higher sensation seeking, greater susceptibility to peer influence and a tendency to overestimate their own skills. Therefore the final section of this review examines each of these factors in relation to young drivers’ collision risk to explore the relative influence of each.

1.2 Risky Driving Behaviours

Driving behaviour has been identified as one of the most critical elements involved in collision occurrence (Sabey & Taylor, 1980) and in line with this young drivers' tendency to engage in high-risk driving behaviours has been found to be an important contributor to their greater collision involvement rate (Harre, 2000). Specifically, behaviours such as speeding, alcohol use, the tendency not to wear a seatbelt, driving at night and at the weekend, being distracted and driving with peers have all been implicated in the over-representation of young drivers' collision and injury rates (Vassallo et al, 2007; Clarke et al, 2002; Dunsire & Baldwin, 1999; Dobbie, 2002; Begg & Langley, 2001).

1.2.1 Speeding

Speeding is considered a risky driving behaviour because it not only affects the severity of a collision, but is also linked to the likelihood of being involved in a collision in the first place (Aarts & van Schagen, 2006). Excessive driving speed for the conditions of the road has been found to be one of the most important contributors to collisions in general, irrespective of driver age and level of skill (Elliott et al, 2005). Bedard et al. (2002) found that travelling at a speed greater than 70 miles per hour was independently associated with a 164% increase in the odds of a fatality compared with speeds of less than 35 miles per hour. In addition to this, Clarke et al. (2002) found that speed was the most common factor involved in driving offences among young drivers. Whilst speeding is one of the most common risky behaviours performed by drivers of all ages, it is particularly dangerous for young novices. This is because a) they tend to have difficulty identifying and responding to road hazards quickly enough (Scott-Parker et al, 2013), and b) because they are more likely to carry out other risky behaviours simultaneously e.g. speeding whilst also being distracted when with peer passengers (Moller & Haustein, 2014).

Although there is some variability in content, among developed countries pre-license driver training provides learner drivers with comprehensive information regarding the risks of

excessive speed while driving (Cestac et al, 2011). This, combined with government initiatives and educational campaigns to reduce speeding, provides most young drivers with conscious awareness of the risks associated with speeding (Cestac et al, 2011). Thus collisions occurring as a result of young drivers' speeding are unlikely to be as a result of a lack of knowledge related to speeding behaviour, but rather through actively deciding to speed. In addition, through the use of vehicle tracking data Ayuso et al. (2014) found that both novice and experienced young drivers had a collision sooner when they had a higher proportion of speed limit violations, and this was particularly the case for young males. This finding suggests that regardless of how much driving experience young drivers have, when they engage in speeding behaviour they are more likely to have a collision.

Despite awareness of the risks, Simons-Morton et al. (2005) found that young drivers consistently commit speed violations. Using observation methods they found that the observed rate of high risk driving for a teenage male driver (defined as speed greater than 15 miles per hour or more above the specified speed limit and/ or headway of less than 1.0s) was double that of general traffic. We know that young drivers engage in high-risk speeding behaviour but it is less well understood why this is. One line of explanation concerns the freedom, pleasure and feelings of self-enhancement that comes from driving fast (Rothengatter, 1988); along with the notion that young drivers consider speed as a form of test of their driving skills (Rolls & Ingham, 1992) and a way to impress females/ girlfriends (Lewis et al, 2013). Speed is also used as a way of exercising superiority and power over others whilst driving, and represents a way to compete with others in a thrilling sense (Gabany et al, 1997). Not forgetting most simply, that driving fast saves time and gets the driver to their destination quicker (Fylan et al, 2006). All drivers are subject to these incentives to speed, but for young drivers the influence of such factors is that much greater because they are new and coincide with the greater social changes occurring during adolescence such as reduced adult supervision (McKenna, 2012). Further consideration of what factors underpin young drivers' engagement in high-risk behaviour will be detailed later.

Fernandes, Hatfield and Job (2010) found that young drivers were more likely to report speeding when they also reported higher sensation seeking and higher anger evoked from driving situations. Similarly, a recent study by Scott-Parker et al. (2013) investigated the personal characteristics associated with young novice drivers' tendency to engage in speeding. They found that factors such as gender, reward sensitivity, depression and personal attitudes predicted higher rates of speeding, suggesting that personality factors may influence young drivers' willingness to speed. A study by Knight, Iverson and Harris (2013) also found that many young drivers do not perceive speeding to be particularly high risk. In fact, some tend to consider speeding to be an involuntary behaviour that is both acceptable and inevitable; in contrast to drink driving, which is viewed as being more risky.

So whilst drivers of all ages violate speed restrictions, speeding is particularly prevalent and dangerous among young drivers (Simons-Morton et al, 2005; Clarke et al, 2002; Bedard et al, 2002). There are many social factors influencing young drivers' propensity to speed, such as the desire to impress peers (Lewis et al, 2003), prove their skills (Rolls & Ingham, 1992) or compete in a thrilling sense (Gabany et al, 1997). Indeed, speeding is particularly evident in young drivers reporting high sensation seeking tendencies (Fernandes et al, 2013). Whilst learner drivers do receive tuition regarding the risks associated with speeding (Cestac et al, 2011), there is evidence to suggest that young drivers do not actually perceive speeding to be particularly risky (Knight et al, 2013) which may then influence their willingness to engage in risky driving above the speed limit.

1.2.2 Alcohol Use

Evidence from laboratory, simulator and driving studies have provided extensive and consistent support for the notion that driving whilst intoxicated by alcohol produces severe impairments in driving ability (Kelly, Darke & Ross, 2004). Laboratory research has shown how relatively small doses of alcohol can have detrimental effects on varied skill areas required for driving,

such as psychomotor skills, vision, perception, tracking, steering, coordination, reaction time, information processing and attention (Moskowitz & Burns, 1990; Hindmarch, Kerr & Sherwood, 1991). Similarly, using simulator and real life road driving researchers have demonstrated how alcohol use can impair various skills essential for safe driving including brake reaction time, speed control, indicator use, steering responsiveness and lane control (Clayton, 1976; Robbe & O'Hanlon, 1999).

Young drivers are at increased risk of having a collision at all blood alcohol levels and when teenagers drink and drive they are at a much higher risk of a collision than when older drivers do (Mayhew et al, 1986; Voas et al, 1998; Zador et al, 2000). The common explanation for this is that young people are inexperienced at driving, inexperienced at drinking and inexperienced at combining these two activities (Williams, 2003; McKenna, 2012). In the UK, young male drivers less than 25 years of age have the highest incidence of failing a breath test after being involved in a collision in which someone was injured (DfT, 2005). In 2004, 5.7% of male 20 – 24 year-old drivers and 4.2% of male 17-19 year-old drivers involved in injury collisions failed breath-tests. This was in comparison to just 3.1% of drivers of all other ages (DfT, 2005).

Similarly, despite the high collision risk a recent survey revealed 29% of young drivers between the ages of 17 and 24 said that they would be willing to risk driving after drinking (Brake, 2011). Although this figure has fallen from a reported 44% in 2007, the number of young drivers who would risk driving the morning after drinking has risen from 45% in 2007 to 53% in 2011 (Brake, 2011). Clarke et al. (2010) examined police reports of collisions in the UK involving 1 or more fatalities. They found that whilst 20% of all reported fatalities involved a driver over the drink drive limit, this figure increased to more than one quarter when the driver was under the age of 30. The researchers in this study did not partition this result to see the rate for the younger members of this age band (the 17 – 25 year olds). However if they had, it is expected that this figure would have been even higher.

Bingham et al. (2007) explored the social and behavioural characteristics of young drink drivers and found that the severity of their drink driving was predicted by certain factors; namely lower perceived risk and greater social support for drunk driving, greater aggression and more risky driving behaviours. These findings suggest that when young drivers engage in multiple risky driving behaviours and are surrounded by peers that encourage riskiness, they are more likely to drink drive as well. Similarly, Greening and Steppelbein (2000) found that young drivers were more likely to report intentions to drink and drive when they felt vulnerable to the risks of drunk driving, but also perceived rewards for doing so. Intentions to drink drive were also higher among those who perceived low self-efficacy and more personal costs for employing alternative actions to drink driving; further supporting the idea that young people may feel an implicit obligation to drink drive.

To summarise, when young people drink drive they are at a much greater risk of a collision (Zador et al, 2000), and these collisions are more likely to result in injury (DfT, 2005). Those who perceive drink driving to be low in risk are more likely to engage in this risky behaviour (Bingham et al, 2007) and young drivers surrounded by peers that support risk-taking are also more likely to drink drive (Greening & Stoppelbein, 2000).

1.2.3 Seat Belt Use

Historically, teenage drivers and passengers have repeatedly been found to use seat belts less often than older adults (Wells et al, 1989; Womack et al, 1997; Williams et al, 1997). As teenagers are more likely to be involved in a collision than adults it is considered even more of a necessity for young drivers to benefit from the injury protection that seat belts provide (Ouimet et al, 2008).

National telephone surveys have been used by researchers to gather self-reported information on teenager's seat belt use on a large scale. One relatively recent study using this methodology found that around 79% of 16-to-20-year-old drivers and 84% of adults reported using their seat

belts (Boyle & Vanderwolf, 2003). More recently still using a telephone survey method, Ouimet et al. (2008) found that when assessed at three, six or twelve months post-licensure, a third of teenagers reported at least once in the past week not always using their seat belt.

Cross-sectional observation studies have also been used by researchers in the USA aiming to uncover rates of seat belt use among high school students at the same locations over time. For example Wells et al. (1989) and Williams et al. (1997) compared seat belt use of student drivers arriving at the same high schools in one town over a series of studies. The seat belt law came into effect in 1986, so these studies were able to compare the rates of usage before and after the law. Considerable progress was observed, for example in one high school driver belt use was 1% in 1982, 29% in 1988, and 52% in 1995. However despite the advances in seat belt usage there were still considerable differences observed in seat belt use between teenagers and adults. At all three data collection points, the rates of seat belt use were still consistently higher for adult drivers in the surrounding areas than for the high school teenagers (Williams et al, 1997; Wells et al, 1989).

Further to this, a large scale observational study carried out by Womack et al. (1997) across eight cities in four states of the USA, found differences in seat belt use of up to 14% between teenage and adult drivers, with teenage driver seat belt use ranging from just 20% to 58%. Similarly a more recent study found that both teenage drivers and passengers are less likely than adults to wear a seat belt; with up to a 24% difference found between teenage drivers and adult drivers (Williams et al, 2003).

Other studies have compared fatality rates for young drivers wearing or not wearing a seat belt at the time of a collision. McCartt and Northrup (2004) examined teenage (16-19 years) seat belt use for drivers and passengers fatally injured in traffic collisions in the USA over a 4 year period. They found that among fatally injured teenage drivers just 36% were wearing a seat belt at the time of the collision, and this figure was even lower for fatally injured teenage passengers

at just 23% (McCartt & Northrup, 2004). Therefore whilst young drivers are in great need of the protection of a seatbelt they are less likely to be wearing one at the time of a collision and are more likely to be fatally injured as a result.

Similarly, Williams and Shabanova (2002) compared fatally injured teenagers' and adults' seat belt use, and examined the situational factors affecting likelihood of usage. It was found that in a variety of situations teenage drivers were less likely to be wearing a seat belt at the time of collision than adult drivers (e.g. in the morning, in the evening, when under the influence of alcohol, and when accompanied by 1 or more passengers). Teenage drivers were most likely to be wearing a seat belt when transporting passengers over the age of 30, and least likely to be wearing one when transporting passengers in their twenties. Further to this, as the number of passengers increased, the likelihood of seat belt usage decreased for teenage drivers, but not for adult drivers. These results mirror other recent findings that suggested the association between young drivers, collision risk and presence of passengers is unique to teenage drivers only (Chen et al, 2000). This reinforces the notion that whilst young drivers are at the highest risk of receiving fatal or non-fatal injuries from a collision, they are also the least likely to wear a seat belt. That is to say, those who statistically require the most collision protection, which seat belts provide, most often choose to forgo it (Williams & Shabanova, 2002).

As can be seen from the evidence detailed above, it is widely accepted that young teenage drivers are the age group most likely to not wear a seat a belt. Research has now been conducted to attempt to ascertain why this may be. Begg and Langley (2001) interviewed nearly 1,000 21-year-olds and asked them about their seat-belt use, reasons for non-use, and their involvement in risky driving practices, motor-vehicle traffic collisions and thrill-seeking activities. Although Begg and Langley (2001) found relatively high rates of seat belt use (particularly for the front seat at 85-96%, less so for the back seat at 29-47%) they did find that predictors of non-use related to academic qualifications (with less qualifications associated with less seat belt use) and a tendency toward more risky driving behaviours. Although the primary cited reasons for non-

use were forgetfulness/ laziness, a perceived low risk of injury, and discomfort; these findings add further weight to the argument that teenagers engaged in general risky driving behaviours (including driving after drinking and speeding) are also less likely to wear a seat belt, and more likely to end up in a collision (Begg & Langley, 2001).

Ouimet et al. (2008) found that newly qualified teenage drivers viewed the risk of not using a seat belt to be high and it was perceived to be one of the factors most likely to cause a collision/ injury to newly licensed drivers. Although driving under the influence of alcohol or drugs was considered more likely to result in parent-imposed consequences than driving without a seat belt, teenagers were most likely to report using their seat belt when they perceived the risk of not using a seat belt to be high, combined with the sure prospect of parents' repercussions (Ouimet et al, 2008). Conversely, Fernandes et al. (2010) found that when young drivers, particularly males, perceived low likelihood of a collision, they were also less likely to report wearing seat belts.

So in summary, whilst young drivers are most in need of wearing a seat belt due to their high collision risk (Ouimet et al, 2008), studies have shown that they are less likely than older drivers to consistently wear one (e.g. Williams et al, 2003). In addition to this when young drivers perceive the risk of not wearing a seat belt to be low they are even less likely to use it (Fernandes et al, 2010) and this appears to be in-line with a reduced perception of risk amongst young drivers, more of which will be discussed later.

1.2.4 Driving at Night and at the Weekend

For drivers of all ages, and controlling for miles driven, the risk of a collision increases over the weekend (Schwing & Kamerud, 1988). However research has shown that driving at night is specifically associated with a higher collision risk among young drivers (Williams, 2006). Whilst only 20% of teenage driving occurs at night-time, more than half of all collisions involving young drivers happen at night (Williams, 2006). Doherty, Andrey and MacGregor

(1998) analysed collision data recorded by police involving a fatality, injury or substantial property damage as a function of the time of day and day of the week on which the collision occurred. Their results firstly concurred with prior literature that 16-19 year old drivers had the highest collision involvement rates, over and above all other age groups, at every time of the day and each day of the week. But their results also highlighted how teenage driver collision rates were disproportionately high on weekends, at night time and with passengers in particular (Doherty, Andrey & MacGregor, 1998).

Studies conducted in various countries have found a consistent and enduring relationship between young drivers' collision risk and night-time driving. Rice, Peek-Asa and Kraus (2009) analysed police collision data where a collision resulted in the severe or fatal injury of 16 and 17 year old drivers in California. They found that for drivers aged 16 and 17, the injury collision rate increased during night-time hours; with particularly high levels of risk between 10pm and midnight. Similarly, Williams and Preusser (1997) noted how of all the miles 16- to-17- year-olds drive, only 15% of these occur between 9pm and 6am; and yet about 40% of their fatal collisions occur during these hours.

In the UK between the years 2000 - 2009, 25.1% of young driver collisions occurred between 9pm and 6am and 24.4% occurred with a 15- to 24-year old passenger in the car (Jones, Begg & Palmer, 2013). Furthermore, data from Australian studies reports that up to 60% of young driver deaths happen at night, with the majority of these (37%) being on weekend evenings (ATSB, 2004). Laapotti and Keskinen (1998) analysed collision data and found that fatal loss of control collisions involving young male drivers typically took place during evenings and nights; and using similar methodology Clarke et al. (2006) found that the casualty rate for teenage males aged 17 – 20 years was the highest of all ages, particularly in the early evening and during the hours of 10pm – 2am. Similarly, Williams (2003) found that both the highest mileage of teenage driving and highest teenage fatal collision rates were between the hours of 9pm and midnight.

There are many possible explanations for this including but not limited to: the increased prevalence of alcohol and drug-impaired drivers during the night time hours, reduced visibility, driver fatigue and the misconception that because the roads are quieter it is safe to drive fast and without careful attention (Brake, 2011). Lowden et al. (2009) examined the performance of young and elderly drivers in a car simulator at night, finding that young drivers were sleepiest, particularly during prolonged driving, whereas older drivers were better able to resist tiredness and maintain driving ability.

Ayuso et al. (2014) found that both novice and experienced (particularly male) young drivers were more likely to have a collision when driving at night and when speeding; suggesting that driving experience does not necessarily protect young drivers from the risk of a collision when speeding during night-time hours. Clarke et al. (2006) analysed more than 3000 collision reports over a 2 year period and found that the collisions involving young drivers during the hours of darkness were not due to a matter of reduced visibility, but were a consequence of how the roads were used by young drivers at night, i.e. for recreational use.

Therefore whilst it is clearly evident that young drivers are at increased risk of having a collision when driving at night (e.g. Jones, Begg & Palmer, 2013); this risk may not be primarily due to reduced visibility or greater fatigue, but through other confounding factors such as lifestyle choices and recreational use of roads during night-time hours (Clarke et al, 2006).

1.2.5 Distraction

Driver distraction is defined as the "diversion of attention away from activities critical for safe driving toward a competing activity" (Lee, Young & Regan, 2008) and distraction can result from both in-vehicle and out-vehicle factors (Sheridan, 2004). Distraction types have been categorized as visual (e.g. reading a map), auditory (e.g. listening to a conversation), biomechanical (e.g. adjusting a satnav) and cognitive (e.g. 'being lost in thought') (Ranney et al, 2000). However as most distractions combine many if not all of these different forms,

researchers often categorize distractions by the task the drivers are engaged in whilst driving, e.g. using a mobile phone (Neyens & Boyle, 2007) rather than the combination of forms themselves.

Driver distraction has been cited as a critical issue leading to road traffic collisions with up to one quarter of collisions predicted to be a result of drivers carrying out non-driving related activities whilst behind the wheel (Young & Regan, 2007). A driver's ability to carry out many of the cognitive aspects of driving such as visual processing of the road, and motor control and response, has been found to be detrimentally impacted when the driver is distracted (e.g. Lee & Strayer, 2004; McPhee, Scialfa, Dennis, Ho, & Caird, 2004). As young drivers are more likely than experienced drivers to partake in distracting activities whilst driving (Lam, 2002) and have a higher number of distraction-related collisions than their older counterparts (Neyens & Boyle, 2007) this appears to be a critical issue to address when considering young drivers over-involvement in collisions.

Young drivers are believed to be at an increased risk of collision whilst distracted because of factors related to both their driving inexperience and behavioural styles of driving (associated with their age). From an inexperience perspective, young drivers have not yet automated the mechanical skills of driving. This means the majority of their attention needs to be focused on recalling the skills required for operating and controlling the vehicle, leaving only a small proportion of their cognitive resources left available for other tasks. So when they do engage in distracting activities they are less able to operate the vehicle in a safe manner (Shinar, Meir & Ben-Shoham, 1998). In addition to this, a young driver's willingness to engage in a secondary task whilst driving, the likelihood of which is associated with their age and personality factors, is also proposed to contribute toward the possibility of distraction and subsequent increased likelihood of a collision (Donmez, Boyle & Lee, 2007). Using camera-equipped vehicles Simons-Morton et al. (2014) analysed the circumstances preceding a sample of young drivers' collisions and near collisions. They found that collision risk increased according to the duration

of their glance away from the road. The longer they spent engaged with the secondary, distracting task, the more likely they were to have a collision.

When assessing driver's reaction times, simple tasks are used requiring drivers to respond as soon as the stimulus is provided; usually by removing their foot from the accelerator pedal (decelerating) and/ or by pressing the brake (Collet et al, 2010). Alm and Nilsson (1995) employed this procedure and found that the time needed to start braking, in response to a lead vehicle braking, was increased by 0.56 seconds when distracted by a secondary stimulus. Other studies have found that reaction times tend to increase from 15% to 40% when participants engage in secondary distracting activities, such as using a mobile phone whilst driving (Horswill & McKenna, 1999).

1.2.6 Mobile phone use: phone calls

Mobile phone use is a widely researched source of driver distraction (e.g. Lesch & Hancock, 2004; Strayer et al, 2003). Using a phone while driving has been suggested to increase a driver's risk of collision because the act involves two tasks competing for limited attention capacity at the same time (Collet, Guillot &Petit, 2010). In one study where collision victims were asked about the details of their collision, and mobile phone companies provided corroborative information regarding phone use, using a mobile phone whilst driving was linked to drivers being four times more likely to sustain collision injuries resulting in hospitalization (McEvoy et al, 2005).

Since 2007, in the UK it has been illegal to drive a car whilst using a hand-held phone (gov.uk). Similar laws are in place in various countries around the world and some have even banned the use of hands-free devices (drivers.com). The laws put in place are in part a result of extensive research from various sources that have found a continued and substantial link between mobile phone use and collision risk (Collet et al, 2010). McEvoy's (2005) case study analysis revealed that a driver's use of a mobile phone within 10 minutes before a collision was associated with a

fourfold increased likelihood of having a collision. Research using questionnaire-based evidence has led to a similar conclusion. Sagberg (2001) for example, had 9000 drivers who had recently reported a collision to their insurance company complete a questionnaire on their driving behaviour. It was found that mobile phones were estimated to be used in 0.86% of collisions, 72% higher than the expected rate (Sagberg, 2001). In addition, Laberge-Nadeau et al. (2003) analysed more than 36,000 questionnaire responses concerning driver behaviour and found that the risk of collision was 38% higher for mobile phone users.

Experimental data has also been instrumental in demonstrating the hazardous nature of using a mobile phone whilst driving. Driving performance in this type of research is often operationalized into two interrelated domains: a) the ability to detect and respond to external stimuli; and b) the ability to keep motor control on a vehicle moving under usual conditions of driving (Collet et al, 2010). Much research has focused on the first of these domains, with researchers most commonly evaluating driver's attention by assessing their signal detection ability and reaction time, where the number of missed targets and longer time to brake is taken as indication that the driver's attention is divided (Collet et al, 2010). McKnight and McKnight (1993) for example, presented participants with a 25-minute video clip containing 45 highway traffic situations. Participants had to observe the video and respond to the situations by manipulating simulated vehicle controls whilst under one of five distraction conditions: placing a mobile phone call, carrying on a casual mobile phone conversation, carrying on an intense mobile phone conversation, tuning a radio and no distraction. McKnight and McKnight (1993) found that all of the distractions led to substantial increases in the proportion of situations to which participants failed to respond; and that the number of non-responses for younger participants was particularly evident when they were partaking in an intense phone conversation.

Similarly a recent naturalistic driving study following the in-car behaviour of a group of adolescent drivers found that over a 6 month period electronic device use was the most common

single type of distracted behaviour they engaged in (Foss & Goodwin, 2014). Young drivers are at a particularly elevated risk of collision whilst using a mobile phone because of their lack of automatic driving skills. It is argued that because they have not yet automated the mechanical aspects of driving, they have difficulty in maintaining steady control of the vehicle whilst their attention is directed toward use of the phone, and are therefore more at risk of having a collision (Neyens & Boyle, 2007).

There is a vast amount of evidence supporting the notion that phoning whilst driving substantially increases the likelihood of a collision (Collet et al, 2010) and the laws that are in place worldwide limiting the use of a mobile phone whilst driving reflects this. However in many countries, including the UK, it is not illegal for people to use hands-free devices whilst driving. Drivers consider hands-free mobile phone use to be safer than hand-held (White et al, 2004) however research such as that conducted by McEvoy et al. (2005) found that using a mobile phone up to 10 minutes before having a collision, was associated with a collision being four times more likely to occur, regardless of whether the device being used was hands-free or handheld. Similarly Nunes and Recarte (2002) found that when the conversations on a hands-free device were more cognitively demanding, drivers' visual detection and response capacities were impeded. Nunes and Recarte (2002) used a driving simulator to test various aspects of participants driving ability whilst they performed several cognitive tasks including phone conversations on a hands-free phone. They found that when the hands-free phone conversations were demanding, drivers' visual processing capacities were negatively affected, whereas when the phone conversations were not too cognitively demanding, very little changes to visual search and processing performance was found. Nunes and Recarte (2002) suggested that the distracting effect of hands-free mobile phone conversations is similar to that of live passenger conversations, but the degree of conversation complexity and type of content will increase the risk of driver distraction.

1.2.7 Mobile phone use: text messaging

Another increasingly studied aspect concerning mobile phone use and its association with collision rates is the effect of text messaging while driving. It is claimed that text messaging may be even more of a distraction than talking on a mobile phone while driving (Lee, 2007) and a recent survey found that up to 92% of young drivers report reading texts while driving, 81% reply to them, and 70% reported initiating them (Atchley, Atwood & Boulton, 2011). A slightly older, more conservative estimate suggests that around 48.5% of drivers between the ages of 18 and 24 text while driving; but this is still substantially higher than the figure of 14.1% for all other aged drivers (American Automobile Association, AAA) (2008). Benson, McLaughlin & Giles (2015) found that young drivers were the age group most likely to report ever having sent a text message while driving and McEvoy, Stevenson and Woodward (2006) found that young drivers are more likely to text and drive than their older counterparts, and so they may be more at risk of the distracting effects of text messaging whilst driving because they are more likely to engage in this activity.

Studies using driving simulators have shown that sending and receiving text messages while driving can affect various aspects of young drivers' driving behaviour (e.g. Crisler et al, 2008; Hosking, Young & Regan, 2009). In Hosking et al.'s (2009) study they found that texting was associated with a 400% increase in young drivers' time spent not looking at the road (compared to a baseline no-texting condition), and missed lane changes increased by 140%. Similarly, Crisler et al. (2008) found that when text messaging young drivers became impaired on lane keeping, speed modulation and steering performance. Drews et al. (2009) extended this procedure, having young drivers follow a vehicle in a driving simulator whilst maintaining a free-form text message conversation with a friend using their personal mobile phone. They found that whilst texting, these participants had slower brake onset times, longer following distances, poorer lane keeping and more collisions. In other studies using driving simulators, evidence suggests that whilst texting, drivers are more likely to spend more time looking inside the car, increase their following distance, miss more lane-change cues and deviate from the lane

more often (Hosking et al, 2009). They also have collisions more often, are more likely to strike a pedestrian, cross centre-lines and have more road edge excursions than controls (Alosco et al, 2012).

There is also some evidence from a naturalistic physical-road study that texting while driving negatively impacts driver behaviour. Owens, McLaughlin and Sudweeks (2011) implemented a steering-wheel controlled text messaging system and observed participants' driving behaviour on a real road as they sent and received text messages whilst manoeuvring the vehicle. They found that whilst texting, drivers had a higher mental demand, conducted more frequent and longer glances away from the roadway, and showed degraded steering ability. Interestingly, older drivers' behaviour was more negatively impacted than the young drivers, perhaps due to less familiarity with texting, however young drivers were also significantly impaired when text-driving, so it is essential that this risk be minimised (Owens, McLaughlin & Sudweeks, 2011).

In addition to this, Atchley et al. (2011) found that young drivers know the risks of texting while driving, and perceive texting to be more risky than talking on the phone, but this awareness does not result in fewer intentions to text while driving. This refutes the idea that young drivers may not be aware how dangerous it is, and rather actively engage in the behaviour irrespective of the potential risks. This suggests that young drivers perceive risks differently and that a general awareness of danger may not translate into actual safer driving. These findings support the body of literature built from driving simulator studies, that texting while driving has serious negative distracting effects on various aspects of driving behaviour. In a recent review of the literature Kinnear and Stevens (2015) identified that texting on a mobile phone while driving is one of the most risky in-car distractions that a driver can engage in, because of the multiple forms of distraction it entails. The authors identified five key areas of distraction that can divert a driver's attention away from the road – cognitive, visual, auditory, manual and exposure time – and showed how texting on a phone leads to a high level of distraction on three of the five areas – cognitive, visual and manual. As younger drivers use text messaging whilst driving more often

than older drivers (AAA, 2008) it is thus logical to assume that text messaging may play a substantial role in their high collision rate.

Although mobile phone use while driving is one of the most widely studied aspects of driver distraction, there are many others that warrant more research. Brodsky & Slor (2013) investigated how background music in the car may influence young drivers' behaviour. They found that whilst listening to their preferred music evoked feelings of positive mood and enjoyment in young drivers, this also resulted in them driving more aggressively and making more errors, misjudgements and violations. As young drivers often cite listening to music as a popular in-car activity, with one study suggesting that music is present in up to 91% of transport experiences (Sloboda et al, 200), this may be a concerning factor influencing their driving behaviour. Similarly, a survey conducted by an insurance brand for young drivers has highlighted how the increasing availability and functionality of mobile phone apps are creating more distractions for young drivers (Ingenie, 2012). Based on responses from 1,000 18 - 25 year olds, they found that up to one third admitted using Facebook whilst driving and up to 18% said they had played games such as Draw Something or Angry Birds while in control of the car. These apps are hugely distracting and take a high level of concentration from the user. Combined with the complex need to control a vehicle and watch for hazards, this puts the young driver at a much higher risk of collision as a result (Ingenie, 2012).

To summarise, young drivers are more likely than older drivers to engage in distracting activities whilst driving (Lam, 2002); and are more likely to have a collision as a result (Neyens & Boyle, 2007). Various in-car distractions have been shown to be linked to young drivers' collision risk; the most widely studied being mobile phone use (McEvoy et al, 2005). When distracted young drivers have slower reaction times (Alm & Nilsson, 1995), longer glances away from the road (Simons-Morton et al, 2014) and missed lane changes (Hosking et al, 2009). Whilst young drivers do understand the risks they tend to report engaging in distracting behaviour regardless (Atchley et al, 2011). Other forms of distraction e.g. listening to preferred

music has also been linked with young drivers committing more traffic violations and aggressive driving (Brosky & Slor, 2013). As Young and Salmon (2012) pointed out research is now needed to draw out the role of causation between driver distraction and driver error.

1.2.8 Driving with Peer Passengers

Young drivers often use driving as a means of socialising with their peers and in this way are more likely to have passengers more often and to have a greater number of passengers per trip than older drivers (Shope & Bingham, 2008). However the presence of peer passengers in the car with a young driver is a key factor implicated in the risky driving behaviour and collision rate of drivers under 21 years old (e.g. Aldridge et al, 1999; Preusser et al, 1998). As previously described, young drivers are more likely to engage in various high risk behaviours when accompanied by peer passengers. For example they are more likely to speed (Moller & Haustein, 2014), drink drive (Bingham et al, 2007), not wear a seatbelt (Williams & Shabanova, 2002) and drive at night and at the weekend (Doherty, Andrey & MacGregor, 1998) when in the car with passengers of a similar age. There is overwhelming consensus in the literature that all of the aforementioned risky driving behaviours that young drivers tend to engage in are even more likely to occur when peer passengers are also present. This suggests that peer passengers are a huge risk factor for young drivers in their own right, and so more research is needed to understand why this is, and how to reduce this risk.

Rice, Peek-Asa and Kraus (2003) analysed police reports for collisions involving 16- to- 17-year- old- drivers and found that driving with passengers was one of the most common predictors of a collision resulting in the driver being seriously or fatally injured. Not only are collision rates higher for teenage drivers accompanied by teenage passengers, but these collisions are also more likely to be judged the fault of the young driver as well (Williams, 2003). For example, Preusser, Ferguson and Williams (1998) analysed data from the Fatality Analysis Reporting System (FARS) system for a period of 5 years and found that the presence of passengers was implicated in proportionately more at-fault fatal collisions for drivers under

the age of 24; whereas for drivers aged 25 and over the presence of passengers was at worst neutral, and at best a protective factor against at-fault collisions. The highest level of risk was found for teenage drivers travelling with 2 or more teenage passengers at any time of the day or night.

Preusser et al. (1998) found that it was similar-aged passengers that pose the greatest risk for young drivers' involvement in an at-fault collision. Ouimet et al. (2010) investigated this notion further, using data from FARS and the US National Household Travel Survey to identify the characteristics of certain passenger types associated with young drivers' high collision risk. Their results indicated that whilst young drivers were most at risk when accompanied by teenage passengers (particularly male teenage passengers); their collision risk was much reduced when in the presence of adult passengers. Similarly Simons-Morton et al. (2011) employed recording systems to collect data on young drivers' driving performance and passenger presence during their first 18 months of licensure. They found that collision/ near collision rates for young novices were 75% lower in the presence of adult passengers but 96% higher among teenagers with risky friends. The authors suggested that the low rate of risky driving when accompanied by adult passengers was indicative that teenagers have the ability to drive in a safe manner; but that when they are in the presence of risky friends, social influence may result in much higher rates of risky driving.

Ouimet et al. (2014) conducted a systematic review of the literature concerning the presence of peer passengers and their effect on young drivers' collision risk. They found that there was a clear, consistent increased risk for passenger presence in particularly fatal collisions, even when the young driver was accompanied by only one passenger. Similarly, Williams, Ferguson and McCartt (2007)'s review found that in 2005, 61% of teenage passenger deaths occurred in cars driven by other teenagers, and 42% of 16- and 17- year-old drivers in fatal collisions were accompanied by other passengers with no adults present (Williams, Ferguson & McCartt, 2007). Further to this, studies using other research methods have also found a clear and consistent link

between passenger presence and young drivers' risky driving. Rhodes, Pivik and Sutton (2015) found that when young males were accompanied by a passenger they drove faster than when alone. Speeding was particularly evident when they were in a happy mood and accompanied by a passenger, suggesting that both mood and passenger presence were factors influencing young males' decision to speed.

In addition to this, male peer passengers have been found to have the greatest negative effect on young drivers' risky driving. Simons-Morton et al. (2005) observed young drivers' actual driving behaviour when exiting high school car parks in the presence of passengers or when alone. They found that teenage drivers drove faster than the general traffic and allowed shorter headways, particularly when accompanied by a male teenage passenger. Interestingly, whilst both male and female teenage drivers allowed shorter headways whilst in the presence of a male teenage passenger, when male teenage drivers were accompanied by a female teenage passenger, they allowed greater headways. Those most at risk were found to be male teenage drivers accompanied by male teenage passengers; wherein the observed rate of high risk driving was found to be double that of general traffic (Simons-Morton et al, 2005). Similarly, by analysing collision report data Chen et al. (2000) found that both male and female young drivers were most at risk of a fatal collision when accompanied by male passengers; and this was evident irrespective of the time of day that the collision occurred.

It has been suggested that susceptibility to peer influence, and greater affiliation with risk-taking peers may explain some of the heightened risk associated with young drivers and their peer passengers. Mirman et al. (2012) investigated factors associated with young drivers' likelihood to drive with multiple passengers and to engage in risky driving behaviours. They collected survey data from a sample of young drivers and found that young drivers with greater perceptions of risk, and who had parents perceived as being strong rule setters, were less likely to engage in risky driving and reported less often having multiple passengers. In comparison, the drivers who reported greater sensation seeking tendencies were more likely to drive with

multiple passengers and engage in risky driving behaviours (Mirman et al, 2012). Similarly Ouimet et al. (2013) used a driving simulator to investigate how young male drivers' behaviour differed when in the presence of a peer passenger. They found that when accompanied by a male passenger, the male drivers' attention on the road was affected, with them making fewer eye glances at hazards. Similarly when drivers reported higher tolerance of deviance and higher susceptibility to peer influence they were also more likely to initiate early left turns into steady streams of oncoming vehicles. Not all the results followed this pattern however, and there was some evidence that even when accompanied by risk-accepting passengers some drivers maintained a safe course of action. Further investigation into the role peer influence has on young drivers' propensity to take risks will be considered later.

In conclusion, driving with passengers is a factor consistently found to be implicated in young teenage drivers' engagement in high-risk driving and subsequent over-representation in collisions (Doherty, Andrey & MacGregor, 1998; Mirman et al, 2012). Whilst the presence of an adult passenger is found to reduce collision risk (Ouimet et al, 2010; Doherty, Andrey & MacGregor, 1998), when young drivers are accompanied by teenage male passengers they are most at risk of having a collision and being critically or fatally injured (Simons-Morton et al, 2005; Rice, Peek-Asa & Kraus, 2003).

1.3 Adolescents and Risk Taking

The research outlined above demonstrates how young drivers tend to engage in a lot of risk-taking behaviour, which in turn increases their collision risk. The apparent increase in risk taking observed through late adolescence and early adulthood is the subject of many theories attempting to explain it. For example Steinberg et al. (2008) proposed a dual neurobiological model consisting of two distinct systems: socio-emotional and cognitive-control. They argued that the socio-emotional system develops early, and quickly, peaking around mid-adolescence, and leads to heightened reward sensitivity. The cognitive-control system, on the other hand, matures more slowly resulting in a delay in the onset of impulse control and behavioural inhibition. Steinberg et al. (2008) suggested that the discrepancy between the maturation of the two systems leads to a heightened vulnerability to risk taking in middle adolescence (from early teenage years to young adulthood) when there is a greater desire to seek rewards, and a still relatively immature capacity for self-control.

Behavioural Decision Theory (Beyth-Marom & Fischoff, 1997) takes a slightly different approach in explaining adolescents' increased risk taking. Behavioural Decision Theory suggests that when making a decision, individuals consider all possible consequences for each potential decision outcome, and then integrate the costs, benefits and likelihood of each consequence, when making their final decision. Thus from this perspective, adolescents may perceive their risk taking as rational, because they believe the benefits of a particular risky action to outweigh any potential costs (Reyna & Farley, 2006). In the context of driving, despite warnings that they are at an increased risk of having a collision if they speed, if the driver doesn't think they will personally be involved in a collision they will speed anyway. This was found by Stead et al. (2005), who suggested that speeding does not hold the same stigma as for example, drink driving, and is accepted by the majority of drivers.

Fuzzy Trace Theory (FTT, Reyna & Brainerd, 1995; 2011) has been found to successfully explain adolescents' and adults' risk taking in various contexts. FTT posits that there are two different forms of mental representations that individuals use when making risky decisions. Verbatim representations are based on specific details of events or judgements using exact, quantitative information. Gist representations are based on the meaning associated with events which create intuitive, qualitative representations. These representations can be influenced by an individual's culture, emotional state, experience and knowledge (Reyna & Farley, 2006). Our ability to use both forms of reasoning when making general decisions increases with age from childhood through to adulthood.

According to FTT most adults tend to consider risk using gist representations. For example Reyna & Farley (2006) argued that when adults make judgements, they get the gist of the level of risk they face, based on the risk avoidant principles they have acquired from memories of past behaviours and experiences. In this way, adults' rates of risk taking are substantially reduced, as they tend to adopt a general "avoid risk" approach. For example, when deciding whether or not to speed, older adults with more years of post-test driving experience will have knowledge and awareness of many incidents of near-miss and actual collisions. Thus when making their decision, with many more negative incidents in their memory to recall, they are more likely to avoid speeding, and drive in a general risk avoidant manner.

Conversely, FTT suggests that the risk perceptions and risk taking behaviours of adolescents differs from those of adults. Whilst adults are believed to consider risk using mostly gist reasoning, FTT proposes that in addition to a gist approach, adolescents have higher sensation seeking tendencies and lower impulse control. This means they are more likely to query the specific pros and cons of particular actions, therefore also using verbatim representations when considering risk. For example if a young driver was to use gist representations when deciding whether or not to speed they might think about the fact that one in five new drivers in the UK has a collision within six months of passing their test (DfT, 2008a). However young drivers are

less likely to consider risk in this way, and instead may be more likely to ask themselves: Have I sped above the speed limit before that did not result in bad consequences? Do I have any friends that speed, that have not had anything bad happen to them? Do I know anyone who has had something bad happen to them while they were speeding? Thus while adolescents get the gist of the risky situation they are more likely to consider specific instances (or lack of) where negative consequences occurred. In this way they display a tendency to use verbatim representations, which can result in increased risk taking when their limited personal experiences do not inform them of the high risk they face (Reyna & Brainerd, 2011). Equally, adults' relatively more common use of gist reasoning reduces their risk taking behaviour, leading to the discrepancy in level of risk acceptance during the transition from childhood to adulthood (Reyna & Farley, 2006).

Taken together these theories suggest that young people differ from older adults in how they assess risk and decide on risk-taking behaviour. This is in line with evidence suggesting that there may be certain personality characteristics particularly associated with adolescence that may help to explain why young drivers' engage in heightened risk-taking. Detailed below are some of the common personality factors associated with adolescence that have also been implicated in their risk-taking behaviour.

1.4 Common Youth Personality Factors

Personality factors, driving behaviour and decision making processes are universally understood to contribute to collision involvement (Grayson & Maycock, 1988). Sabey and Taylor (1980) analysed more than 2000 traffic collisions to determine what influenced their occurrence, and personality factors were found to be involved in 95% of them. Researchers are beginning to consider the role of psychosocial characteristics such as personality traits and susceptibility to social influence, in order to understand why young drivers may engage in risky driving behaviours to a greater extent than older drivers (Scott-Parker et al, 2013). Ulleberg and Rundmo (2003) found that personality traits have an indirect effect on young drivers' risk taking behaviour through their influence on attitudes toward road safety. High scores on certain personality traits were associated with risk-taking, negative attitudes toward road safety and in turn, higher self-reported risky driving behaviour. Therefore more research is now being conducted to investigate how personality factors are related to young drivers' heightened risk.

1.4.1 Sensation Seeking

Sensation seeking refers to "the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experiences" (Zuckerman, Kolin, Price & Zoob, 1964). A high sensation seeker is an individual who "feels a heightened need for different experiences, actively seeks thrill and adventure experiences, is disinhibited and easily bored" (Thombs et al, 1994). It is defined as a personality trait, and therefore there are individual differences in the level of sensation seeking people seek as their optimal degree of arousal and stimulation (Zuckerman, 1994, 2007). Sensation seeking is most often measured using the Sensation-Seeking Scale (SSS, Zuckerman, 1994); a 40-item questionnaire based on four subscales: Thrill and Adventure Seeking, Experience Seeking, Disinhibition, and Boredom Susceptibility.

High levels of sensation seeking have found to be related to increased risk-taking across a range of health behaviours. Jonah (1997) conducted a review of the literature concerning sensation seeking and risky driving, finding that in the vast majority of studies reviewed (36 out of 40 studies) there was a positive relationship between the degree of sensation seeking reported and engagement in one or more dimensions of risky driving (e.g. non-use of seatbelts, speeding etc). Jonah, Thiessen and Au-Yeung (2001) used Zuckerman's (1994) SSS to report results in line with those previously found. They showed how self-reported high sensation seekers were more likely than low sensation seekers to speed, not wear seatbelts, drive after drinking, be aggressive whilst driving and perceive a low risk of detection for impaired driving (Jonah, Thiessen & Au-Yeung, 2001).

Research has also found a clear and consistent link between adolescents and the motivation to seek sensation, with one study reporting that sensation seeking tends to rise between the ages of 9 and 14, peaks at age 20 and declines steadily after that (Zuckerman, 1994). Similarly, Giambra, Camp and Grodsky (1992) reported sensation seeking tendencies decreasing with increasing age. Young people that score high on sensation seeking scales are found to be more likely to engage in high risk driving behaviours (Delhomme, Chaurand & Paran, 2012);and in turn, risky, aggressive driving is considered to be a prominent factor implicated in young drivers' high collision rate (Reason et al, 1990). For example, Arnett (1996) had high school and college students complete questionnaires on a range of behaviours considered 'reckless' and found that sensation seeking was a predictor of reckless driving in adolescents. Furthermore, Machin and Sankey (2008) used questionnaire measures to investigate the relationship between young drivers' personality characteristics, risk perceptions and driving behaviour. They found that young drivers who reported higher levels of excitement-seeking, lower levels of altruism and lower aversion to risk taking were more likely to report greater speeding than those who did not display these characteristics.

Similarly, Cestac, Paran and Delhomme (2011) had more than 3000 young drivers with varying levels of driving experience complete the Mobility, Attitudes, Risk and Behaviour (MARC) survey to investigate factors influencing young drivers intention to speed. They found that sensation seeking had the greatest impact on young drivers in general, and specifically males', intentions to speed (Cestac, Paran & Delhomme,2011). Scott-Parker et al. (2011a, 2013) had young drivers complete questionnaires on a wide range of personality trait and state measures (including sensation seeking, reward sensitivity, anxiety and depression), aiming to determine which factors best predicted young drivers' involvement in risky driving behaviours. The results consistently indicated that sensation seeking and anxiety predicted the engagement of risky driving amongst a sample of young drivers, with gender acting as a moderator: reward sensitivity predicted only males risky driving, and anxiety particularly influenced young females' involvement in risky driving (Scott-Parker et al, 2011a, 2013).

Some recent research has identified that attitudes may mediate the effect of sensation seeking on young drivers' desire to engage in risky driving behaviours (Ulleberg & Rundmo, 2003). In this study nearly 2000 adolescent drivers completed a questionnaire referring to their risk perception, attitudes toward road safety and self-reported risk taking on the road, with measures of personality including aggression, anxiety, sensation seeking etc. It was found that the young drivers scoring high on sensation seeking, normlessness and aggression measures were also more likely to report having risk-taking attitudes (i.e. negative attitudes toward road safety) and risky driving behaviour. Further to this, it was also suggested that the personality traits (i.e. sensation seeking) primarily had indirect effects on risk-taking behaviour through their influence on the young drivers' attitudes toward road safety (Ulleberg & Rundmo, 2003).

Jonah (1997) proposed two potential explanations for why young drivers may be particularly influenced by their level of sensation seeking in conducting risky driving behaviours. One possibility is that sensation seekers may not perceive some driving situations as risky because of their exaggerated confidence in their driving skills, and thus reduced worry for safety. In this

case, when negative consequences do not follow from their risk taking, this would act as a form of positive reinforcement, affirming their 'skills' and further decreasing their perception of risk, resulting in even more risk-taking (Rosenbloom, 2003). Jonah's (1997) second proposed explanation is that sensation seekers do see and acknowledge some driving situations as risky but accept that risk so that they can experience the thrill.

Recent research by Delhomme et al. (2009b) provides support for this second explanation. Using a sensation seeking scale adapted specifically for driving, they found that sensation seekers are aware of the risks they take but accept these risks in order to gratify their want for sensation (Delhomme et al, 2009b). Hatfield et al.'s (2014) findings are also in line with this idea, as low thrill and adventure seekers were less likely to drink drive, or not wear a seat belt because they perceived there to be higher risk associated with these behaviours. In this study participants completed a series of self-report measures related to their personality and driving behaviour, including the thrill and adventure seeking sub-scale of Zuckerman's (1994) sensation seeking scale. They found that thrill and adventure seeking moderated the relationship between perceived risk and risky driving for drunk driving, driving while fatigued and not wearing seat belts in a sample of young, Australian drivers. For low thrill and adventure seekers, higher perceived risk was associated with lower levels of drunk driving, driving while fatigued and wearing a seat belt more frequently. In this way, for those who were low in thrill and adventure seeking, perceived risk worked as a deterrent for risky behaviour. These findings suggest that sensation seeking does not only have an effect on risky driving for high sensation seekers, but rather it also affects low sensation seekers in that they then seek to avoid risk.

The research outlined above suggests that not only are adolescents and young adults likely to score high on measures of sensation seeking (Zuckerman, 1994; Giambra, Camp & Grodsky, 1992); but young people scoring high on sensation seeking tend also to report engaging in risky driving behaviour (Delhomme, Chaurant & Paran, 2012). As risky driving is known to be a factor implicated in collisions, these young, high sensation seekers are considered to be at an

increased risk of having a collision, when compared to older, low sensation seekers (Reason et al, 1990).

1.4.2 Optimism Bias

Another age-related factor associated with young drivers' increased risk is their distorted perception of risk. It is suggested that young novice drivers tend to underestimate the level of risk present in potentially hazardous situations whilst simultaneously overestimating their driving skills. Combined, this forms the notion of their having an optimism bias: an inaccurate perception of risk on the road, and increased chance of collision (Deery, 2000).

The term risk perception refers to the subjective experience of risk in driving situations where potential traffic hazards are present (Deery, 2000). An individual's perception of risk while driving is believed to play an important role in their safety (Gregersen, 1996). Brown and Groeger (1988) suggested that risk perception is determined by the information available to the driver regarding the potential hazards in the roadway environment (hazard perception), and the perceived ability of the driver him/herself to prevent those potential hazards from resulting in actual collisions.

Finn and Bragg (1986) found that young drivers consistently rated specific driving situations, illustrated in both static images and video clips, as less 'risky' than more experienced drivers. Several methods were used to assess how drivers of different ages differed in their risk perception of certain driving situations. Participants answered questionnaires about their prior involvement in collisions, and rated the riskiness of specific driving situations illustrated in both still images and short video clips. Young drivers tended to perceive their risk of being involved in a collision as substantially lower than older drivers, and this was evident across a diverse range of contributory factors such as tailgating, speeding, driving at night, driving on a snow covered road and driving after drinking. Further to this, not only did young drivers perceive that they were at a lower risk of collision compared to older drivers, but they also perceived that they

were less likely to have a collision than their own peers (Finn & Bragg, 1986). This finding supports the idea that young drivers underestimate risk (DeJoy, 1989, Weinsten, 2003) and have a perceived superiority of driving skills (Matthews & Moran, 1986); which when combined form the notion of an optimism bias.

Matthews and Moran (1986) employed a similar methodological procedure to Finn and Bragg (1986); comparing the responses from young (18-24 years old) and older (35-50 years old) male drivers on questions of collision risk and driving ability, where they had to rate the riskiness of various driving situations depicted in video clips. They found that younger drivers perceived that they had a much lower risk of being involved in a collision than their peers, rated their driving skills as superior to their peers and equal to more experienced drivers, and believed that their reflexes were better than older drivers. In this way the younger drivers perceived their risk of being involved in a collision as substantially less likely when compared to their peers and older drivers alike; and it was suggested that drivers' interpretation of their driving ability influenced their risk perception which in turn impacted on their driving behaviour (Matthews & Moran, 1986; Deery, 2000).

Further support for the idea that young drivers have a reduced perception of risk than older drivers comes from Trankle, Gelau and Metker's (1990) study. Male and female drivers of varying ages rated the collision risk of traffic situations contained within still images. Young male drivers were found to consistently rate a lower risk of a collision than their older counterparts; were more accepting of risky driving situations and rated situations as risky much less often than older drivers. On the basis of these findings and further supporting literature, Trankle et al. (1990) suggested that young drivers may have poorly developed driving skills and require further training specifically targeting their low risk perception and acceptance of high risk situations, to help reduce collision risk amongst the young driver population.

Rundmo and Iversen (2004) evaluated an educational campaign promoting safe driving finding that young drivers aged between 18 – 24 years demonstrated a change in their risk perception and actual driving behaviour following involvement in the campaign. Rundmo and Iversen (2004) showed how these drivers were able to perceive risks much more than at the beginning of the intervention and reported fewer occasions of risky driving events following the campaign. These findings show how novice drivers may require additional training in risk perception following learning of the basic mechanical skills of driving, in order to develop the skills required for accurate risk perception.

Another study explored the effects of driving experience on risk perception. Borowsky & Oron-Gilad (2013) compared the eye movements of young novices, experienced and commercial drivers in a series of hazard awareness tasks – both in real-time and with the use of hindsight. The study found that young drivers were less sensitive to hidden hazards than older drivers, and when evaluating the risk of hazards in real-time scenarios, young novices tended to base their risk perception on the severity of the collision outcome, rather than on the likelihood of the collision. Older, more experienced drivers tended to use both components, and when using hindsight, young drivers also used both components to evaluate the level of risk they faced. Although this study confounded age and inexperience by only using a young-novice group (and not an appropriate older-novice or younger-experienced group), it does provide evidence that "in the moment" young drivers may use less sophisticated measures of risk perception than their older counterparts.

In conjunction with their tendency to underestimate the level of risk posed by the roadway environment, evidence suggests that young drivers might not be particularly accurate when assessing their own level of driving skill (OECD – ECMT, 2006). It is suggested that they tend to overestimate their driving skills, and combined with their reduced risk perception this forms an optimism bias that may have an influence on their high collision risk (Gregersen, 1996). Also referred to as the self-enhancement bias (Brown, 1986), the traditional approach to studying its

existence is to use a questionnaire that asks drivers to compare their skills with the 'average driver'. Using this procedure, Dejoy (1992) for example, found that in a sample of 136 young drivers, 93% of males and 75% of females rated themselves as a more skilful driver than their peers.

There is general consensus in the literature that young drivers have a less accurate perception of their ability, and tend to overestimate their skill to a greater degree than older drivers (OECD-ECMT, 2006). Many studies have replicated these findings (Dejoy, 1992; Gosselin et al, 2010 etc); however some results suggest that drivers in general, regardless of age, tend to rate themselves as better drivers than the average driver (e.g. Mccormick et al, 1986; McKenna et al, 1991). For example Mayhew and Simpson (1995) examined the findings from a wide range of studies into driver's assessment of skill, and observed that some studies found young drivers did not display elevated assessment of their skill; and rather often expressed less overconfidence than older drivers.

Similarly in naturalistic research, Mynttinen et al. (2009) compared novice driver's self-assessed competence with assessments made by their driving examiners and found between 40% and 50% of the novices made realistic assessments of their driving skills. Between 30% and 40% tended to overestimate their competence; however the younger novices were not found to be more overconfident than older novices; suggesting that overestimating one's driving skills may not necessarily be a 'young driver' problem so much as more generally a 'novice driver' tendency (Mynttinen et al, 2009).

Grayson and Elliott (2004) reported data from the Cohort II study, wherein they found that young drivers reported variable levels of confidence, depending on how long they had held their driver's license. The Cohort II study was a large-scale initiative that recruited several thousand people who had just taken their driving test. Over their first two years of fully-licensed driving they completed questionnaires reporting their attitudes and opinions of their own driving skills,

collisions and driving offences they had committed. Several interesting findings were reported concerning young drivers' self-assessment of their own ability. Grayson and Elliott (2004) found that immediately after passing their driving test, young drivers tended to report themselves as being very confident in their driving ability. Six to twelve months after passing, their confidence levels substantially decreased, presumably because with the additional post-test experience they had gained a more realistic view of the roadway demands, and their relative lack of driving knowledge. However it is also worth noting that whilst new drivers of all ages appeared to show this initial peak of confidence followed by a drop, only young drivers then increased in confidence quite substantially after the twelve month post-test mark. This self-assessed over-confidence appears misplaced when considered in association with other findings from the Cohort II study; specifically that young drivers reported making many more slips, lapses and violations than older drivers; and considered themselves substantially less attentive, careful, responsible and safe, less patient, considerable and tolerant, and more decisive and fast than their older counterparts (Grayson & Elliott, 2004).

De Craen et al. (2011) found support for the notion that young drivers tend to overestimate their driving skills, but only when compared in relation to their actual driving behaviour. Young novice drivers (with a mean age of 20 and only two weeks post-driving test experience at the beginning of the study) and older, more experienced drivers (with a mean age of 41 and at least 10 years driving experience) completed questionnaires over a two-year period and participated in an on-road driving assessment. De Craen et al. (2011) found that young novice drivers were not more likely than experienced drivers to over-estimate their skills, with the older drivers actually showing a tendency to perceive themselves as better than 'the average driver'. However when their self-assessed confidence ratings were compared with their driving behaviour from the on-road assessment, it was found that their skills were rather less developed than they had assumed. Therefore it was suggested that although young drivers recognise that they are not yet as skilled as the average driver, they do still tend to overestimate their driving skills more than experienced drivers (De Craen et al, 2011).

Attempts have been made to reduce young drivers tendency to display an 'optimism bias' and there are varying degrees of support for the idea that by improving their own awareness of their skill deficits in more dangerous driving situations, novices may then be more accurate in assessing their ability. In one of the first studies to address the idea that young drivers tend to overestimate their driving skill, Gregersen (1996) had learner drivers complete one of two training strategies aimed at reducing their degree of overestimation of abilities. In the 'skill' group learners were given intensive tuition to improve their overall braking and avoidance manoeuvre techniques in critical situations. The 'insight' group were told their skill in braking and avoiding collision in dangerous situations may be limited and unpredictable. Both groups had to estimate their perceived ability and then carry out an actual driving task, where it was found that novice drivers in the 'skill' group tended to estimate their skill level as being higher than the novices in the 'insight' group; however there was no difference found between the groups on their actual driving ability. Therefore Gregersen (1996) suggested that after receiving extra skill training, novice drivers tend to falsely overestimate their driving ability to a greater degree than drivers receiving other types of training. This has potentially crucial implications for the types of training provided for learner drivers, and the importance of reminding them of their own skill deficits.

The evidence highlights how young drivers often underestimate the level of risk they face on the road (Finn & Bragg, 1986; Weinstein, 2003) and have a perceived superiority of driving skills (Matthews and Moran, 1986). Whilst this is often baseless, for example they tend to use less sophisticated strategies when searching for and interpreting risk (Borowsky & Oron-Gilad, 2013) they also often rate themselves as being better at driving than both older drivers and their own peers (Finn & Brag, 1986). Taken together it is therefore logical to assume that young drivers' risk is elevated by a combination of overconfidence in their own driving skill and underestimation of potential hazards in the road environment, leading to an optimism bias whilst driving.

1.4.3 Susceptibility to Peer Influence

It has previously been discussed that the presence of older passengers and younger siblings may be protective against young drivers' collision risk (Lee & Abdel-Aty, 2008). However the presence of same-aged passengers has been found to be one of the key factors associated with their high collision risk (Lin & Fearn, 2003). The reasons why peer passengers pose such a risk to young drivers are still relatively unclear, but as it has been suggested that adolescents are more susceptible to peer influence than other age groups (Steinberg, 2004), it might be that young drivers are influenced by their peers to drive in a certain way.

High susceptibility to peer influence has been linked to various measures of risky driving amongst young people. Scott-Parker, Watson and King (2009) had participants complete questionnaires measuring the types of driving behaviours they engaged in and 'thrill seeking' variables, finding that social norms and affiliation with risk-taking peers was associated with more risky driving. Similarly, Simons-Morton et al. (2011b) investigated newly licensed teenage drivers, recording their driving performance and passenger characteristics over the first 18 months of licensure, and found that their likelihood of engaging in risky driving was predicted by the number of their friends who carried out risky driving behaviours. Further research by Scott-Parker et al. (2014) found that young drivers who perceived their friends to be risky drivers and also reported 'patterning' their friends' driving i.e. modelling their own driving behaviour on their friends' style of driving, also reported engaging in more risky driving themselves.

There has been some disagreement over the impact peer influence may have on certain risky driving behaviours. For example Fernandes et al. (2010) found that peer influence was associated with young drivers' likelihood of driving under the influence of alcohol, but not speeding. However recent longitudinal research conducted by Simons-Morton et al. (2011b) found that peer influence did predict the prevalence of speeding among a sample of teenage

drivers. They collected survey data concerning participants' driving behaviours and susceptibility to peer influence and measured their speed using recording systems installed in their cars. They found that speeding was associated with young drivers' susceptibility to peer influence, number of risky friends, tolerance of deviance, substance use and higher sensation seeking. The perception of risk acted as a mediator between the relationship of speeding and risky friends; with the authors suggesting that having risky friends reduced perceptions of risk about speeding, and lower risk perceptions were then associated with more speeding (Simons-Morton et al, 2011b).

Similarly, Moller and Haustein (2014) found that the perceptions young males had of their friends' speeding was the biggest predictor of their own speeding behaviour. They also found that for younger males (18 years old) peer influence socialised them into increased speeding, whereas for older males (28 years old) peer influence was just a means to maintain or justify their existing speeding behaviour. Moller and Haustein (2014) therefore suggested that peers differentially influence younger and older males, and that adolescent 18-year-old males are vulnerable to being coerced into driving more dangerously.

The impact of peer influence has also been found to interact with other psychosocial factors such as sensation seeking tendencies. Kim and Kim (2012) investigated personality and socio-psychological factors associated with individuals who choose to ride in a vehicle with an alcohol-impaired driver (RAID). They had adults from 20 – 66 years of age complete survey questionnaires and found that the three major predictors of RAID involvement, particularly for younger drivers, were sensation seeking propensity, perceived peer influence, and frequent harmful drinking (Kim & Kim, 2012). In addition to this, a recent study has found evidence supporting a neural basis for susceptibility to peer influence and risk taking in adolescence (Falk et al, 2014). In this study young drivers' neural responses to social exclusion predicted an increase in simulated risk taking behaviour in the presence of a peer one week later. These

results suggest that young drivers may consider risky driving an appropriate way to reassert their position within a social group if they are feeling marginalised.

Research into substance use by teenagers has shown how indirect peer influence, i.e. adolescents' own perceptions of how they assume their peers wants them to behave, influences their likelihood of engaging in risky behaviours (Simons-Morton & Farhat, 2010). Indirect influence can be exerted in many different ways; for example through modelling or acting in accordance with certain social norms that are perceived to be acceptable and expected by their friends and peer group. Direct influence, on the other hand, refers to observable encouragement or persuasion to behaviour in a certain way, including verbal or otherwise means of expression (Allen & Brown, 2008; Sarkar & Andreas, 2004).

There is inconclusive evidence on whether indirect 'passive', or direct 'active' forms of peer influence play a greater role in encouraging young drivers to be risky. Sela-Shayovitz (2008) found that indirect, passive forms of influence, transmitted via social norms and the drivers' own perception on how he/ she should drive, were related to more self-reported driving violations by young drivers. Similarly Ouimet et al.'s (2013) simulator study found that the mere presence of a male teenage passenger in the vehicle with a male teenage driver was enough to reduce their attention to the road. Even in the absence of any overt pressure or encouragement to drive dangerously, when young male drivers were accompanied by a similar-aged male passenger they were more likely to make less eye glances at hazards. Not all evidence follows this pattern however, as Horvath et al. (2012) found that direct, active verbal encouragement by peer passengers had just as much effect on young drivers' intentions to commit driving violations; and in fact driving alone resulted in greater intentions to speed than when with peer passengers.

The idea that young people engage in risky driving when with peer passengers to be in accordance with their peer groups' norms has been the subject of further recent study.

Guggenheim and Taubman-Ben-Ari (2015) investigated the relationship between risky driving and the nature of young people's friendship groups by conducting several in-depth interviews with young drivers. They found that whilst safe driving was related to utilitarian aspects of friendship (responsibility, concern for others, practical interactions); those whose friendships were based on aspects of pleasure e.g. spending leisure time together, were more likely to report risky and distracted driving. This was particularly evident for young male drivers (17-19 years of age). Similarly further research by Taubman-Ben-Ari et al. (2015) found that in addition to parental influence on young people's risky driving, perceived popularity of risky driving among peers was associated with higher levels of reported risky driving.

These results suggest that the nature of young people's friendships has an impact on their driving behaviour. Interventions that foster features of utility e.g. responsibility and concern for others, may help to reduce young drivers' risk. This idea has been developed by Buckley and Davidson (2013) who developed a psychosocial theoretical model of prosocial behaviour, concerning the characteristics of peer passengers willing to intervene in their friends' unsafe driving. They found that the strongest predictor of intervention was expectations from peers, and they suggested this supports the idea that young people may try to conform to the behaviour of the peers in order to gain social acceptance.

Thus it appears that engagement in both risky (e.g. Guggenheim & Taubman-Ben-Ari, 2015) and safe (e.g. Buckley & Davidson, 2013) driving is influenced by how young drivers perceive their peer passengers want them to drive. Whilst research into substance use by young people suggests that indirect peer influence plays a greater role in their risky behaviour (Simons-Morton & Farhat, 2010), it is still relatively unclear how young drivers are influenced by their peers to drive in a dangerous way.

1.4.4 Conclusion

In conclusion, the review presented above highlights the areas in which young, novice drivers appear to be deficient and vulnerable. Research has shown how young drivers display limited visual search strategies (Underwood, 2007), reduced automaticity when in control of a vehicle (Chapman & Underwood, (1998); and less well developed hazard perception skills (Pollatsek et al, 2006). Whilst skill-based deficits may explain young drivers' collision involvement to a certain extent, their heightened risk when compared to older new drivers suggests that there are other risk factors that require consideration as well.

Young drivers are more likely to engage in several high risk behaviours that in turn increase their chances of a collision. These include: speeding (Simons-Morton et al, 2005), drunk driving (Zador et al, 2000), non-use of seatbelts (McCartt & Northrup, 2004), driving at night, at the weekend and with peers (Williams, 1985; Ouimet et al, 2010); and engaging in distracting activities whilst in the car (Lam, 2002). It is important to understand what it is about young drivers' 'age' that puts them at such risk, and so personality factors that may increase their propensity for risk-taking behaviour were also considered. These include a desire to engage in sensation seeking activities (Delhomme, Chaurand & Paran, 2012), heightened sensitivity to peer influence (Scott-Parker, Watson & King, 2009); and an optimism bias comprised of reduced risk perception and overestimation of skill ability (OECD-ECMT, 2006).

The diagram in Figure 1.2 summarises how the factors described in this review may underpin young drivers' risky driving and provides a framework for understanding the linkages between the contributory factors. The evidence reported so far has been primarily acquired through laboratory studies, simulation experiments, and analysis of police collision report data. Another way to explore the determinants of young drivers' risk-taking is by evaluating current young driver interventions. These interventions are delivered to young drivers in the hope that by educating them about the risks of dangerous driving this will then lead to an improvement in their subsequent driving behaviour. By reviewing the findings from evaluations of previous

interventions, and exploring what does and doesn't work in a current intervention, we will be able to better understand why young people engage in risk-taking behaviours. We will turn to this in the next chapter.

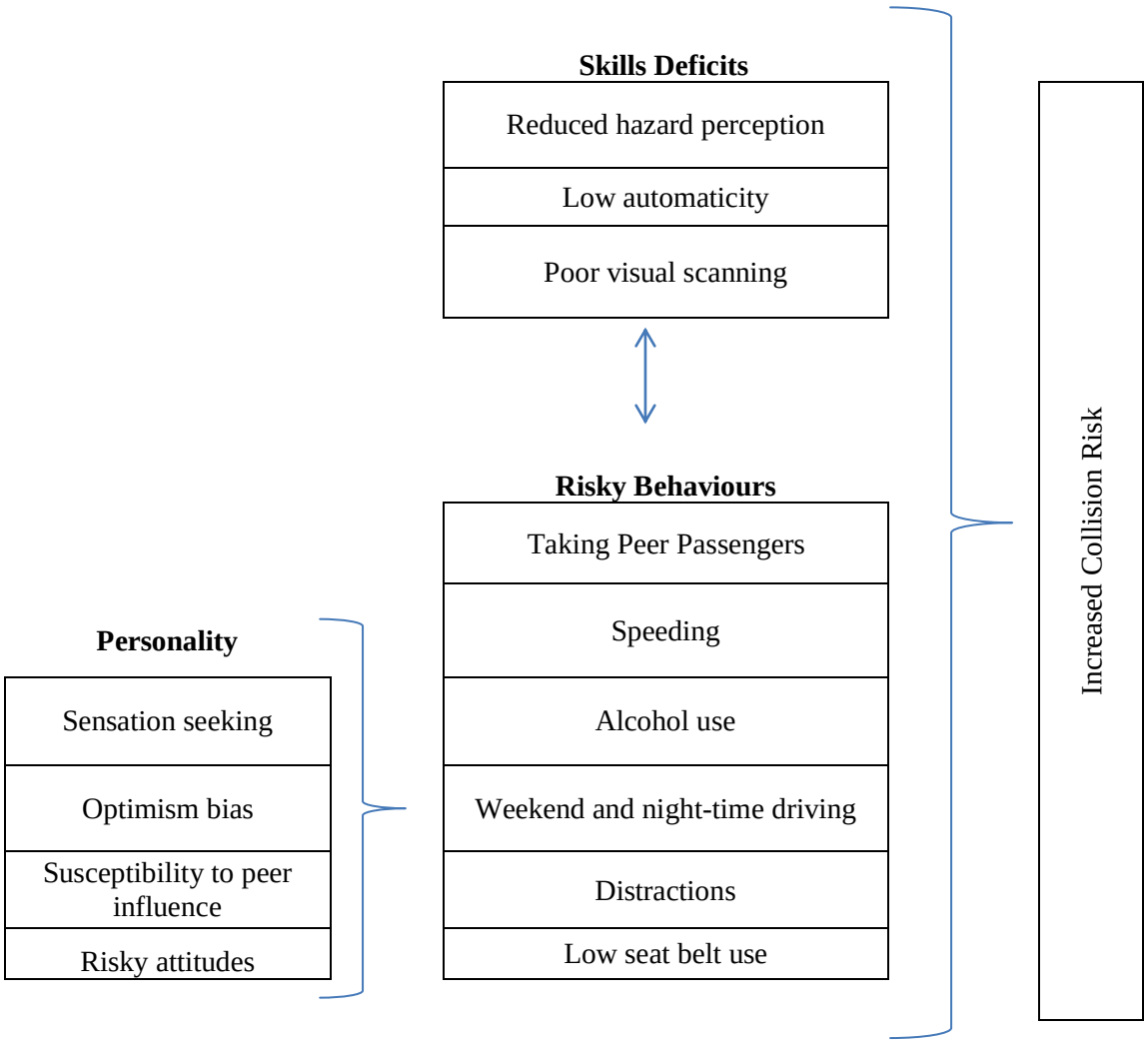


Figure 1.2. Factors thought to underpin young drivers' increased collision risk

Chapter Two

Study One: Longitudinal Evaluation of the Learn2Live Road Safety Intervention for Young People

2.1 Introduction

Research has explored the extent to which age-related factors versus skill deficits have contributed to young drivers' collision involvement. As shown in Figure 1.2, the evidence suggests that much of young drivers' risky behaviour may not be a result of driving inexperience, but rather other personality and temporal characteristics that influences their decision making. However the evidence base is largely reliant on the use of driving simulators and self-report measures of past behaviour, which limits the extent to which a rounded picture of young driver behaviour is being formulated. Another way to understand why young drivers are so at risk is to look at real world evidence, such as the effectiveness of young driver interventions designed to reduce their risk. Therefore the purpose of this study was conducted with two overarching aims in mind:

> To explore the efficacy of previous interventions and conduct an evaluation of a current intervention, to provide evidence from another perspective about what underpins young drivers risk; and
>
> To use this evidence to inform the design and delivery of future interventions to maximise their efficacy in reducing young drivers' risk.

Driver training and education are often cited as the antidote to young drivers' over representation in road traffic collisions, and interventions are widely supported by parents and the professionals themselves that design them, who believe that they result in safer drivers. Even insurance companies often base their premium discounts on evidence of acquisition of further training (Lonero, 2008). However the content and delivery style of these interventions varies widely; and there is a general lack of evidence regarding their efficacy (McKenna, 2010). By exploring which interventions work and which don't, the specific risk factors related to

young drivers' over-representation in collisions will be made clearer, and there will be better understanding about how to effectively reduce this risk.

In the UK a person can legally start learning to drive at the age of 17 and the formal driving theory and practical tests focus on the skill-based aspects of driving (ROSPA, 2012). Originally it was thought that young drivers were more at risk primarily because their driving skills were under developed. Therefore the first types of young driver intervention aimed to further develop these skills. However evaluations of advanced driver training have found that there is a lack of scientific evidence that they do in fact reduce novice drivers' collision (Begg & Langley, 2009). This is a finding echoed by numerous literature reviews (e.g. Lonero, 2008; Mayhew & Simpson, 2002) and reinforces the point made earlier, that skill-based training tends to over-inflate young drivers' already heightened optimism bias, with no actual improvement to their driving ability (Gregersen, 1996). On this basis, more recent interventions have focused less on improving young drivers' skills (which have the potential to increase risk-taking due to increased confidence) and focus more on reducing specific risky driving behaviours associated most with young drivers.

These new interventions vary in form and delivery style but are often delivered to pre-and-learner drivers in years 12 and 13 of secondary school, tending to take the form of large staged events, presentations and discussion forums (ROSPA, 2012). They are often interactive and multi-agency, involving the police, fire & rescue, local authorities and schools. The full extent and spread of young driver interventions is unknown, but a 2007 survey found that out of 173 UK road safety teams, 122 (71%) had a pre-driver initiative in place (Launchbury et al., 2007), and that's likely to have increased further since then. However despite being implemented in almost every county across the UK, the number of formal, scientific evaluations are few. In Launchbury's (2007) review of predriver education only 55% of respondents reported that they had information available to support the effectiveness of their programme. This finding was echoed by Glendon (2011) who reviewed nearly 1500 traffic psychology articles published

between 1998 and 2008 and found that less than 2% could be classified as either an intervention or evaluation study.

Evaluations of interventions are critical in order to investigate their actual impact on young drivers' safety and identify areas requiring development (Iverson et al, 2005); however the number of evaluations being conducted continues to remain low. In a recent report by ROSPA, it was noted that still, very few evaluations are being conducted into the efficacy of pre-driver education interventions (Rospa, 2012). In addition to this, interventions vary in form, delivery style and target age groups; and the criteria for evaluating their efficacy is often poorly defined and lack sound theoretical grounds (Rospa, 2012). Therefore despite the number of interventions across the UK increasing, there is still a lack of evidence regarding their influence in producing safer young drivers. This evidence is critical in order to understand why young drivers are at risk, and to capitalise on methods proven to be effective in reducing this risk.

To address this gap in knowledge, evaluations determining the effectiveness of young driver interventions are needed. Interventions are designed with a view to improve young drivers' attitudes towards risky driving, the extent to which they engage in risky driving behaviours and, as a result, to reduce their involvement in collisions. Collision data has not been considered a reliable outcome measure, due to the relatively low frequency of their occurrence and random variability of collision numbers (Hutchinson and Wundersitz, 2011). Instead, predictors of unsafe driving such as risky attitudes have been suggested as a suitable alternative to use; based on the assumption that these may then correspond to subsequent driving behaviour (Ulleberg & Rundmo, 2003). As predictors such as attitudes and perceived risk have been shown to reliably predict higher collision involvement (Hatfield & Fernandes, 2009; Iverson et al, 2005), and more risky driving behaviour including speeding (Parker et al, 1998); this method of evaluation may thus be considered appropriate.

One evaluation conducted by Deighton & Luther (2007) investigated the effectiveness of the Scottish Executive New Driver Project. This was a classroom-based initiative focusing on assessing the attitudes, behavioural intentions, driving knowledge and subjective norms of learners and novice drivers. The researchers used three groups: Group 1 were a control group who acquired their driving license through typical combination of formal tuition and private practice. Group 2 did the same and also attended one afternoon of pre-driver training whilst a learner. Group 3 did the same as group 1 and also attended one afternoon of post-driving test training once they'd acquired their license. Participants were aged 17 – 21 years old and had had less than 2 hours of professional driving instruction when they were recruited to the study. Nine months after passing their driving test the researchers found no significant differences in attitudes, knowledge or intentions to drive safely between the three groups. They concluded that the attitudes and beliefs new drivers have towards driving are already formed by the time they started learning to drive; so they suggested that it appears critical to target adolescents' attitudes in the predriver phase, before they start learning to drive, in order to more effectively reduce their risk.

Another evaluation reported by Poulter & McKenna (2010) investigated the effectiveness of the Safe Drive Stay Alive initiative; a well-known intervention that is used widely across the UK. The format is like many others of its kind – they use a DVD showing a reconstruction of a fatal collision involving a young driver and live testimonials from members of the emergency services cover the key factors associated with young driver collisions. They had 730 fifteen and sixteen year old predriver students complete a questionnaire measuring their attitudes toward road safety at three time points - before the intervention, immediately afterwards and again five months later. They found that post-intervention, students showed some improvement in attitudes toward certain risky behaviours but after five months this effect had substantially deteriorated. In addition to this it was found that certain attitudes had substantially deteriorated five months after the intervention, including a reduced intention to keep within the law, reduced intentions to adhere to the advice of the Highway Code; and reduced perceptions of girlfriends/ boyfriends

disapproving of speeding. These findings provide evidence regarding what underpins young drivers' risk-taking behaviour, supporting the idea that young drivers are not necessarily skill-deficient but in fact choose to ignore safe-driving guidelines and deliberately drive more dangerously.

Evaluations of young driver interventions from other countries have yielded varied results. King et al. (2008) evaluated the 'You Hold the Key' programme in the USA; a 10 week comprehensive school–based programme that incorporates safety promotion education, student–oriented discussion, interactive lessons, prevention videos, and presentations from safety experts. They compared students' self-reported engagement in various risky driving behaviours before, immediately after the programme and 6 months later; finding substantial immediate and long-term improvements in students' reported seatbelt use, safe driving and perceived confidence in preventing drink driving. However this study did not make use of an appropriate control group, so it is unclear whether these effects are independent of other extraneous factors.

Another US study evaluated the effect of the 'Checkpoints Program' on risky driving and collision outcomes. Simons-Morton et al. (2006) surveyed 3743 families of teenagers who had recently acquired a learner's permit. Families were randomly assigned to the intervention or control group; the intervention group receiving a series of persuasive communications via mail related to high-risk teen driving. Up to 12 months post-licensure teenagers in the intervention group reported significantly less risky driving behaviour and traffic violations, than those in the control group. However, critically, there was no effect of intervention on actual collision outcomes. So whilst those who received the intervention may have reported engaging in less risky driving behaviour they were just as likely as the control group to be involved in a collision within their first year of licensure.

Brijs et al. (2014) evaluated 'On the Road', a post-license driver education programme in Belgium. This programme focuses on addressing risk-related knowledge and reducing risky

driving behaviour like speeding and drink driving. Participants were 366 newly qualified drivers aged 18 – 25 years old who all took part in the programme. Participants completed a questionnaire based on the Theory of Planned Behaviour (TPB) to assess their intended behaviour before and immediately after the programme, and again two months later. The evaluation found that participants did report improved risk-related knowledge immediately after the programme and at the subsequent follow up; but no improvements were found in participants' intended risky behaviour, or ability to detect risks. This suggests that young drivers may be aware of the risks of dangerous driving, but do not necessarily use this knowledge to direct their future driving behaviour. It was also found teaching procedural skills such as skid-control often led to increased risk-taking, further supporting the idea that young drivers may not need additional skill training, but rather their risky decision making still needs to be addressed.

Glendon et al. (2014) conducted an evaluation of an Australian school-based road safety intervention, measuring students' attitudes towards unsafe driving behaviours and risk perception before the intervention, immediately after, and again 6 weeks later. They compared these students with a matched control sample from a different school and their results were somewhat surprising. The control group reported no changes in their attitudes, but the intervention group reporting riskier attitudes towards unsafe driving at both post-intervention follow ups. The authors suggested that this might be due to the intervention not being specific enough in relation the risky attitudes they were trying to improve. It might be that young people require educating on specific predictors of unsafe driving, rather than a more general approach.

Nelson, Weitzman & Wechsler (2005) evaluated the effect of the 'A Matter of Degree' program on drinking and driving outcomes of University-age students. This programme was a campus-community coalition initiative, present at more than 10 colleges in the USA, aiming to reduce college binge drinking. The evaluation compared students' self-reported drinking and driving behaviour, both from colleges participating in the programme and from control colleges not involved. Over the course of a four-year period they found significantly reduced levels of self-

reported driving after drinking, and riding with a drunk driver from students at the participating colleges, in comparison to students from the control colleges. The authors therefore suggested that an intervention based on a collaborative effort between students and enforcers may be an effective approach for reducing drink driving among college students.

Other studies have utilised different approaches to young driver education. Falk & Montgomery (2009) explored the potential use of elaboration-based interventions to reduce the risky behaviour of young male drivers. Their study split 353 young men aged 18 – 23 years old into two groups: the experimental group were induced to imagine a severe collision scenario, to visualize their feelings about it and consider the consequences on their future lives. The control group were interviewed about neutral issues. Both groups were asked to report their attitudes towards risky driving and current behaviour. At follow up one month later, both groups reported more "ideal" attitudes about risky driving and less engagement in risk-taking behaviour; the authors suggesting that mere reflection on one's own driving behaviour may be a potential means to promote traffic safety.

Similarly, Lenne et al. (2011) explored the efficacy of using a driver-passenger training programme to combat the negative impact of passengers on young drivers' risk. 31 pairs of male friends aged 18-21 years old were randomly assigned to a training or no-training condition. Both groups operated a driving simulator in pairs, navigating through scenarios designed to measure aspects of safe driving and hazard perception. The training group also received a training programme, based on elements of existing team training programmes. Communications between drivers and their passengers were measured, and the study found that compared to the untrained group the trained pairs were more likely to reduce their speed when encountering unexpected hazards, allowed larger following distances and displayed safer communications. The researchers suggested that training young passengers to be a positive influence on young drivers may prove to be an effective method to reduce their risk; which

highlights the substantial role that peer passengers has on young drivers' propensity to take risks.

To summarise, the limited evidence to date regarding the efficacy of young driver interventions is mixed and inconclusive. Some studies have found that young drivers report engagement in fewer risky driving behaviours post-intervention (e.g. King et al, 2008; Nelson et al, 2005) whilst others have found that small short-term improvements may not be sustained at follow-up a few months later (e.g. Poulter & McKenna, 2010; Simons-Morton et al, 2006). One study found that an intervention might actually lead to riskier attitudes (Glendon et al, 2014) and provision of skill-based training may only serve to enhance young drivers' optimism bias (Brijs et al, 2014). There was also some evidence to suggest that interventions need to target pre-drivers' attitudes towards risk, before they start learning to drive, in order to have better chances of success (Deighton & Luther, 2007).

From a theoretical perspective, young driver interventions such as those described above, may not work because they tend to utilise a 'fear appeal' approach. Fear appeals are designed to evoke an immediate emotional response from the viewer, and this is used as indirect evidence that behaviour change will follow (Lewis et al, 2007). Fear appeals are widely used in various public health campaigns, such as promoting cessation of smoking, being aware of the symptoms of a stroke and particularly in road safety. Indeed most of the road safety interventions delivered across the UK and globally are based on these scare techniques. They are framed in terms of losses and focus on the negative consequences of driving recklessly, reinforcing the message by showing grisly collision scenes and continually emphasising the high risk young drivers face. The evaluations described above refer to many interventions that use a fear appeal approach, for example the Safe Drive Stay Alive initiative (Poulter & Mckenna, 2010) and the Checkpoints Programme (Simons-Morton et al, 2006); both of which were found to have no long-term improvements to young drivers' level of risk.

Fear appeals are not just used in local young driver interventions. For example, the mass media advertising commonly used in road safety publicity campaigns often depict an unsafe driving behaviour and the associated negative outcomes. These adverts employ shock tactics and graphically explicit crash scenes designed to evoke fear responses from the viewer at the prospect of the negative outcome (Dejong & Atkin, 1995; Tay & Watson, 2002). The underlying assumption is that this fear will motivate the viewer to adapt their driving behaviour to that recommended in the message of the advert (Maddux & Rogers, 1983; Witte, 1992).

In order for fear appeals to be effective, studies have identified the need for them to be perceived by the viewer as being personally relevant for them (e.g. Das, de Wit, & Stroebe, 2003; LaTour & Rotfeld, 1997). However research has found that young people recognize that fear appeals are trying to scare them and find the messages irrelevant (Hastings & MacFadyen, 2002; Cohn, 1998), they doubt the consequences will happen to them (Kempf & Harmon, 2006) and they perceive shock tactics as being effective for others but not themselves (Hastings et al, 1990). As mentioned previously, young people are more likely to be sensation seeking, risk-taking drivers than older people (Jonah, Thiessen & Au-Yeung, 2001); but they also tend to have an optimism bias, over-estimating their skills and under-estimating the level of risk they face on the road (e.g. Delhomme, 1991). Therefore despite fear appeal messages being directly, and particularly relevant for this age group, they are also the age group who are least likely to believe that they will be involved in a collision, and thus consider the fear appeal messages will not be applicable to them (Walton & McKeown, 2001).

This is particularly evident for young males, the target group most in need of help, but who are least likely to respond to these fear appeal messages. For example Lewis, Watson and Tay (2007a) found that young females were much more likely than males to report reduced intentions to speed and drink drive after watching a fear appeal style safety message; whilst Tay (2002) found that a fear-appeal advertising campaign was broadly effective at reducing drivers' self-reported intentions to drink and drive, but was least effective for young males – who were

the primary target audience. In line with this it has been suggested that young males may be less likely to respond to fear appeal messages because they do not feel personally vulnerable to the threats conveyed, and so alternative methods that do resonate with them, e.g. threatening loss of licence, may be an effective alternative (Lewis et al, 2007b).

The Extended Parallel Process Model (EPPM) (Witte, 1992) has been used to try and explain why fear appeals may not be effective for young drivers. The model posits that the success or failure of a fear appeal depends on how the viewer evaluates two aspects of the message: perceived threat and perceived efficacy. Perceived threat refers to how susceptible the individual feels to the threat as well as the severity of the threat. Perceived efficacy refers to both the efficacy of the recommended response and how able the viewer feels him/herself to be in performing the advocated action. Fear appeals are mostly likely to lead to a change in the viewer's behaviour when they perceive both the threat and efficacy as high. However in circumstances when, for example, perceived threat is high and perceived efficacy is low, the EPPM suggests that the fear appeal may have an unintended outcome known as the "boomerang effect". In these cases it may be that the viewer will do the opposite of what is advocated in the appeal (Witte, 1992) because they lack confidence in the appeal, in themselves or in both to carry out the prescribed action. As mentioned previously young drivers often find fear appeal messages irrelevant (Hastings & MacFadyen, 2002) and effective for others but not for themselves (Hastings et al, 1990); so here the EPPM provides one account of why traditional interventions using fear appeal techniques may not be effective for young drivers.

Another proposed explanation for fear appeals' limited efficacy on young drivers is Terror Management Theory (TMT) (Greenberg, Pyszczynski & Solomon, 1986). Here it is suggested that upon viewing a fear appeal, viewers will be reminded of their vulnerability to death (a fundamental source of distress in our lives, according to TMT) and their immediate coping mechanism is to deny this vulnerability. This may be achieved by ignoring the threat, suppressing it or convincing themselves that the risk is not pertinent to them (Pyszczynski,

Greenberg & Solomon, 1999). Young drivers may be particularly likely to respond in this way because risky driving may form an important dimension of their self-esteem. Thus being told to reduce their engagement in risky driving may be especially likely to elicit defensive responses to enable them to continue with their behaviour without feeling at risk (Carey & Sarma, 2011).

Despite theories such as these providing explanation about why fear appeals may not be effective for young drivers, large-scale fear appeal interventions continue to be delivered, both nationally in public health media campaigns, and locally within county-wide educational initiatives, in efforts to reduce young drivers' collision rates. Whilst some interventions have reported relatively long-term improvements to risky behaviour and attitudes post-intervention (e.g. King et al, 2008; Nelson et al, 2005), many more have failed to demonstrate enduring positive effects (Poulter & McKenna, 2010; Deighton & Luther, 2007; Simons-Morton et al, 2006; Brijs et al, 2014; Glendon et al, 2014). Ker et al. (2003) reviewed post-qualification driver education interventions and found that interventions were not effective in preventing road traffic injuries or collisions. More recently, Kinnear et al. (2013) found that despite there being a large amount of pre-driver interventions available, very few publishable evaluations of sufficient scientific quality could be found.

There needs to be more evaluations using sound methodology for current UK young driver interventions. These are needed to understand the risks faced by young drivers, to provide evidence of their effectiveness, and to justify the money spent on the design and delivery of these events. Evaluations of previous interventions have shown that young drivers may be at the most risk because they choose to engage in high risk driving, even after they have been educated about the risks of dangerous driving, the importance of the highway code, and taught procedural skills designed to help them minimise risk (Poulter & McKenna, 2010; Brijs et al, 2014). They have also shown that peer passengers influence the risky behaviour of young drivers, and in particular suggest that peers may be used as a positive tool for reducing risky driving (Lenne et al, 2011). By demonstrating what works and what doesn't we can better

understand what underpins young drivers' risk; and develop more cost-effective interventions that are shown to be effective at reducing this risk. Therefore the present study was conducted to build on the findings from previous evaluations: to investigate whether a current widely-used intervention called 'Learn2Live' would be successful in improving young peoples' attitudes and intentions to behave safely on the road; and to use these findings to further uncover and understand exactly what underpins young drivers' risk taking behaviour.

2.1.1 Learn to Live

Learn 2 Live (L2L) is an educational initiative aimed at pre-drivers and young drivers, designed to personalise the consequences of risky driving in order to reduce this amongst young drivers and passengers. The initiative has been running since 2008 and is delivered to approximately 12,000 students per annum in Devon and Cornwall. L2L is presented as a staged event in large venues for students in years 12 and 13 who attend the participating schools and colleges. After a spoken introduction a DVD is presented showing a group of friends in the moments leading up to and including a collision. As the emergency services begin to arrive the DVD is paused, and a member of each agency comes on stage to recount a personal experience of a collision they attended. Family members who have lost loved ones in road traffic collisions provide accounts of their loss, and a driver responsible for a collision recalls the consequences of their actions. Each speaker highlights a particular risk factor involved in the incident, and where possible the collisions of which they speak are local to the area and involve place or road names the students will be familiar with, thus further personalising the experience.

A recent evaluation of L2L conducted by Burgess et al. (2011) found that there did appear to be some change in behavioural intentions of passenger behaviour after attendance at the event, particularly with females a sense of empowerment was achieved. However the study yielded a poor response rate and the findings were based on only 8.7% of the target population. Therefore although there appears to be some good effects on young peoples' attitudes toward road driving safely after attendance at this event, further investigation is needed.

The L2L intervention is presented to young people with an average age of 17; the majority of whom have yet to obtain a full UK driving license. However most, if not all, will be a regular passenger in a car often driven by another young person. As has been described in Chapter One, teenage drivers often use the act of driving as a mode of socializing, rather than simply as a means to transport themselves. The presence of passengers is a key factor implicated in the collision rate of drivers under 21 years old (e.g. Aldridge et al, 1999; Bedard and Meyers, 2004; Preusser et al, 1998); and their collision risk is at its highest when peer teenage passengers accompany young drivers in the car (Ouimet et al, 2010). Therefore if the risky driving attitudes of young drivers and their young passengers can be improved, this may help to reduce the huge problem of young drivers being involved in so many collisions.

Learn2Live, like many young driver interventions, utilises a fear appeal approach to try and improve young peoples' risky attitudes and behaviour. However the efficacy of this type of intervention has long been queried (Cohn, 1998) and based on the evidence to date it is expected that Learn2Live may only have a limited short-term effect. Therefore in this study we sought to explore whether incorporating an additional element to the intervention, known as implementation intentions, would enhance its efficacy. To our knowledge implementation intentions have not yet been used to improve young drivers' behaviour but they have been found to be effective for behaviour change in other health-related areas. Therefore it may be that they can be used to help increase the efficacy of the Learn2Live intervention described here.

2.1.2 Implementation Intentions

Implementation Intentions (Gollwitzer, 1993, 1996) are 'if-then' plans which aim to promote goal attainment by linking a situational cue (i.e. a good opportunity to act) with a response that would be effective in endorsing the end goal, and thus bring about behavioural change (Gollwitzer and Sheeran, 2006). Implementation intentions differ from mere goal intentions as they not only specify an action they want to achieve, but also detail environmental cues or

contexts in which the action can be carried out (Gollwitzer, 1993). In this way a course of action is specified when certain environmental conditions occur, and the individual will be prompted to carry out their predefined action. Thus control is held by the environment rather than the individual, as the environmental context specifies when they should act. For example Prestwich, Lawton and Conner (2003) evaluated the effectiveness of an implementation intention intervention for promoting exercise behaviour. All participants completed self-report exercise logs but participants in the implementation intention group were also asked to specify the time, place and type of extra exercise that they would engage in over the following four weeks. They found that participants in the implementation intention group engaged in more exercise activities, spent a longer amount of time exercising per week and displayed greater fitness improvements than the control group.

'Good intentions' have found to have little impact on behaviour when they are generic and poorly specified (Sheeran, 2002) and in a meta-analytic review Armitage and Conner (2001) found that an intention to do something accounts for as little as 20% of the variance in actual observed behaviour and 31% of self-reported behaviour. In order to best predict future behaviour, intentions need to include specific actions planned for specific contexts (i.e. implementation intentions). Studies using self-report behaviour outcome measures have found that using implementation intentions can have a substantial effect on a range of health-related behaviours; such as increased weight loss (Luszczynska, Abraham & Sobczyk, 2007), increased physical activity (Prestwich, Lawton and Conner, 2003); and improved diet (Armitage, 2004). They have also been shown to reduce the rates of risky behaviours carried out by young people, such as a reduction in the number of consultations for emergency contraception among teenage women (Martin et al, 2009); and reduced risky drinking on Friday nights among young women (Murgraff, Abraham & McDermott, 2006).

There is a growing body of evidence linking implementation intentions with improved goal attainment across a number of health-related behaviours, but investigation of their use in the

realm of road safety is sparse. Elliott and Armitage (2006) conducted the first study into the use of implementation intention plans to influence driving behaviour. They found that compared to a control group, drivers who made implementation intention plans reported increased compliance with speed limits one-month post baseline. In a second more recent study Brewster, Elliott and Kelly (2015) found that when participants made implementation intentions, they reported significantly less self-reported speeding behaviour one month later when compared to participants who just received general information about the risks of speeding.

Fylan and Stradling (2014) described how there are a range of behavioural change techniques (BCTs) that could be employed to support young drivers improve their driving behaviour but many of these have not yet been utilised in young driver RSIs. Building on initial work by Abraham and Michie (2008) they collated and grouped 27 BCTs commonly used in many areas of health improvement, such as providing information about risk, setting general goals, keeping a record of behaviour and reviewing goals, and explored the extent to which each of the BCTs were being used in six current young, novice and pre-driver RSIs. They found that many of the BCTs were not being used and most RSIs tended to focus on increasing awareness of risks and the potential negative consequences that might occur as a result of specific risky behaviours. None of the RSIs reviewed used any BCTs that would help the young drivers decide on a behaviour change, feel supported to make the change or know how to manage the change process. Fylan and Stradling (2014) suggested that young driver RSIs may be more effective if they contain specific messages about what behaviour changes need to occur, rather than just giving general encouragement to drive more safely.

To our knowledge the potential for using implementation intentions to improve young driver safety has yet to be directly investigated. Both Elliott and Armitage (2006) and Brewster, Elliott and Kelly (2015) used a large age range of participants, and did not explicitly partition the effect of implementation intentions for older and younger participants. Similarly none of the six interventions reviewed in Fylan and Stradling's (2014) paper made use of implementation

intentions within their RSI design. Therefore the present study sought to address this gap in knowledge, exploring whether implementation intentions would act as an enhancement to the Learn2Live intervention. Specifically, we sought to investigate whether participants who attended Learn2Live and made implementation intentions would report improved attitudes and intentions to a greater degree than those who just attended Learn2Live.

Based on the evidence described in the literature review, that when adolescent passengers are in the car with young drivers they are at an increased risk of collision (Simons-Morton, Learner and Singer, 2005) current road safety initiatives are concerned with targeting this issue. They attempt to educate young people of the dangers associated with being a passenger of a teenage driver in order to try and reduce their subsequent involvement in risky driving behaviour. Rowe et al. (2013) investigated the development of risky attitudes from pre-driving to fully-qualified driving in a longitudinal sample of 17-20 year olds. They found that as driver training and driving experience increased, attitudes to driving violations became riskier, especially for speeding. In addition, the attitudes that individuals had as learners predicted their later self-reported engagement in violations as fully qualified drivers. These results are in line with those of Deighton & Luther (2007), who found that learner drivers have already formed their attitudes towards risky driving by the time they start learning to drive, and so they suggested that interventions need to target the attitudes of pre-drivers in order to be effective. Similarly recent research by Roman et al. (2015) found that young drivers' engagement in various forms of risky behaviour continues throughout their first few months and years of licensure, suggesting that early intervention targeting attitudes and intentions towards risky driving may be necessary in order to effectively reduce their later risk.

On this basis, interventions improving the attitudes of pre-drivers may then help to reduce their engagement in subsequent risky driving once they have passed their test. The L2L initiative targets 17-18-year-old pre-driver adolescents, whom are often passengers in a car owned by a

young driver. Thus the L2L initiative would appear to be targeting the age group that requires the most critical protection. However to date the evaluation of the scheme has been limited. Understanding whether interventions work will inform the future design and delivery of these events, and will provide critical evidence regarding which factors underpin the risky behaviour of young driver.

2.1.3 Present Study

The present study was a longitudinal, within- and- between subjects field study, evaluating the effectiveness of an educational intervention (Learn2Live) and implementation intentions on pre-drivers' self-reported attitudes and behavioural intentions to behave safely as a passenger. The study was carried out in collaboration with Devon County Council, who organises and runs the L2L event. A questionnaire was constructed based on components of the Theory of Planned Behaviour (TPB) (Ajzen, 1991); and participants completed it at three time points: 2 weeks prior to the intervention (pre-intervention), 2 weeks after the intervention, where only some completed implementation intention plans (post-intervention), and then three months later (follow-up). At each time point attitudes towards risky driving, behavioural intentions, perceived behavioural control, behavioural beliefs, social norms of friends, social norms of family, and regret were measured.

It was hypothesized that participants who attended the intervention would report a significant decrease in risky responses on all measures from pre-intervention to follow-up. It was also hypothesised that participants who made implementation intention plans, in addition to attending the intervention, would report the biggest decrease in risky responses on all measures from pre-intervention to follow-up. Based on previous evidence that males are less likely than females to respond to fear appeal messages (Lewis, Watson & Tay, 2007a) it was also hypothesised that males attending the intervention would report less improvements to their risky responses at follow-up than females. For the control group i.e. those not attending an

intervention, it was hypothesised that they would not demonstrate any significant decrease in risky responses from pre-intervention to follow-up.

2.2 Method

2.2.1 Participants

Participants were aged 16 – 21 years old; recruited through local secondary schools and Babcock, HMS Drake. The experimental group was made up of students and apprentice engineers attending the Learn2Live event. 2,000 Year 12 students and 200 apprentice engineers attended the Learn2Live presentation evaluated in this study. Of those, 1,242 completed the pre-intervention questionnaire. Once respondents with incomplete data were removed, 780 valid responses were available pre-intervention. Of the 780 responses from pre-intervention, 154 participants (90 females, 64 males) provided complete data sets at follow-up: 90 females (Mean age = 16.39 years, SD = .49) and 64 males (Mean age = 17.28 years, SD = 1.34).

The waiting list control group was made up of students from secondary schools in the South West of England that did not attend the Learn2Live presentation or any other road safety intervention during the time period of the study. This was the only difference separating the schools in each group; and for these schools, driver education interventions were scheduled for later in the academic year. Questionnaires were distributed to a total of 924 students from 6 participating schools. Complete data sets were available for 272 participants Pre-Intervention. Of these, 66 respondents provided complete data at follow-up: 45 females (Mean age = 16.56 years, SD = .59) and 21 males (Mean age = 16.62 years, SD = .67).

2.2.2 Design

A longitudinal, within- and- between subjects field study design was used. It was not possible to randomly assign participants to the intervention and control groups because the schools taking part in the intervention were already pre-determined before the study commenced. However participants attending the intervention were randomly assigned to one of two experimental

conditions: driver-education intervention alone (DE) or with added implementation intention planning (DE+II). A third, control, condition was made up of students from schools that did not attend the L2L event (CO). Participants in DE and DE+II conditions completed three questionnaires: one prior to the L2L event (Pre-intervention), one immediately after the event (post-intervention), and one three months later (follow-up). Participants in the CO condition completed two questionnaires separated by a three month interval period (pre-intervention and follow up). Please see Table 2.1 for the data collection schedule. There was one independent variable 'intervention type' with three levels: DE, DE+II, CO; and seven dependent variables based on components of the Theory of Planned Behaviour (TPB) (Ajzen, 1991): Behavioural Intentions, Perceived Behavioural Control, Behavioural Beliefs, Social Norms of Friends, Social Norms of Family, Regret and Attitudes.

Table 2.1. Data collection schedule for each of the three groups at each time point. / means data was collected, X means data was not collected.

	Pre-Intervention	Post-Intervention	Follow-Up
DE	/	/	/
DE+II	/	/ and made IIs	/
CO	/	X	/

2.2.3 Measures

The Theory of Planned Behaviour (TPB; Ajzen, 1985, 1991) suggests that our behaviour is driven largely by our intentions; and our intentions are influenced by several other factors, including our attitudes, subjective norms (the perceptions individuals or groups have about how they think they should behave) and the level of control over a situation we perceive ourselves to have. The elements of the TPB have frequently been applied when studying the determining factors of risky driving behaviour (e.g. Prat et al, 2015; Parker et al, 1998); and they have been shown to reliably predict future behaviour in a range of studies. For example, attitudes towards

road safety have been found to be associated with speeding and self-reported collision involvement (Parker & Manstead, 1996; Parker et al, 1998); and young drivers in particular are more likely to overestimate their own driving skills (Matthews & Moran, 1986) and underestimate the risk associated with specific traffic situations (Deery, 2000). Therefore interventions that effectively improve young peoples' attitudes and intentions to drive safely may be crucial to reducing their risk on the road.

The measures used in this study were based on components of the Theory of Planned Behaviour (Ajzen & Fishbein, 1980) in order to assess the attitudes and behavioural intentions reported by attendees. Participants from all conditions completed the same set of measures. Normally, TPB studies on driving behaviour frame questions in terms of personal experience (Poulter & McKenna, 2010). However the participants in this study were typically pre-drivers, so measures assessed passenger dimensions of behaviour instead. At each of the three time points attitudes towards risky driving behaviours were assessed using 12 statements, based on those used by Burgess et al. (2011). Participants had to indicate the extent to which they agreed with each of the statements on a 5-point likert scale where 1 = strongly agree and 5 = strongly disagree. An example statement was, "I think distracting the driver in any way could result in a serious crash" (see Appendix 2A for the full list of statements used in all three questionnaires).

Participants were then presented with 10 road traffic scenarios, as used in Burgess et al. (2011), each detailing a specific risky driving situation (drink driving, speeding, seat belt use, overtaking, distraction and night-time driving). An example overtaking scenario was: "You are in a car with your friends driving down a country road. The speed limit is 60mph but the car in front is doing about 50mph. You are about to approach a bend in the road and the driver cannot see traffic coming in the opposite direction. Your friend decides to overtake the car in front". For each scenario participants were presented with a list of 6 statements based on the TPB (Ajzen & Fishbein, 1980); measuring behavioural intentions, perceived behavioural control, behavioural beliefs, social norms of friends, social norms of family and regret. An example

statement for the overtaking scenario was “I would try to discourage my friend from overtaking the car in front on a bend”. Participants had to rate on a likert scale where 1 = strongly agree and 5 = strongly disagree, the extent to which they agreed or disagreed with each of the statements (see Appendix 2B for the full list of statements used in each of the three questionnaires).

Post-Intervention, DE+II condition

Participants randomized to the DE+II condition were asked to specify an implementation intention at the post-intervention data collection point. First they specified a behaviour and how many times they currently do this behaviour each week and each month. They were then asked to indicate on a 5-point likert scale (where 1 = not at all and 5 = very much) how much they wanted to make their chosen behaviour safer. Participants then had to indicate how they were going to make this behaviour safer and what might stop them from doing this. Finally they wrote down ways to overcome this problem, and a reminder to ensure they would remember to do this every time they got in the car (see Appendix 2C for full script).

Post Intervention, DE condition

At the post-intervention data collection point participants randomized to the DE condition were asked to specify a risky driving behaviour they wanted to make safer but were not asked to make an implementation intention plan (see Appendix 2D for full script).

Follow-Up

At the end of the questionnaire distributed at the follow-up data collection point participants from the DE and DE+II conditions were asked to recall what their risky behaviour was and how many times they now do this behaviour. The following text was added to the end of the follow-up questionnaire given to all participants in the DE and DE+II conditions:

We previously asked you to choose a risky passenger behaviour that you wanted to make safer. Please write down in the space provided what that behaviour was.

……

How many times do you think you do this behaviour now: Each week?.... Each month?....

2.2.4 Procedure

Local education providers that had already consented to participate in the L2L intervention were contacted by telephone and email, informed of the research and invited to participate. Each school's Head of Year 12 was given detailed information regarding the time-frame of the study, what would be required of them, and the voluntary nature of the research. Due to the poor response rate obtained in Burgess et al.'s (2011) evaluation, the present study sought to improve upon this with additional resources to encourage participation. In order to maximise response rates each school was given the opportunity to receive paper based copies of the questionnaire and/ or access to the web link containing an online version.

For the experimental groups, two weeks prior to the L2L intervention the researcher provided each education provider with either paper-based copies of the pre-intervention questionnaire or an email to distribute to students (as pre-arranged). The email was accompanied by instructions directing the recipient to a URL which contained the online version of the pre-intervention questionnaire. Heads of Year 12 at each school invited their students to complete the questionnaire (either online or on the paper versions provided) regarding their current driving/ passenger attitudes and behaviour. The questionnaires were administered in class in the presence of a teacher. At the beginning of the questionnaire participants were asked to set a self-generated anonymity code in order to ensure their responses were anonymous and so that their data could be linked with any subsequent questionnaires they completed. The codes were constructed by using the first two letters of the student's Mother's first name, followed by the student's birthday date, and ending with the last two letters of the student's first name. Participants were also informed that upon completion of the questionnaire, both at this point and again in the future, they would be entered into a prize draw to win an iPad. This was used as an incentive to encourage continued participation at all three data collection points. Three winning

entries were selected at random after the conclusion of the study (one for each time point), and each student was presented with their prize at school.

Attendance at the L2L event was organised and coordinated by members of Devon County Council. The day after the event Heads of Year 12 invited students to complete the questionnaire again (via the same medium used at the first time point). At this point participants were randomly allocated to either the DE condition (whereby they simply completed the original pre-intervention questionnaire again and specified a risky passenger behaviour they wished to reduce) or the DE+II condition (whereby they completed the original questionnaire and a further if-then planning task). Due to the fact that teachers from each school were responsible for administering the questionnaires to participants it was not possible to control who was assigned to the DE versus DE+II conditions. Equal numbers of questionnaires for each condition were supplied to all schools, and it was left up to the schools themselves to administer the different versions equally.

Three months after the L2L event the final questionnaire was distributed to participants, and they were asked questions about whether they had successfully reduced their chosen risky behaviour. Participants in the II condition were also asked how many times they now carried out the risky behaviour each week and each month. At each time point a reminder of the chance to win an iPad was stressed to the students in efforts to maximize continued participation.

For the control group, schools not attending the Learn2Live intervention were contacted and invited to participate in research on young driver safety. They were provided with details about the time-frame and voluntary nature of the study, and were asked to confirm if students would be attending any other road safety event during the course of the study's time-frame. Questionnaires were distributed to students via the Head of Year 12 at each school, in a format consistent with the experimental groups. Participants completed two questionnaires separated by

a time-frame of three months, with no road safety intervention occurring between the two data collection points.

2.3 Results

2.3.1 Reliability of Measures

Reliability analyses were carried out on each of the measures to ensure they were reliable. The alpha scores (see Table 2.2) indicated good and very good reliability for all measures.

Table 2.2 Cronbach alpha values for all measures

	Pre-Intervention	Post-Intervention	Follow-Up
Attitudes	α = .70	α = .89	α = .92
Behavioural Intentions	α = .76	α = .92	α = .97
Perceived Behavioural Control	α = .77	α = .84	α = .94
Behavioural Beliefs	α = .73	α = .92	α = .97
Social Norms of Friends	α = .61	α = .80	α = .89
Social Norms of Family	α = .79	α = .96	α = .98
Regret	α = .84	α = .92	α = .94

2.3.2 Analysis

The mean scores for each of the measures were calculated and Figure 2.1 shows the mean sum TPB scores for each group at pre-intervention and follow-up. Some respondents had completed the TPB measures but not the implementation intention plans and were therefore excluded completely from this analysis. Figure 2.1 shows that participants from all groups started with similar mean sum TPB scores. Participants who then attended the intervention were found to have lower (i.e. safer) scores on the TPB at follow-up three months later. Participants who made implementation intention plans also appeared to have slightly lower scores than those who

attended the intervention alone. In comparison, the participants from the control condition, who did not attend the intervention, demonstrated very little change in TPB scores.

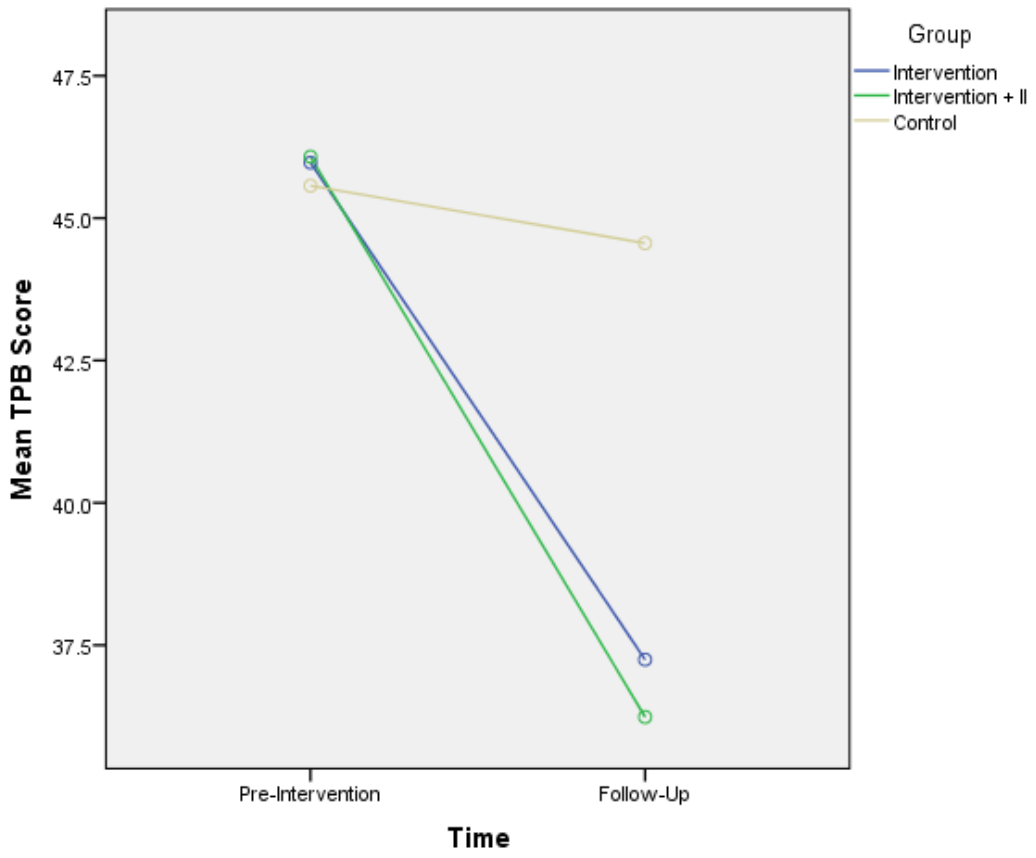


Figure 2.1. Mean sum TPB scores for participants in each group: intervention, intervention with implementation intention plans, and control.

Table 2.3 provides further descriptive information for the three groups' responses on each of the individual TPB measures. The data shows that this pattern of results was similar for each of the individual TPB measures, as well as the mean sum TPB score. Pre-intervention all participants started with similar scores on each of the TPB measures. At the follow-up, intervention participants had lower scores on each of the TPB measures, whereas control participants did not. Very few participants completed full implementation intention plans (N=16) so gender differences were unable to be investigated at this point.

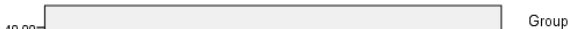
Table 2.3. *Descriptive statistics for participants' scores on each of the TPB component scores, the sum TPB score, and attitudes towards road safety. The scores are split by the type of intervention received.*

	Intervention			Intervention + II			Control		
Variable	Pre-Intervention mean (SD)	Follow-Up mean (SD)	N	Pre-Intervention mean (SD)	Follow-Up mean (SD)	N	Pre-Intervention mean (SD)	Follow-Up mean (SD)	N
TPB: Behavioural Intention	39.5 (4.5)	30.5 (12.4)	39	40.2 (5.5)	30.0 (14.3)	16	39.3 (5.3)	39.1 (4.8)	66
TPB: Perceived Behavioural Control	37.2 (4.8)	31.6 (9.8)	39	37.0 (6.9)	31.8 (13.4)	16	38.0 (4.2)	35.8 (3.9)	66
TPB: Behavioural Beliefs	38.0 (4.2)	31.9 (10.5)	39	38.9 (4.1)	30.0 (13.6)	16	37.5 (3.6)	38.3 (3.8)	66
TPB: Social Norms of Friends	35.2 (3.8)	30.5 (8.8)	39	35.2 (4.2)	29.9 (10.1)	16	35.1 (4.6)	33.6 (4.6)	66
TPB: Social Norms of Family	41.0 (4.8)	31.3 (13.5)	39	40.4 (4.5)	29.9 (10.1)	16	40.8 (5.4)	40.5 (5.1)	66
TPB: Regret	38.3	30.7	39	38.8	29.3	16	45.6	35.5	66
TPB: Mean Total	46 (4.1)	37.2 (12.7)	39	46.1 (5.3)	36.2 (14.7)	16	45.6 (4.4)	44.6 (4.0)	66
Attitudes	45.5 (5.2)	36.6 (12.8)	39	46.2 (4.7)	34.9 (13.2)	16	44.4 (5.5)	44.8 (6.1)	66

A 3x2 mixed model ANOVA was then used to investigate the effect of intervention type on change to mean sum TPB scores. The between-subjects variable 'group' had three levels: intervention, intervention + implementation intentions, and control. The within-group variable 'time' had two levels: pre-intervention and follow-up. There was a significant interaction found between group and time $F(2, 118) = 10.6$, $p < .001$. There were also significant main effects found for both time $F(1, 118) = 40.2$, $p < .001$ and group $F(2, 118) = 6.2$, $p < .01$. Figure 2.1 indicates that this interaction may have occurred because of the higher post-intervention scores for the control condition, when compared to the two experimental conditions. A simple main effects analysis confirmed the significance of the difference between the control condition and the intervention only condition $F(1, 103) = 18.7$, $p < .001$. A simple main effects analysis also confirmed that the difference between the intervention and intervention + II conditions was not significant $F(1, 153) = .07$, $p > .05$.

The results suggest that there was no significant difference between the improvement in TPB scores of the intervention group and the intervention with implementation intentions group. Therefore for the remainder of the analyses, both experimental groups were collapsed to form one experimental group, with the effect of implementation intentions no longer being considered.

In the first analysis certain respondents' data was excluded because they did not complete implementation intention plans. However their responses on the TPB measures were completed in full. Therefore in order to maximise the sample, and to explore potential gender differences, these respondents were included from here on in. Therefore a subsequent 2x2x2 mixed model ANOVA investigated the effect of intervention group, gender and time on change to mean sum TPB scores, with the previously excluded responses now included. There was a significant interaction found between group, gender and time $F(1, 216) = 32.1$, $p < .001$. There were also significant main effects found for group $F(1, 216) = 76.9$, $p < .001$ gender $F(1, 216) = 19.9$, $p < .001$ and time $F(1, 216) = 124.7$, $p < .001$. Figures 2.2 and 2.3 indicate that these effects may



have occurred due to the female intervention group having much lower TPB scores at follow-up than the male intervention group and all participants in the control group. Simple main effects analyses confirmed that for all participants pre-intervention there were no significant differences between males' and females' mean sum TPB scores $F(1, 218) = 1.5$, $p > .05$; showing that all participants started off with similar scores. At follow-up, female intervention and male intervention scores were significantly different $F(1, 152) = 109.7$, $p < .001$, with females having much safer scores than males. Although the male intervention scores were safer than the male controls' at follow-up, this difference was not significant $F(1, 83) = 3.7$, $p > .05$.

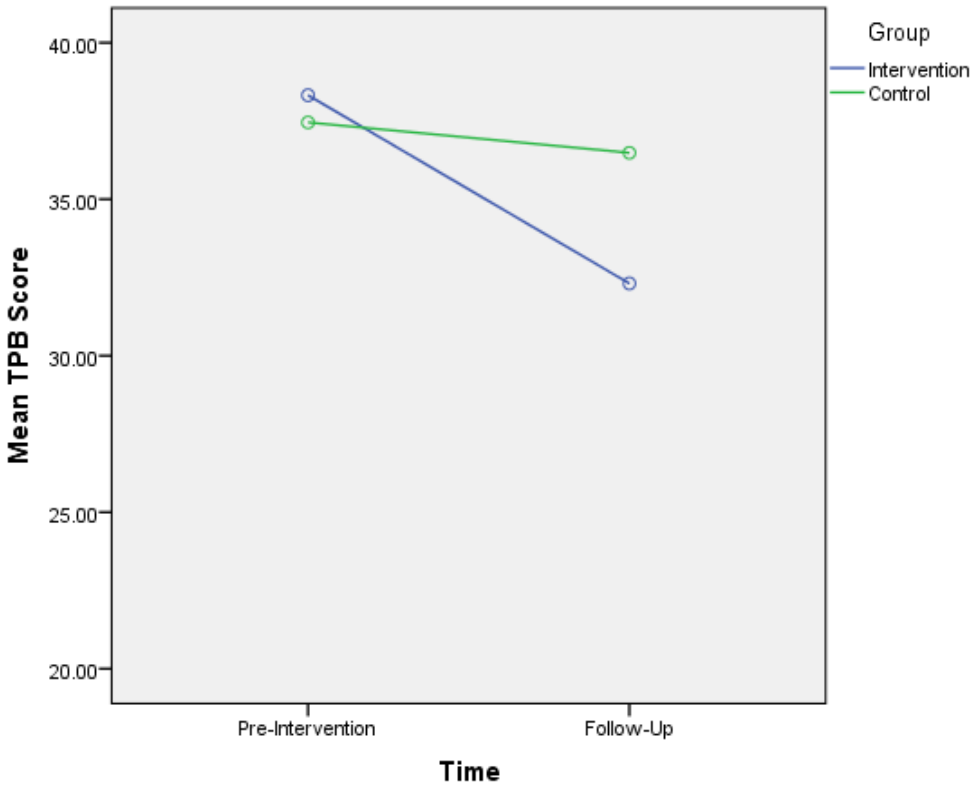


Figure 2.2. Mean TPB scores for male participants at pre-intervention and follow-up, split by group: intervention or control.

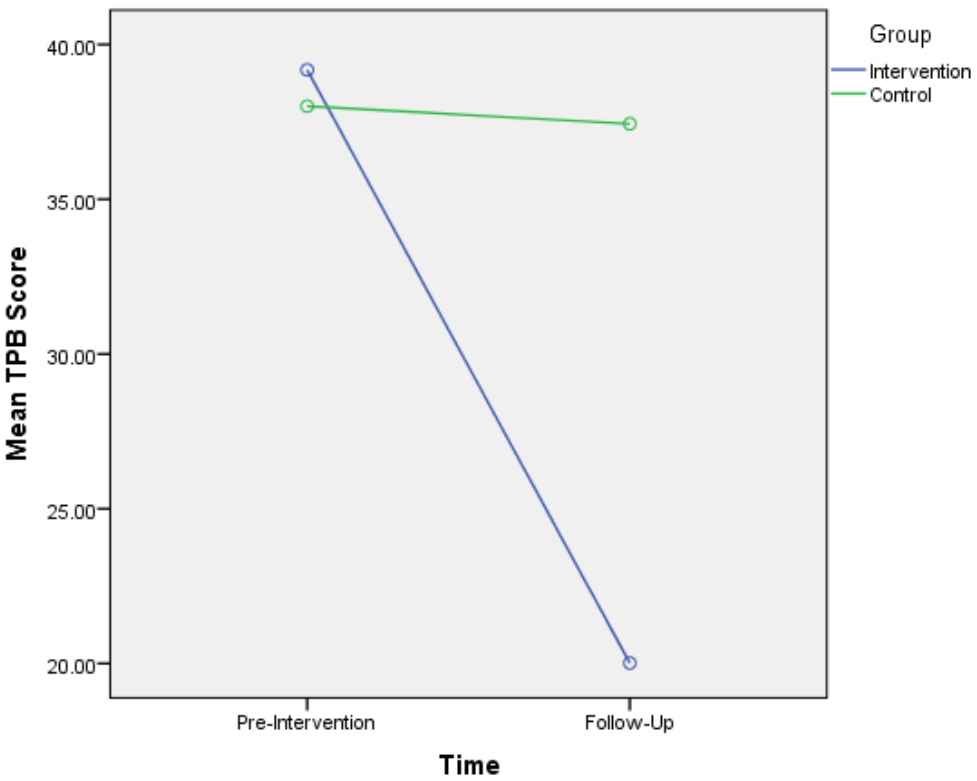


Figure 2.3. Mean TPB scores for female participants at pre-intervention and follow-up, split by group: intervention or control.

Table 2.4 shows the intervention group males' and females' mean scores on each of the TPB measures. The pattern of results for each of the TPB measures follows that of the mean sum TPB scores. Males and females started out with similar TPB component scores, but at the follow-up, three months after the intervention, females' scores were much lower (i.e. safer) than males' scores. There was some change in males' TPB scores but to a lesser degree than the females. Table 2.5 shows mean responses on each of the TPB measures for the control group, and split by gender, and it can be seen that again males and females started out with similar TPB scores. However contrary to the intervention group, three months later the control group scores did not appear to have changed much overall and there was still little difference between males' and females' scores.

Table 2.4. Descriptive statistics for intervention group scores on each of the TPB component scores, the mean total TPB score, and attitudes towards road safety. Scores are split by gender and presented for pre-intervention and follow-up.

Variable	Intervention Group					
	Pre-Intervention mean (SD)			Follow-Up mean (SD)		
	All	Males	Females	All	Males	Females
TPB: Behavioural Intention	40.3 (5.1)	39.7 (5.4)	40.7 (4.8)	24.4 (10.6)	32.3 (11.3)	18.7 (4.8)
TPB: Perceived Behavioural Control	37.9 (5.3)	38 (5.5)	37.9 (5.2)	25.6 (9.7)	32.6 (10.0)	20.7 (5.6)
TPB: Behavioural Beliefs	38.6 (4.2)	38.2 (4.8)	39 (3.7)	25.4 (9.7)	32.9 (9.8)	20.1 (5.0)
TPB: Social Norms of Friends	35.8 (5.1)	35.3 (4.9)	36.1 (5.2)	26 (8.2)	31.8 (8.0)	22 (5.4)
TPB: Social Norms of Family	41.6 (5.2)	40.8 (5.4)	42.1 (5.1)	24.2 (11.4)	32.8 (11.8)	18 (5.8)
TPB: Regret	38.8 (5.7)	38 (6.2)	39.3 (5.3)	25.2 (9.3)	31.4 (9.6)	20.7 (6.0)
TPB: Mean Total	38.8 (4.1)	38.3 (4.5)	39.2 (3.7)	25.1 (9.4)	32.3 (9.8)	20 (4.5)
Attitude	46 (5.0)	45.3 (5.2)	46.5 (4.8)	30.3 (10.7)	38.2 (11.7)	24.7 (4.8)
N	154	64	90	154	64	90

Table 2.5. Descriptive statistics for control group scores on each of the TPB component scores, the mean total TPB score, and attitudes towards road safety. Scores are split by gender and presented for pre-intervention and follow-up.

Variable	Control Group					
	Pre-Intervention mean (SD)			Follow-Up mean (SD)		
	All	Males	Females	All	Males	Females
TPB: Behavioural Intention	39.3 (5.3)	39 (4.8)	39.5 (5.6)	39.1 (4.8)	39.1 (5.5)	39.1 (4.5)
TPB: Perceived Behavioural Control	38.0 (4.2)	39.4 (5.0)	37.5 (4.3)	35.8 (3.9)	36.2 (4.3)	35.6 (3.8)
TPB: Behavioural Beliefs	37.5 (3.6)	36.5 (3.5)	38 (3.6)	38.3 (3.8)	38.4 (3.7)	38.3 (4.0)
TPB: Social Norms of Friends	35.1 (4.6)	34.9 (5.1)	35.2 (4.4)	33.6 (4.6)	32.2 (4.8)	34.3 (4.4)
TPB: Social Norms of Family	40.8 (5.4)	40.9 (5.1)	40.7 (5.6)	40.5 (5.1)	38.8 (4.9)	41.4 (5.1)
TPB: Regret	37.1 (5.6)	36.9 (5.6)	37.2 (5.7)	35.5 (4.5)	38.8 (4.2)	36 (4.6)
TPB: Mean Total	37.8 (3.6)	37.5 (3.7)	38 (3.6)	37.1 (3.4)	36.5 (3.7)	37.4 (3.2)
Attitude	44.4 (5.5)	44 (5.3)	44.6 (5.6)	44.8 (6.1)	45.9 (5.9)	44.3 (6.2)
N	66	21	45	66	21	45

A 3x2 MANOVA was then conducted to assess the effect of intervention type on changes to each of the mean TPB component scores, for males and females separately.

For females, significant interactions were found between group and time for each of the components: behavioural intentions $F(1, 133) = 251$, $p < .001$, perceived behavioural control $F(1, 133) = 97.9$, $p < .001$, behavioural beliefs $F(1, 133) = 249.3$, $p < .001$, social norms of friends $F(1, 133) = 76.9$, $p < .001$, social norms of family $F(1, 133) = 245.7$, $p < .001$ and regret $F(1, 133) = 120.9$, $p < .001$. The data from Tables 2.3 and 2.4 appear to indicate that these interactions have occurred because intervention females reported safer scores from pre-intervention to follow-up on each of the measures; whereas control females did not report safer scores on any of the measures from pre-intervention to follow up. Indeed for each of the component measures, main effects were found for both group and time. For behavioural intentions: group $F(1, 133) = 270.2$, $p < .001$, and time $F(1, 133) = 268.6$, $p < .001$. For perceived behavioural control: group $F(1, 133) = 218.9$, $p < .001$, and time $F(1, 133) = 152.9$, $p < .001$. For behavioural beliefs: $F(1, 133) = 327.3$, $p < .001$, and time $F(1, 133) = 232.6$, $p < .001$. For social norms of friends: group $F(1, 133) = 123.5$, $p < .001$, and time $F(1, 133) = 99.3$, $p < .001$. For social norms of family: group $F(1, 133) = 341.1$, $p < .001$, and time $F(1,133) = 221$, $p < .001$. For regret: group $F(1, 133) = 115.6$, $p < .001$, and time $F(1, 133) = 156.2$, $p < .001$. Whilst there were no significant differences between intervention and control females' scores pre-intervention (as shown in Figure 2.3 and Tables 2.3 and 2.4) intervention females reported significantly safer scores than control females on each of the measures at follow-up.

For males, significant interactions were found between group and time for behavioural intentions $F(1, 83) = 7.1$, $p < .01$, perceived behavioural control $F(1, 83) = 4.5$, $p < .05$, behavioural beliefs $F(1, 83) = 9.1$, $p < .01$ and social norms of family $F(1, 83) = 4.3$, $p < .05$. When considering the nature of the significant interactions, main effects of group and time were found for behavioural intentions: group $F(1, 83) = 4.1$, $p < .05$, time $F(1, 83) = 6.8$, $p < .05$; suggesting that intervention males did report safer behavioural intentions from pre-intervention

to follow-up, whereas control males did not. For perceived behavioural control a main effect of time was found $F(1, 83) = 5.1$, $p < .05$ but not group $F(1, 83) = .5$, $p > .05$; showing that here both intervention and control males reported some safer behavioural control scores from pre-intervention to follow-up. For behavioural beliefs there were no main effects of either group $F(1, 83) = 2.2$, $p > .05$ or time $F(1, 83) = 2.2$, $p > .05$; and for social norms of family there was a main effect of time found $F(1, 83) = 12.9$, $p < .01$, but not group $F(1, 83) = 3.8$, $p > .05$; showing how both intervention and control males reported some safer scores from pre-intervention to follow-up.

Finally, a mixed model ANOVA investigated the effect of gender and intervention type on change to mean attitude scores. This analysis was conducted separately from the other TPB measures as attitudes were assessed using a separate set of questions. There was a significant interaction found between group, gender and time $F(1, 216) = 19.6$, $p < .001$. There were also significant main effects found for group $F(1, 216) = 64.3$, $p < .001$, gender $F(1, 216) = 19.5$, $p < .001$ and time $F(1, 216) = 93.5$, $p < .001$. Figures 2.4 and 2.5 indicate that these effects may have occurred due to the intervention group having lower (i.e. safer) attitude scores at follow-up than the control group. Simple main effects analyses confirmed that the difference between male control and male intervention attitude scores at follow-up was significant $F(1, 83) = 8.3$, $p < .01$; as was the difference found between female control and female intervention scores at follow up $F(1, 133) = 410.4$, $p < .001$. Simple main effects analyses also confirmed that whilst there was no significant difference between males and females from the intervention group on their attitude scores pre-intervention 1 $F(1, 152) = 2.3$, $p > .05$; at follow-up this difference was significant $F(1, 152) = 96.1$, $p < .001$.

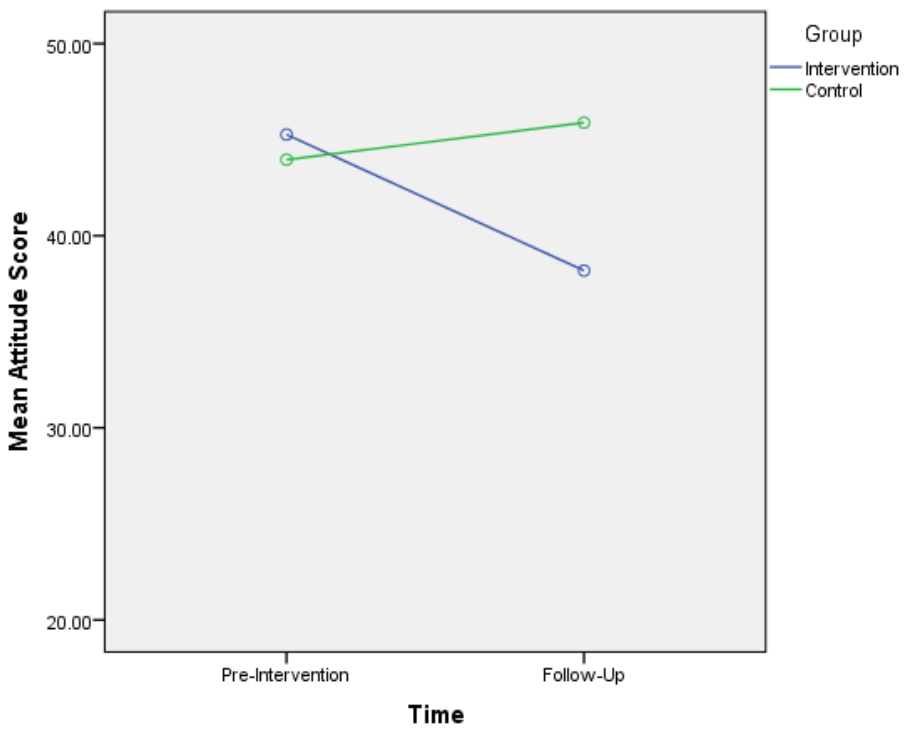


Figure 2.4. Mean attitude scores for male participants at pre-intervention and follow-up, split by group: intervention or control.

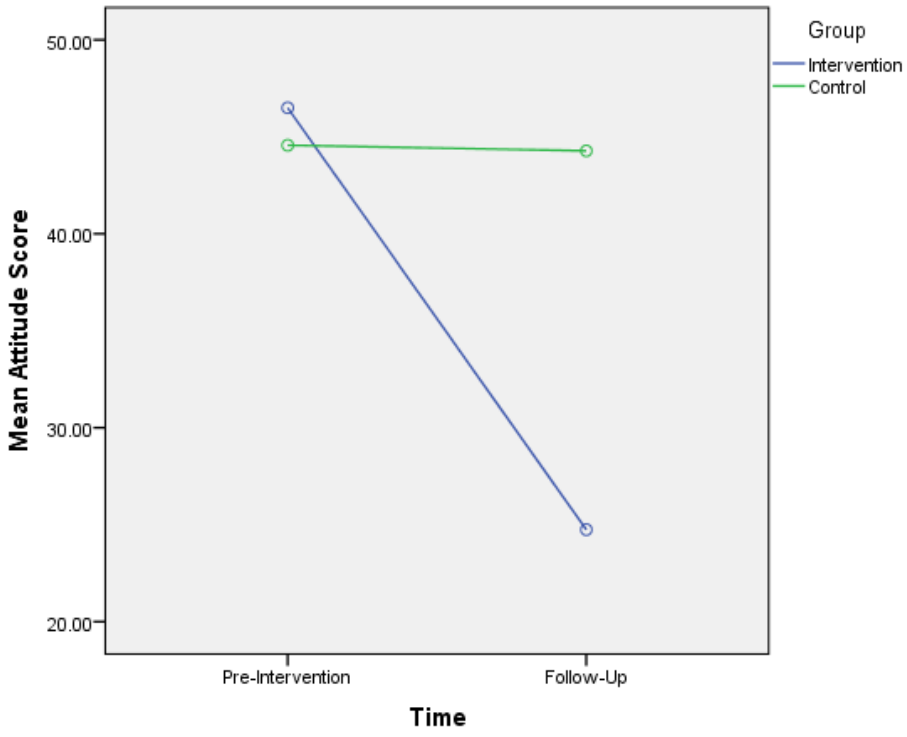


Figure 2.5. Mean attitude scores for female participants at pre-intervention and follow-up, split by group: intervention or control.

In summary, there was no significant difference between intervention (DE) and intervention with implementation intention planning (DE+II) groups' follow-up TPB scores. Therefore the two experimental groups were collapsed to form one general 'intervention' group. Pre-intervention, intervention group females and males had similar TPB and attitude scores. At follow up, all intervention groups' TPB and attitudes scores were significantly lower, i.e. safer, than all control participants'. Intervention group females demonstrated the biggest improvement on all measures. The males and females in the control group had similar pre-intervention and follow up TPB and attitude scores.

2.4 Discussion

The aim of the present study was to evaluate the effectiveness of the Learn2Live road safety intervention, and the potential additional benefit of implementation intentions, on pre-drivers' self-reported attitudes and intentions to behave safely as a passenger. It was thought that understanding what was effective at reducing young peoples' risk on the road would help to inform theory regarding why young drivers and their passengers are so at risk. The prediction that participants who attended the intervention would report less risky attitudes and TPB scores at follow-up was partially supported by the data: females reported much safer attitudes and scores on all TPB measures after attending the intervention and males showed some smaller improvements on specifically their attitudes and intentions. Although the effect sizes were smaller than for intervention females, the intervention males' scores were significantly safer than control males' scores on these measures at follow-up. The prediction that the control group would not report safer intentions and TPB scores at follow-up was supported by the data, with both males and females in the control group reporting similar risky attitudes and TPB scores at both time points. The present study did not look for an effect of implementation intention plans on attitudes and TPB scores, because of the very low response rate of intention plans obtained.

Despite a large number of interventions being run across the UK (Launchbury et al, 2007) the number of evaluations conducted investigating their effect remains low (McKenna, 2010). Therefore the results provide much needed insight into the efficacy of a large scale young driver intervention. They are partially in line with previous research (e.g. King et al, 2008) in that for young females the intervention appeared to successfully improve their attitudes and intentions to behave safely as a passenger. However the results also reflect findings of other studies (e.g. Poulter & McKenna, 2010; Glendon et al, 2014) that have shown few long-term positive effects from these interventions. In the present study young males were least likely to report safer attitudes and intentions after the intervention, suggesting that they are not being effectively targeted. Given that young males tend to be higher sensation seekers (Zuckerman, 1994), and less likely to respond to fear-appeal-style persuasion (Lewis, Watson & Tay, 2007), this may

explain why they were less likely to report improved attitudes after the intervention. In order to reduce young males' risk more effectively, further investigation is needed to identify the underlying causes that make them more prone to risky driving tendencies.

The use of implementation intention plans has been found to have a positive effect on a range of health-related behaviours (e.g. Luszczynska et al, 2007; Prestwich et al, 2003). This was the first known study conducted investigating the effect of implementation intention plans on pre-drivers' self-reported behaviour, and participants who completed the plans in addition to attending the intervention reported the safest TPB scores three months post-event. However their scores were not significantly safer than those who just attended the intervention, so this study cannot provide conclusive support for the use of such plans in deterring risky passenger behaviour.

Despite the insignificant findings, it should be noted that this was a first-of-its-kind exploration for using implementation intention plans to improve young people's passenger behaviour, and further investigation using more comprehensive methods may be useful. Previous studies investigating the use of implementation intentions have often used face-to-face interview-style methods in order to ensure participants fully understood the task and how to complete their plans (e.g. Luszczynska et al, 2007). However in this study the large population from which the sample was drawn meant that it was not possible to conduct individual training sessions. Therefore participants in this study had to make their plans alone, without any formal training or guidance about how to effectively design one. This may have resulted in them not understanding the concept of an implementation intention, and thus this may have affected both the likelihood that they would complete one in the first place (hence the low response rate) and also their understanding about what was required of them after the questionnaire was complete. Therefore it may be that the use of implementation intention plans are only suitable in a face-to-face setting with an experimenter present, to ensure that participants fully understand and engage with the process.

Similarly whilst both Elliott and Armitage (2006) and Brewster, Elliott and Kelly (2015) used a pre-determined driving behaviour that participants had to make an implementation intention plan for – complying with speed limits - participants in the present study were not given a particular behaviour to consider, and this lack of direction may have increased confusion and lack of engagement. However participants were given the freedom to choose one particular behaviour of their choice because previous evidence has shown that both too much choice, and too little, can have an effect on the efficacy of implementation intentions. For example Chapman et al. (2009) found that implementation intentions were only effective at increasing young adults' intake of fruit and vegetables when they made a specific plan, linking a situational cue with a response for a particular behaviour. "Global" plans, on the other hand, that failed to specify a situational cue with a goal-directed response, did not result in any increased intake of healthy produce. Therefore in this study participants were not required to make "global" safe-driving plans, but instead chose one particular behaviour and considered a specific cue and response to reduce their risk.

In line with this, participants were not given a predetermined, or prescribed, behaviour to change because previous evidence has shown that individuals need to feel personally motivated to change their behaviour, otherwise implementation intentions may not be effective. For example the findings from Brewster, Elliott and Kelly's (2015) study showed that only participants who reported that they drove above the speed limit more often than they intended to, actually reported reduced speeding after completing their implementation intentions. For all other participants, implementation intentions were not effective at reducing their self-reported speeding behaviour. This suggests that motivation to change is crucial in determining the effectiveness of implementation intentions, and if participants are not concerned by their current behaviour or do not want to change, implementation intentions are less likely to be effective. For young passengers, there are a range of risky behaviours they may consider more or less relevant to them personally, so to avoid excluding any potential participants that felt

unmotivated by a behaviour presented to them, it was considered necessary to let them decide for themselves which behaviour they wanted to improve. Fylan and Stradling (2014) suggested that future young driver RSIs may benefit from incorporating a wider range of behavioural change techniques to support young drivers as they attempt to make their roadway behaviour safer. The findings here do support this notion and it be might that an individualised approach, supporting young people throughout the change making process, may result in better engagement and more positive behavioural change outcomes.

Evaluations of young and pre-driver interventions in various countries have found inconsistent effects (e.g. Glendon et al, 2014; Poulter & McKenna, 2010). The present study found that Learn2Live was more convincingly effective for females than for males in improving their risky passenger intentions. Previous studies have found that females are more likely than males to feel that safety messages are relevant and effective for them (Glendon & Walker, 2013) and there is some evidence that fear appeals are more effective for females than for males (e.g. Tay & Ozanne, 2002; Goldenbeld, Twisk & Houwing, 2008). Tay and Ozanne (2002) evaluated an Australian road safety intervention and found that young females and older males (aged 35 – 54) had reduced collision rates following the intervention, but the main target group – young males – remained unaffected. Therefore the findings here are in line with previous studies concerning young females' responses to fear appeals and it might be that they responded well because they felt personally involved in the messages that were conveyed. In line with EPPM (Witte, 1992) it might be that the females perceived the threat of risky driving to be high following the Learn2Live intervention but also perceived themselves able to behave in line with the messages conveyed.

Gender differences in unsafe driving behaviour have been found in various studies (e.g. Lonczak et al, 2007) and young males are often reported to be involved in more high risk driving behaviour than females. Therefore although we found some safer intentions amongst the intervention group males in this study, their heightened risk (over and above their female

counterparts) means it is critical that we continue to build upon these findings in understanding what underpins their heightened risk. It might be that we need to consider personality and psychological influences on young males' behaviour in order to better understand their motivations for risky driving and how to target them (Deery, 1999; Glendon et al, 2014). To understand the reasons behind young males' heightened risk, and design more effective young driver interventions, further exploration into the influence of personality factors associated with young males' risky driving behaviour may prove invaluable (Ulleberg & Rundmo, 2003).

Further to this, it has previously been reported that young drivers recognize that fear appeal style interventions are trying to scare them (Crohn, 1998) and for young males this may result in a "rebound effect". They know that they are trying to be scared into changing their behaviour, and as a result may rebel against the expected outcome (Glendon & Walker, 2013; Nestler & Egloff, 2010). This is in line with terror management theory which suggests that people use defence mechanisms to cope with the distress that accompanies a fear of death (Greenberg et al, 1986). The Learn2Live intervention is based on the recall of highly emotive, anecdotal stories that attempt to influence young peoples' behaviour by showing them the potentially tragic consequences that can happen as a result of risky driving. Whilst this format was relatively effective for young females, it might be that young males used unconscious defence mechanisms, brought on to reduce their fear, in order to deny vulnerability, exaggerate immunity and suppress their threat of death (Pysczynski et al, 1999). Similarly whilst females are likely to report feeling that safety messages are relevant and effective for them, males are more likely to experience a "third person effect" whereby they perceive the message to be effective for other people, but not for themselves (Glendon & Walker, 2013). This is another example of a defence mechanism used to suppress their fear, and it may have contributed to their lack of engagement with Learn2Live, because they are able to convince themselves that the consequences are not applicable or unlikely to happen to them.

The findings in this study showed that young males were relatively unaffected by threats and punishment-oriented techniques focusing on long-term negative consequences. This provides some insight into what underpins young males' risk-taking behaviour, in that they might not perceive their own behaviour as being particularly risky and in need of changing (i.e. the aforementioned "third person effect"); or it could be that their desire to engage in sensation-seeking risky driving is so high that they are willing to accept the elevated risk. This then poses the question, what do young males personally get from thrilling, risk-taking behaviour? It might be that they enjoy the thrill, and this in itself is a rewarding feeling that they want to replicate. It might be then that young males have a heightened sensitivity to reward and a heightened sensation-seeking instinct, which is then manifested in their seeking of thrilling, adrenaline-evoking events, of which risky and reckless driving is one. The possibility that reward sensitivity may underpin the risky behaviour of young males is a concept discussed further in the next chapter.

Consideration should also be given to the outcome measures used in this study. As mentioned previously collision data is often considered unreliable as a measure of young driver risk due to the variability in collision numbers and the relatively low frequency of their occurrence (Hutchinson and Wundersitz, 2011). Therefore in this study self-reported attitudes and behavioural intentions to behave safely as a passenger were used as indirect measures of the effectiveness of the intervention. However recent evaluations of interventions using attitudes and risk perception as outcome measures have not found consistent positive effects of interventions on reduced risk. Poulter and McKenna's (2010) Safe Drive Stay Alive evaluation found that whilst short-term improvements in attitudes were observed immediately post-intervention, when followed up five months later these positive effects had substantially deteriorated. Similarly Brijs et al. (2014) found that although drivers reported more risk-related knowledge after engaging in the On the Road intervention, their actual ability to detect risks remained unchanged. Even more worryingly, Glendon et al. (2014) found an Australian school-based intervention actually had the potential to increase risky attitudes. It might be that the

efficacy of these interventions is limited by the nature of their single occasion delivery. For example Elkington (2005) noted how one-off events tend to be less effective because their key messages are not reinforced over time. In order for interventions to be more effective in the future, they may need to repeat information and reinforce key messages more than once. The results from these studies indicate that current interventions may have at best short-term improvements to young peoples' attitudes, and without reinforcement these positive effects may deteriorate quickly post-intervention.

The results from this study should also be interpreted within the constraints of the methodology. Learn2Live is designed by Devon County Council, who organise the delivery of the intervention to certain schools within the catchment area. Therefore it was not possible to randomly assign participants to each condition (intervention or control). Due to a large number of schools across the UK participating in road safety interventions of some kind (Launchbury et al, 2007) it was also challenging to source an appropriate control group. Despite this we did select schools with similar characteristics to participate in the study, and participants from each condition were the same age, in the same year of school (Year 12) and were all pre-drivers. Therefore whilst the assignment of intervention and control conditions to each school was not able to be random, there were attempts made to minimise all other confounding differences between the participating schools.

Compared to the number of students who attended the intervention, the response rate at each time point was relatively low. Therefore it is possible that the group of participants who answered the questionnaire may be in some way different to those that did not consistently respond. For example those providing full datasets may be particularly conscientious and diligent, which may differentiate them in other ways from individuals less careful with their responses. Similarly, it is possible that those who did not provide responses at follow-up may not have done so for reasons relating to their risky passenger behaviour, for example they may have felt embarrassed by their lack of engagement with the intervention, or reluctant to share

their true passenger behaviours. Anonymity codes were used to identify and match participants' responses at each time point, and it was hoped that by preserving their anonymity participants would be less concerned with answering in a socially desirable way. However due to the self-report nature of the questionnaire this is still a possibility, and should be kept in mind when interpreting the results.

In conclusion the findings from this study suggest that participants who attended Learn2Live reported much safer attitudes and intentions to behave safely as a passenger three months after the event. This effect was particularly evident for females; much less so for males. Year 12 students of the same age that did not attend Learn2Live or any other road safety intervention showed no such improvement in attitudes or intentions to behave safely over the same time frame. The results suggest that whilst the intervention may be effective in improving young females' safe passenger behaviour, an alternative approach may be necessary to better engage young males. The young males in this study were relatively unaffected by the fear-inducing threats of long-term negative consequences. This suggests that their desire to engage in risk-taking behaviour may over-ride consideration of negative outcomes, and this may be driven by the rewarding feeling that accompanies high-risk, sensation-seeking activities. Therefore the next chapter presents two studies that were conducted to investigate the role of reward sensitivity and age in risky decision making, in order to better understand whether heightened reward sensitivity underpins greater risk taking in young males.

Chapter Three

Exploring the Relationship between Reward Sensitivity and Risky Decision Making

3.1 Introduction

We know that young drivers' high risk is due to skill deficits, risky behaviours and attitudes. The evaluation conducted in chapter two showed that the intervention was very effective for improving females' attitudes and intentions to behave safely; but was less so for males. This may be because interventions tend not to consider the delivery of the message they are trying to convey; and how personality factors may influence how young males respond to fear appeal interventions. Previous attempts to make young drivers safer, including the intervention evaluated in chapter two, have not sufficiently considered the influence of personality factors and their role in determining young drivers' risky behaviour (Ulleberg & Rundmo, 2003).

As we reported in chapter one, personality characteristics have previously been implicated in the display of various risky driving behaviours among young drivers. It has been found, for example, that young people who score themselves high on measures of sensation seeking, characterised as a need for "varied, novel and complex experiences combined with a willingness to take physical and social risks to achieve such experiences" (Zuckerman et al, 1994), are more likely to engage in speeding, drink driving, aggressive driving and non-use of seatbelts than the young drivers scoring as low sensation seekers (Delhomme, Chaurand & Paran, 2012; Jonah, Thiessen & Au-Yeung, 2011). This is particularly true of young males, who were those less likely to respond to the intervention evaluated in chapter two. Therefore considering personality characteristics associated with risk-taking behaviour might provide understanding about what underpins this risky behaviour, and will enable more effective ways of targeting the high risk young male group of drivers to be developed.

3.1.1 High Risk Group

Although personality has not been found to predict traffic collisions directly (Ulleberg & Rundmo, 2003) it exerts its influence indirectly through encouraging engagement in risky driving behaviours which increases the likelihood of a collision as a result (Elander et al, 1993). It has been suggested that personality should be viewed as a disposition that increases and emboldens the driver's enthusiasm for consistent risky and aggressive driving which in turn increases the chances of collision (Constantinou et al, 2011).

Characteristics such as underestimation of risk, fearlessness and aggression are often considered to be factors associated with young drivers' risky driving behaviour (Constantinou et al, 2011) and there is much research evidence supporting the association between young drivers with sensation-seeking tendencies and their likelihood to engage in risky driving. Using questionnaire measures Jonah et al. (2001) found that college students scoring high on sensation seeking scales were more likely to report that they drove whilst under the influence of alcohol, and frequently in a risky and aggressive manner. Similarly Dahlen et al. (2005) found that young adults scoring high on impulsivity measures; a characteristic defined as a propensity to engage in behaviours without appropriate regard for their consequences (Whiteside & Lynam, 2003), were found to be more likely to drive in a risky and aggressive style, be less aware of traffic signs, and had an increased proneness to crashes (Dahlen et al, 2005).

Factors influencing young peoples' propensity for risk can be summarized as both social and developmental, and are not necessarily unique to the driving context. The age of adolescence involves activities such as social freedom and legal access to alcohol. This, in addition to incomplete neurological development related to suppression of impulsivity and risk, elevates young drivers' risk substantially, as the areas of the brain associated with inhibition of impulsivity and risk-taking do not fully mature until the mid-20s (Giedd, 2004). Therefore young drivers (aged 18 – 25 years) are obtaining a driving license at the precise time that opportunity and appetite for risk-taking and sensation seeking are at their highest. In line with

this it is therefore not surprising that those young drivers who possess elevated levels of aggression, impulsivity and sensation-seeking are at the highest level of risk (Rimmö & Åberg, 1999).

Sensation- seeking behaviours are more prevalent amongst young males than the general population (e.g. Turner & McClure, 2003) and this contributes to their heightened risk. Now we are interested in why young drivers, particularly males, want to engage in sensation seeking driving and what other personality factors may be involved that contributes to their heightened risk-taking. Consideration of these potential underlying influences may help to better understand and reduce young drivers' risk.

3.1.2 Motivational Systems

The way in which young people drive, and the level of risk they accept whilst in control of a car, differs substantially from individual to individual. A proposed explanation to account for these differences is Gray's (1980) reward sensitivity theory (Franken & Muris, 2005) in which it is suggested that there are two basic motivational systems in the brain, behavioural activation system (BAS) and behavioural inhibition system (BIS) that mediate an individual's response to any given event in his or her environment (Genovese & Wallace, 2007). The model posits that differing levels of activity within these two systems are displayed behaviourally as the personality traits of sensitivity to reward and sensitivity to punishment.

BAS controls approach behaviour and is activated only by conditioned signals of reward or non-punishment whereas BIS is responsible for avoidance of an action in response to punishment, frustrative non-reward and novel stimuli. When the BIS is activated, inappropriate behaviours are suppressed and response choice becomes more selective (Avila, 2001). Thus these signals determine approach or active avoidance behaviour. An individual with an overactive BAS will display high sensitivity to reward and thus have trouble with inhibitory learning due to this strong motivation towards rewards; whereas those with an underactive BAS are less likely to be

affected by temptation of a reward, with them being primarily concerned with predicting and avoiding the aversive consequences experienced as a result of a particular event. An individual with an overactive BIS is likely to display high sensitivity to punishment, and is thus more prone to response inhibition when faced with punishment cues; whereas those with an underactive BIS will be less likely to be deterred from an action by a punishment cue. (Avila, 2001; Torrubia, 2001; Avila & Torrubia, 2004).

In line with this theory it is suggested that people displaying high levels of risk-taking may have a particularly overactive BAS and underactive BIS, explaining their particular relish for thrills and indifference to punishment (Torrubia et al, 2001). For example, Penolazzi et al. (2012) used the Columbia Card Task (CCT) (Figner et al, 2009) to explore the way in which various personality traits affects people's risky decision making. Participants have to decide how many cards to pick from a deck of 32 hidden gain or loss cards. They have to try and maximise their total score and base their decision on three game parameters: loss probability, the gain amount of the cards, and the loss amount of the cards. The CCT dissociates the processes of emotional decision making (i.e., the Hot version of the task) and deliberative decision making (i.e., the Cold version) by varying the amount of information participants receive when making card selections. In the hot version of the task participants turn one card at a time and receive feedback after each choice. They can choose to stop selecting cards at any point or continue until a losing card is selected. By contrast in the cold version of the task participants decide at the start how many cards they will turn over, and only receive feedback at the end of the task. For both versions of the task, the number of cards chosen represents the degree of risk-taking the participant engages in. Penolazzi et al. (2012) found that participants scoring high on responsiveness to reward were more sensitive to variations in gains and losses when playing the emotional (i.e. the hot) version of the task. Specifically, high reward-responsive participants could be selectively persuaded by high gains to underestimate the potential co-occurring high losses.

Young people with a high sensitivity to reward have been found to display higher levels of engagement in various risky health-related behaviours. For example Genovese and Wallace (2007) found that secondary school students who were rated as having a high sensitivity to reward and low sensitivity to punishment, reported the highest levels of substance use compared to their peers. Similarly, Simons and Aren (2007) found that marijuana users were more likely to report lower punishment sensitivity and greater reward sensitivity than non-users. Fay et al. (2014) found that sensitivity to food reward, but not generalised reward, was associated with overconsumption of high-calorie foods; and young women who abuse alcohol and have dysfunctional eating have been found to exhibit a heightened sensitivity to reward (Loxton & Dawe, 2001). These findings support the notion that there may be underlying motivation systems that contribute to an individual's response to their environment, and heightened reward sensitivity may be related to various risky health-related behaviours. In the context of driving, those who are relatively insensitive to the threat of punishment and seek activities that offer them high immediate reward, may be those at greatest risk of engaging in risky behaviours that increase their risk of collision.

When considering BAS and BIS systems in relation to risky driving, it has been found that those with a high sensitivity to reward, and thus an overactive BAS, tend to have a greater number of traffic violations, while those with a high sensitivity to punishment, related to an overactive BIS, are more likely to display a greater degree of compliance to road safety laws (Castellà & Pèrez, 2004). Similarly, Constantinou et al. (2011) used self-report measures to investigate the link between personality characteristics, young drivers and risky driving and found that those scoring high on sensation seeking and impulsivity measures as well as high sensitivity to reward, were more likely to report more driving errors, lapses in attention and aggressive violations than low scorers on these measures. By contrast, only more mistakes were reported by those high on sensitivity to punishment (Constantinou et al, 2011).

In a related study, Hayashi et al. (2015) investigated the role of delay discounting in young drivers' decision to text while driving. They suggested that texting while driving involves a trade-off between immediate and delayed outcomes, manifested behaviourally as a preference for smaller immediate rewards i.e. short text messages while driving, over delayed larger rewards i.e. a longer conversation at some point later when not driving. Participants reported their own texting while driving behaviour and then completed a delay discounting task in which they had to make a series of choices between a smaller amount of hypothetical money available immediately and a larger amount of hypothetical money available after some delay. They found that participants who frequently text while driving discounted delayed rewards at a greater rate than the matched control participants (those who did not report texting while driving). That is, young drivers who reported frequently texting while driving tended to display a preference for smaller immediate rewards, rather than wait for larger delayed rewards. These findings support the notion that young drivers might engage in risky driving behaviours because they appreciate the immediate rewards that follow.

The research to date suggests that the young drivers most likely to drive in a risky manner and whom are most likely to be involved in a collision are those who score highly on sensation seeking and impulsivity measures, and correspondingly may have an overactive BAS and underactive BIS. In behavioural terms this means that the riskiest drivers may be driven primarily by a strong motivation for reward (high BAS) and are relatively unaffected by the fear of punishment (low BIS). If this is the case then to effectively reduce young drivers' risk, interventions may need to be designed in a way that focuses on rewarding young people for safe driving, rather than punishing them for unsafe or risky driving.

Penolazzi et al.'s (2012) study investigated the possibility that the personality trait reward sensitivity may influence risky decision making in contexts where deliberation of gains versus losses must be considered. This is what would underpin the relationship between an overactive BAS and risky driving, in the sense that young drivers might be accepting high levels of risk in

order to achieve a rewarding thrill. Whilst Penolazzi et al. (2012) used the CCT to investigate the relationship between reward sensitivity and risky decision making, a more established measure of risk-taking to be used in this context is the Iowa Gambling Task (Bechara et al, 1994).

3.1.3 Iowa Gambling Task

The Iowa Gambling Task was developed by Bechara et al. (IGT, 1994) in order to study the decision-making deficits found in patients with ventromedial prefrontal cortex (vmPFC) lesions. Despite these patients having intact cognitive and memory abilities, they tend to display problems when considering the consequences of their actions and when learning from their mistakes. The IGT was designed to mimic real-life decision making in an experimental setting. Participants select cards from four available decks that differ in the amount of fictitious monetary reward and punishment they are associated with. They are told to choose cards that maximise their long-term outcomes, but are unaware that the reward and punishment outcomes are fixed. Decks A and B contain risky cards that have high immediate rewards but even higher occasional losses, and decks C and D contain safer cards that have smaller immediate rewards but also smaller losses.

During the first few deck selections, when participants are making decisions under ambiguity and do not know the rules associated with each deck, it is assumed that decisions are made based on “gut feelings”, or unconscious emotions (Bechara, 2005; Bechara et al, 1997; Brand et al, 2007). However as the task goes on and participants have more explicit understanding about the risks and benefits associated with each deck, their decision making is more likely to be based on a conscious level, with deliberation of risk and informed judgement occurring (Brand et al, 2007). In this way, the IGT can provide information about how people make risky decisions and the level of risk they accept in order to obtain a reward.

Although Decks A and B are equivalent in their overall total loss, Deck A is often perceived as more disadvantageous than Deck B (Bechara et al, 1994). Prospect Theory (Kahneman & Tversky, 1979) explains this discrepancy by the differences in frequency of loss between the two decks. The punishment from Deck A is highly frequent and almost certain, whereas the punishment from Deck B occurs less frequently and is therefore less probable. Prospect Theory suggests that given the choice between a sure loss versus a possible loss – even though the possible loss will be of higher magnitude – people tend to prefer the less probable punishment and thus choose from Deck B. Although Deck B is a disadvantageous deck Bechara et al. (1994) noted that some individuals continue to choose from it, particularly those who are sensation seekers and have a high tolerance for risk. A similar pattern is often seen in choices from Decks C and D. Although both are equivalent in terms of overall total gain, most people prefer Deck D. According to prospect theory this is because punishments are less probable from this deck, occurring less frequently than from Deck C. Bechara et al. (1994) suggested that individuals highly sensitive to punishment may tend to avoid Deck C, as although it is an advantageous deck, punishments from this deck are highly frequent in comparison to Deck D.

Success on the IGT can be achieved when participants sacrifice the decks offering them high immediate rewards and instead choose those that offer smaller gains but minimise the risk of long-term loss. The foundation for using the IGT to test the decision making capacity of vmPFC patients is based on the assumption that healthy participants will choose this decision-making route, basing their choices on long-term outcomes and so choose the safe cards because they will see that the risky decks are associated with long-term negative outcomes and so will avoid them (Caroselli et al, 2006).

The assumption that healthy participants will learn to choose the safe decks is crucial to the validity of using the IGT to test vmPFC patients, however recent research has cast doubt over this assumption. For example, Caroselli et al. (2006) found that healthy participants often base their deck selection on the frequency of losses; preferring the decks that offer them infrequent

losses (decks B and D), rather than basing their decision on the long-term outcome of the game i.e. choosing decks associated with smaller gains rather than risk larger losses by choosing decks with larger wins. This unexpected finding from the IGT is termed the Prominent Deck B Phenomenon and when Dunn et al. (2006) conducted a meta-analysis of IGT studies they found that many participants including normal, unaffected individuals displayed this preference for Deck B, a "disadvantageous" deck.

Lin et al. (2007) investigated this notion further, presenting participants with a two-stage simple version of the IGT in which participants first selected cards from an AACC format (which had a balanced gain-loss frequency of 5 gains and 5 losses per 10 trials) and then a BBDD format (which had a high-frequency gain and low-frequency loss of 9 gains and 1 loss per 10 trials). This enabled the researchers to monitor participants' preferences after the first 100 trials. Lin et al. (2007) found that even after 100 trials participants failed to develop a preference for the "advantageous" deck D over the "disadvantageous" deck B, suggesting that healthy participants may not be driven by long-term outcomes but by other factors instead. The authors proposed that high-frequency gain may be the primary influence in participants' preference for deck B, because as well as being associated with bigger monetary gains, the win: lose ratio within deck B assures participants that they are much more likely to win, and with a bigger amount, than if they choose from one of the other decks. It was concluded that preference for the high-frequency gain deck B indicates that a bad long term outcome does not mean that participants will end up choosing to avoid it, and thus they are not in fact considering the long term negative consequences of their decisions at all.

A meta-analysis conducted by Steingroever et al. (2013) who analysed the findings of various studies of the IGT involving healthy participants, concluded that healthy participants frequently showed idiosyncratic choice behaviour, and often preferred the decks that were associated with infrequent losses, as opposed to simply the decks that had a large punishment regardless of the frequency with which it appeared. Rivalan et al. (2009) investigated the relative disparity in

healthy participants' deck choices, by developing a rat version of the IGT that assessed for the first time the ongoing decision making process within a single session. The authors presented rats with various options, with the disadvantageous ones offering a larger immediate food reward but were followed up with longer unpredictable time-outs. They found that whilst the majority of rats worked out the favourable options rapidly, some systematically chose disadvantageously, regardless of task complexity; suggesting that poor decision making did not occur as a result of failing to learn the information needed to make an advantageous decision, but from a hypersensitivity to reward and higher risk taking.

Similarly, Franken and Muris (2005) investigated whether individual differences in personality would predict performance on the IGT on a small sample of college students. They found that whilst impulsivity did not predict IGT performance, there was a relationship between sensitivity to reward and sensitivity to punishment on participants' overall IGT performance. More recently Buelow and Suhr (2013) considered the relationship between state mood, personality characteristics and deck selections on the IGT. They found that whilst mood had little effect on deck selections, those high in sensation seeking and impulsivity made more Deck B selections and fewer Deck D selections; and BAS-Drive i.e. the persistent pursuit of desired goals, was also associated with greater Deck B and fewer Deck D selections.

The present study provides further investigation into the relationship between reward sensitivity, punishment sensitivity and risk taking behaviour on the IGT (Bechara et al, 1994). It has already been shown that some healthy participants choose deck B more often than the other decks, suggesting that some people do not base their decisions on long-term outcomes, but rather display a preference for cards that offer high immediate gains and relatively infrequent losses (Lin et al, 2007). In addition, studies such as those conducted by Franken and Muris (2005) and Buelow and Suhr (2013) have found a relationship between individuals' reward sensitivity, punishment sensitivity and the number of cards chosen from specific decks on the IGT. Whilst these studies do appear to support the idea that reward sensitivity may underpin the

risky decision making of some individuals, there has yet to be any consideration of potential gender differences in sensitivity to reward and risk-taking on the IGT. As young males tend to drive more riskily than females, and are at a higher risk of collision, it is especially important to uncover what may underpin their risk-taking behaviour. If reward sensitivity does underpin risky behaviour we would expect to see young males scoring high on this measure because young males are those most likely to engage in high risk driving. On this basis it is expected that reward sensitivity will motivate young males to accept more risk on the IGT when attempting to win rewards and so they will consistently choose more cards from the risky Deck B throughout the task.

We are interested in looking at the relationship between reward sensitivity, punishment sensitivity and risky decision making because the findings have the potential to direct future road safety initiatives. As seen in chapter two current road safety campaigns tend to be oriented around punishments and focus on attempting to educate young people about the negative consequences of risky driving. However it may be that some young people, particularly young males, make choices that reflect a particular sensitivity to reward rather than punishment, and might display this decision making process in their IGT performance. If reward sensitivity does underpin males' risk-taking behaviour then this might explain why males and females responded differently to the intervention in chapter two. This would also then have implications for the best way to advocate safer driving for young males; and using rewards as incentives, such as fuel vouchers or reduced insurance premiums, may prove more effective in promoting continued safe driving than a punishment-oriented approach.

Studies investigating the relationship between reward sensitivity and risk-taking on the IGT (e.g. Buelow & Suhr, 2013; Lin et al, 2007) have not considered potential gender or age differences. Therefore the next two studies investigated the relationship between risky behaviour and reward sensitivity for young males and females, and older males, using the Iowa Gambling Task (Bechara et al, 1994). Participants select cards from four decks that differ in the

amount of fictitious monetary reward and punishment they offer. Selecting from Deck B is risky but those with a high tolerance for risk - in particular, males - may choose from it as rewards are high with only a possible chance of loss. Those who are sensitive to punishment may avoid Deck C as although it is not risky punishments are frequent.

Thus there were two hypotheses for the present study:

a) High BAS scoring males, from here on in referred to as 'sensitive to reward', would choose more cards from Deck B, i.e. make more risky choices, than low BAS scorers throughout the task.
b) High BIS scorers, from here on in referred to as 'sensitive to punishment', would choose fewer cards from Deck C, i.e. fewer risky choices, throughout the task than low BIS scorers.

3.2 Study Two a: The Relationship between Reward Sensitivity and Risky Decision Making

3.2.1 Method

3.2.1.1 Participants

A total of 120 participants (71 females) aged 18 – 25 years old (Mean age = 21.2 years SD = 1.86) completed the present study. As the study was not related to driving behaviour or experience at this point, no data regarding previous driving experience was obtained. Paid participants were recruited via the University of Plymouth paid participant pool and from advertisements around the University campus; and undergraduate psychology students also participated for course credit.

3.2.1.2 Materials

The Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (SPSRQ) (Torrubia et al, 2001)

Participants completed the 48 yes-no response item questionnaire which incorporates two scales – sensitivity to punishment (24 items) and sensitivity to reward (24 items). This scale measures the behavioural expressions of Gray's BIS/BAS by assessing a tendency to avoid punishment and frustrative non-reward and the tendency to approach or prefer rewarding situations. Participants respond 'yes' or 'no' to each item, and their score is based on the total number of positive responses for each of the two subscales. A typical item for the Sensitivity to Reward scale (SR) is, "do you sometimes do things for quick gains?" An example of an item from the Sensitivity to Punishment scale (SP) is, "Generally, do you pay more attention to threats than to pleasant events?" See Appendix 3A for the full questionnaire.

The Iowa Gambling Task (Bechara et al, 1994)

Participants completed a computerized version of the Iowa Gambling Task (IGT, Bechara et al,1994) in which they had to select a card from four available decks varying in their amount of

imaginary monetary reward and punishment. Rewards and punishments were the same as those described in Bechara et al. (1994). Participants were given an imaginary sum of $2000 and presented with four decks of cards. They were told to successively choose cards from the four decks to maximise their long-term outcome. Each time participants chose a card they received feedback on the reward and loss associated with that card, and their running tally. Participants were unaware that the reward and punishment outcomes were fixed, and each of the four decks contained a different payoff scheme. Decks A and B (known as 'bad' or 'disadvantageous' decks) offered high, immediate constant rewards but with even higher, unpredictable, occasional losses resulting in negative long-term outcomes. Decks C and D on the other hand were associated with lower, immediate constant rewards and were accompanied by even lower, unpredictable, occasional losses, thus resulting in positive long-term outcomes. Decks C and D were therefore known as 'good' or 'advantageous' decks (Bechara et al,1994). The decks also differed in the frequency of losses as whilst decks A and C yielded frequent losses, decks B and D yielded infrequent losses. Decks A and B caused participants to lose $250 on average during the course of ten trials, whereas decks C and D caused participants to win $250 on average over ten trials. Participants completed 100 trials and performance on the task was used as evidence of their sensitivity to punishment or rewards in terms of making decisions. See Appendix 3B for a screen shot from the IGT.

3.2.1.3 Procedure

Participants read the information sheet and instructions, after which they signed the consent form and returned it to the experimenter. Participants completed the set of measures on a laptop in their own time. The presentation order of the measures was the same for all participants and was as follows: demographic questions related to their date of birth, gender and education level, then the sensitivity to punishment and sensitivity to reward questionnaire. On completion of the questionnaire participants informed the experimenter who then set up the 'Iowa Gambling Task' on the laptop, whilst the participants read the standardised IGT instruction sheet. The experimenter made sure participants understood the aim of the game and how to play, and then

participants completed 100 trials of the IGT in their own time. Once the trials were completed, participants received a debrief form, were given the opportunity to ask any questions about the study, and were thanked for their time. Participants taking part for course credit were allocated 1 point for their time; paid participants were awarded £4 for their time.

3.2.2 Results

3.2.2.1 Reliability of Measures

Reliability analyses were carried out on the sensitivity to reward and sensitivity to punishment measures to ensure they were reliable. The alpha scores were .75 and .83 respectively, which indicates good and very good reliability for both (Torrubia et al, 2001).

3.2.2.2 Analysis

In a study exploring the influence of reward sensitivity and punishment sensitivity on compulsive buying behaviour, Lawrence et al. (2014) rank ordered each of the responses and divided them in half, producing high and low groups of reward sensitivity and punishment sensitivity. A similar procedure was implemented in this study, whereby the mean scores for each of the measures was calculated, the data was rank ordered and then a median split divided the scores in half. The two halves were labelled as high and low [sensitivity to reward; sensitivity to punishment]. The high sensitivity to reward group consisted of scores over 12.45, and the low sensitivity to reward group of scores less than 12.45. The high sensitivity to punishment group consisted of scores over 12.80 and the low sensitivity to punishment group of scores less than 12.80.

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Table 3.1 provides descriptive information on participants' mean Deck B and Deck C choices on the IGT, separated by gender and organised by sensitivity to reward (HSR/ LSR) and sensitivity to punishment (HSP/ LSP). As can be seen males were more likely to score as highly sensitive to reward rather than low (29: 20); whereas females were more likely to score as being less sensitive to reward rather than high (41: 29). By contrast males were more likely to score as

low in sensitivity to punishment rather than high (33: 16), but females were more likely to score as highly sensitive to punishment rather than low (43: 27).

The number of cards selected from deck B was examined in relation to reward sensitivity scores and the number of cards selected from deck C was examined in relation to participants' sensitivity to punishment scores. It was expected that participants scoring high on reward sensitivity may have selected more cards from deck B because of the relatively infrequent number of losses occurring when compared to potential gains. Whilst this was a disadvantageous deck (with participants losing more money overall than they win) participants with a greater tolerance for risk may have chosen from this deck because of the high potential gains. Conversely people scoring high on sensitivity to punishment may have avoided deck C because losses occurred more frequently on this deck compared to the other advantageous deck, D. Table 3.1 shows that highly sensitive to reward males chose many more cards from Deck B than low sensitive to reward males, whereas reward sensitivity did not appear to affect the number of cards females chose from Deck B. Punishment sensitivity had a slight effect on males' Deck C choices, with highly sensitive to punishment males choosing slightly fewer cards from Deck C than low sensitive to punishment males; however punishment sensitivity did not appear to have an effect on females' Deck C choices, with high and low punishment sensitive females choosing the same number from this deck.

Table 3.1. Descriptive statistics for participants' Deck B and Deck C choices, organised by their sensitivity to reward and sensitivity to punishment scores.

	Males		Females	
	HSR (n=29)	LSR (n=20)	HSR (n=29)	LSR (n=41)
Mean Number of Deck B choices	34	22	27	27
	HSP (n=16)	LSP (n=33)	HSP (n=43)	LSP (n=27)
Mean Number of Deck C choices	25	28	23	23

Reward sensitivity and gender were found to influence the number of Deck B cards chosen. High reward sensitive males chose more cards from risky Deck B than low reward sensitive males or any females. A 2x2 ANOVA revealed a significant interaction between gender and reward sensitivity on the number of deck B cards chosen, $F(1, 115) = 11.81$, $p < .05$; and a simple main effect of reward sensitivity $F(1, 115) = 10.04$, $p < .05$ but not gender $F(1, 115) = .23$, $p > .05$. As Figure 3.1 shows, the interaction appears to have occurred because males scoring high on reward sensitivity chose more cards from deck B than males scoring low on reward sensitivity. All females appeared to choose a similar number of deck B cards, whether they scored low or high on reward sensitivity.

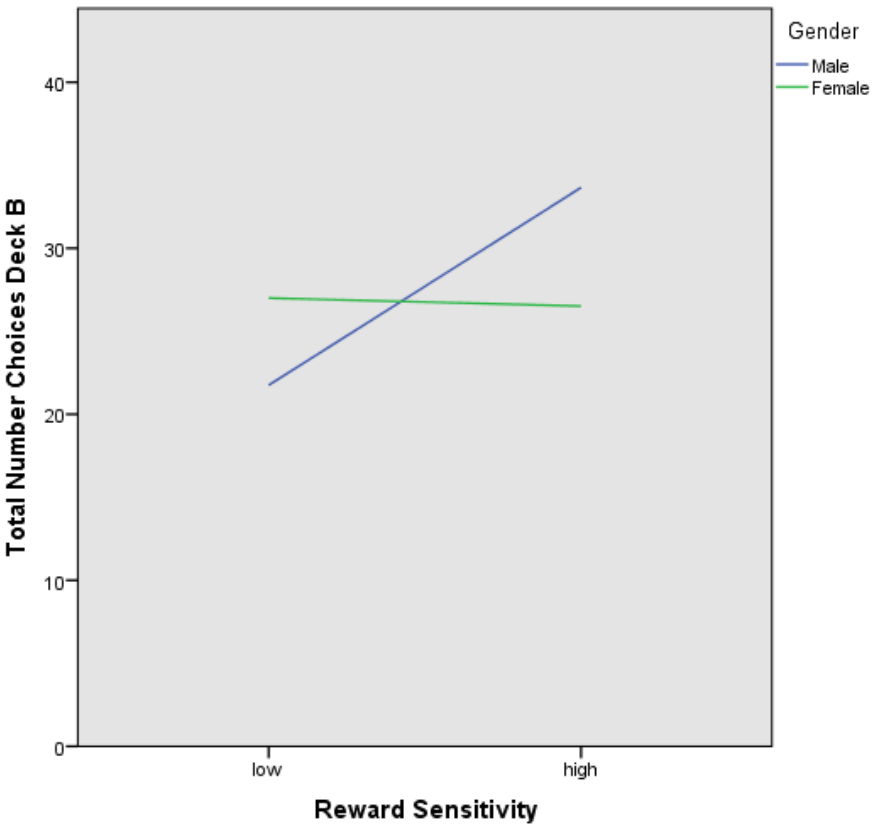

Figure 3.1. Total number of cards chosen from Deck B over 100 trials of the IGT, by high versus low sensitivity to reward male and female participants.

Previous research has highlighted the importance of looking at the learning curve of participants' deck choices throughout the 100 trials of the IGT (e.g. Brogan, Hevey & Pignatti,

2010). In this study, the authors examined the total number of cards chosen from each deck for every 'block' of 20 trials. This provided additional information about participants' decision making patterns, and indicated where certain decks had been learnt to be avoided, and others chosen more frequently. For example a participant may have chosen lots of cards from deck B at the beginning of the task, but after a few blocks of trials learnt that this deck was associated with long-term negative outcomes and stopped choosing from it. If the total number of deck B cards chosen was the only measure used to identify risky decision making, important information relating to the learning curve experienced by the participant would have been lost.

In this way, exploring deck B choices across the 5 blocks of 20 trials can provide an index of learning and strategy used by participants throughout the task. Therefore a 2x2x5 mixed model ANOVA investigated deck B choices across the 5 trial blocks. There was a significant interaction between gender, reward sensitivity and block, $F(4, 460) = 4.4$, $p < .05$. Figures 3.2 and 3.3 show that high reward sensitive males chose more cards from deck B as the task went on whereas all other groups chose progressively less. A simple main effects analysis confirmed the significance of this difference, $F(4, 224) = 10.52$ $p < .05$, suggesting that only reward sensitive males made consistently risky decisions on the IGT; all others made less risky choices as the task went on.

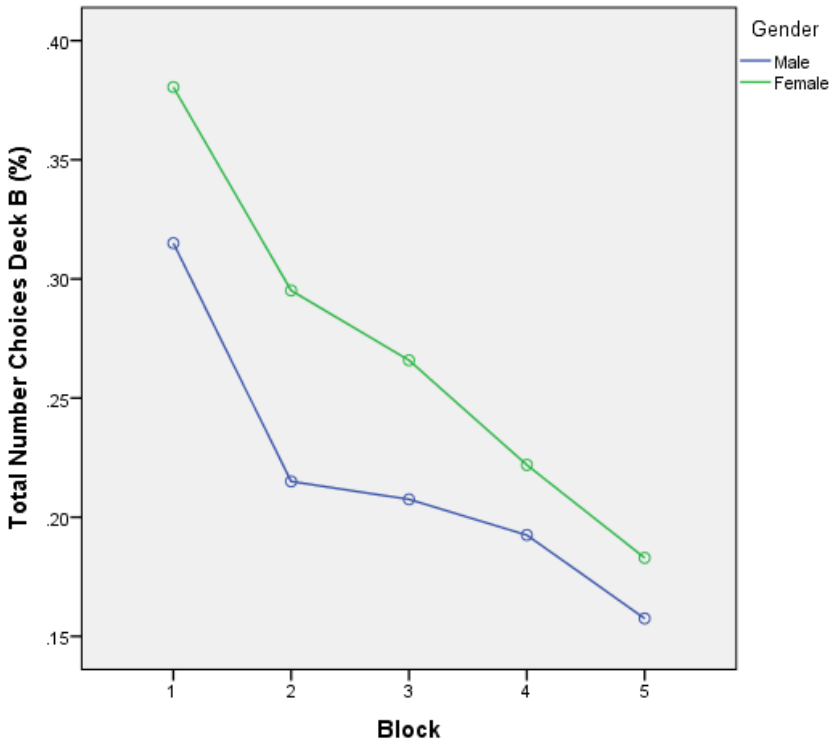

Figure 3.2. Total number of cards chosen from Deck B in each block of 20 trials on the IGT by low sensitive to reward male and female participants over the 100 trials of the IGT.

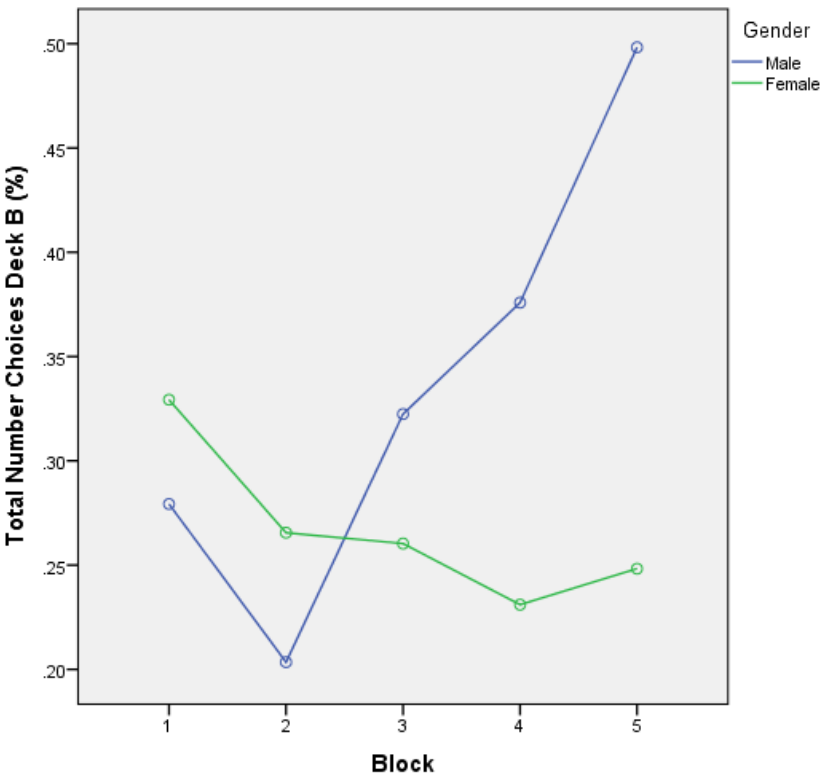

Figure 3.3. Total number of cards chosen from Deck B in each block of 20 trials of the IGT by highly sensitive to reward male and female participants.

A 2x2 between subjects ANOVA found a non-significant interaction between punishment sensitivity and gender on Deck C choices F (1, 115) = .63, p> .05. There was no main effect of gender, F(1, 115) = 3, p> .05 nor punishment sensitivity, F (1, 115) = 1.1, p> .05 (Figure 3.4), but there was a slight trend indicating that low punishment sensitive males chose slightly more deck C cards than high punishment sensitive males. Punishment sensitivity did not have an effect on females' Deck C choices.

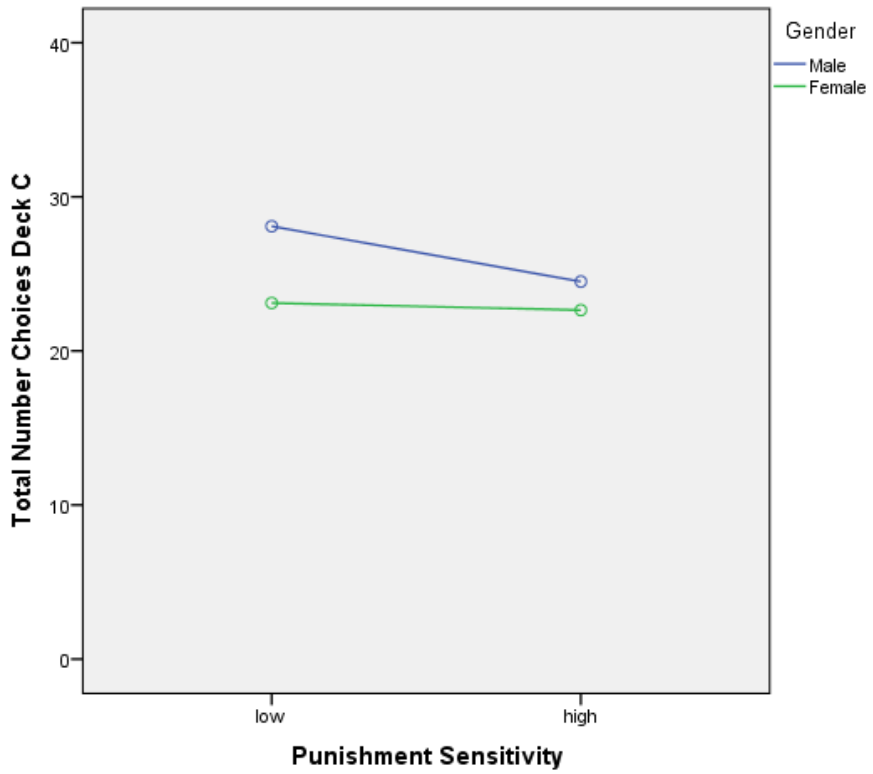

Figure 3.4. Total number of cards chosen from Deck C over 100 trials of the IGT by high and low reward sensitivity male and female participants.

This study found that young males who scored highly on reward sensitivity made more card selections from risky Deck B, throughout the task, compared to low reward sensitive males and all females. These findings suggest that reward sensitivity may underpin specifically young males' risky behaviour because females who were reward sensitive did not display a preference for risky Deck B. This relationship may underpin the differences in males' and females' risky

driving behaviour, and their response to the L2L intervention, because reward sensitivity may only underpin the risky behaviour of young males.

We needed to make sure that the results from this study applied specifically to young males, rather than simply all reward sensitive males in general regardless of their age. It might be that all males who are sensitive to reward are more likely to make risky decisions. If this is the case then heightened reward sensitivity would not adequately explain young males' higher propensity to drive in a risky way. Therefore study two b investigated this notion further by increasing the sample size to include a comparison group of older males, in order to investigate whether reward sensitivity underpins older males' risk-taking in the same way it does for young males.

3.3 Study Two b: The Relationship between Reward Sensitivity, Risky Decision Making and Older Males

3.3.1 Method

The study was conducted using the same overarching measures and procedure as detailed in study two a. Any differences in procedure between the two studies are detailed here. It was predicted that young males scoring high on BAS (sensitive to reward) would choose more cards from Deck B than older males with high BAS scores.

3.3.1.1 Participants

A total of 79 male participants aged 18 – 67 years old (Mean age = 34.5 years SD = 17.23) completed this study. Data for young males (aged 18 – 25 years) was compiled using the same participants from study two a. Therefore there were 30 new participants (aged 42 – 67 years old) recruited via opportunity sampling who made up the older males group.

3.3.1.2 Materials and Procedure

The materials and procedure used were the same as described for study two. Participants read the information sheet and instructions, after which they signed the consent form and returned it to the experimenter. The purpose of this study was to investigate the relationship between reward sensitivity, male participants' age and risky Deck B choices. Therefore only the sensitivity to reward subscale of the SPSRQ was administered. They then completed 100 trials of the IGT on a laptop in their own time. Once the trials were completed, participants received a debrief form, were given the opportunity to ask any questions about the study, and were thanked for their time. All paid participants were awarded £4 for their time.

3.3.2 Results

The mean scores for sensitivity to reward were calculated, rank ordered and then a median split divided the scores in half. The two halves were labelled as high and low [sensitivity to reward]. The high sensitivity to reward group consisted of scores over 13.1, and the low sensitivity to reward group of scores less than 13.1.

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Table 3.2 provides descriptive information on participants' mean Deck B choices on the IGT, separated by age group and organised by sensitivity to reward (HSR/ LSR). As can be seen, highly sensitive to reward young males chose many more cards from Deck B than low sensitive to reward young males. Conversely, low sensitive to reward older males chose more cards from Deck B than highly sensitive to reward older males.

Table 3.2. *Descriptive statistics for participants' Deck B choices, organised by their sensitivity to reward scores.*

	Young Males		Older Males	
	HSR (n=23)	LSR (n=26)	HSR (n=14)	LSR (n=16)
Mean Number of Deck B choices	33.3	24.8	20.6	25.3

Reward sensitivity and age were found to influence the number of Deck B cards chosen by males. High reward sensitive young males chose more cards from risky Deck B than low reward sensitive young males or any older males. A 2x2 ANOVA revealed a significant interaction between age and reward sensitivity on the number of Deck B cards chosen, $F(1, 75) = 7.3$, $p < .01$; and a simple main effect of age $F(1, 75) = 6.3$, $p < .05$ but not reward sensitivity $F(1, 75) = .64$, $p > .05$. The relationship between risky behaviour and reward sensitivity for young and older males is shown in Figure 3.5. It can be seen that males of all ages who were low in reward sensitivity chose a similar number of Deck B cards, but high reward sensitive young males chose more cards from this deck than high reward sensitive older males. One-way ANOVAs

confirmed that whilst there was no significant difference in number of Deck B choices between the two age groups for those low in reward sensitivity $F(1,40) = .02$, $p > .05$, this difference was significant for those high in reward sensitivity $F(1, 35) = 13.3$, $p < .01$. High reward sensitive young males chose significantly more risky Deck B cards than high reward sensitive older males.

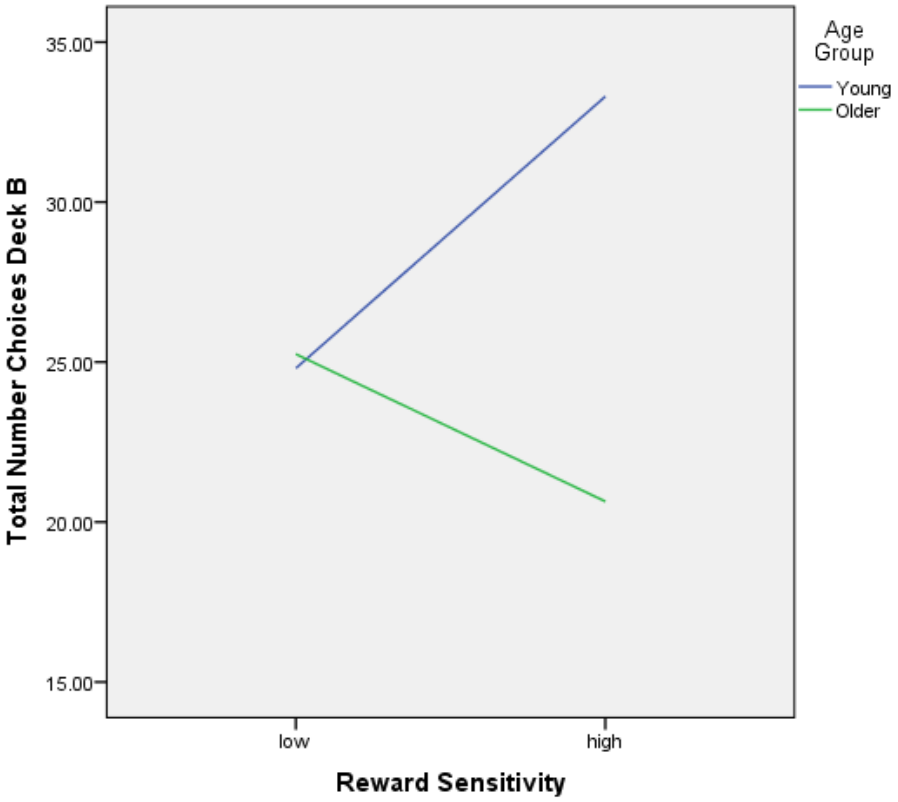

Figure 3.5. Total number of cards chosen from Deck B over 100 trials of the IGT, by high versus low sensitivity to reward young male and older male participants.

3.4 Discussion

In this study choices from Deck's B and C on the IGT were examined in relation to measures of reward sensitivity and punishment sensitivity. We were interested in this because it was thought that heightened reward sensitivity might be an underlying factor motivating young males to engage in risk-taking behaviour. It was hypothesized that high reward sensitivity would relate to more selections from Deck B, particularly for young males; and high punishment sensitivity would relate to less selections from Deck C throughout the duration of the task. It was found that greater Deck B selections were made only by reward sensitive young males, and not by reward sensitive females or older males, suggesting that higher levels of BAS are associated with riskier decisions on the IGT, for young males at least. High reward sensitive young males' preference for Deck B increased as the task progressed, suggesting that their choice for this deck continued even after learning of the associated outcomes. This effect of reward sensitivity was unique to young males, with high reward sensitive older males making fewer risky Deck B selections by comparison. Fewer Deck C selections were not found to be related to higher scores of punishment sensitivity. These findings suggest that the relationship between reward sensitivity and risky behaviour may be what differentiates young males and underpins their risky driving.

The results give some insight into what may underpin young males' aptitude for risky behaviour; and provides evidence to direct the design of future young driver interventions. As seen in chapter two current road safety campaigns tend to be punishment-oriented and focus on the potential negative consequences of risky driving. However as has been shown here, some young males make risky choices that reflect a particular sensitivity to reward rather than punishment. If some young males are motivated by reward rather than punishment, this might explain why males and females responded differently to the intervention in chapter two. In order to effectively target young males in the future, a different approach might benefit from utilising the knowledge that reward sensitivity underpins risky behaviour for the riskiest young males.

The IGT was developed as a tool to study decision-making deficits in patients with vmPFC lesions. The validity of the IGT as a tool in clinical diagnosis has been challenged, with studies finding variation in the total number of cards selected from each deck by healthy participants (e.g. Caroselli et al, 2006). The findings from this study provide further support for the notion that some healthy individuals may not always make decisions based on long-term outcomes (Steingroever et al, 2013). The healthy young males in this study who were more sensitive to reward, tended to choose more cards from Deck B throughout the task. This suggests that they based their deck selections on high frequency gains and lower frequency of loss (even though when they did occur these losses were of a higher magnitude). Thus they preferred Deck B because they considered high magnitude immediate gain to outweigh the risk of a longer-term high magnitude loss.

Lin et al. (2007) suggested that individuals may do this because Deck B assures participants that they are more likely to win, and with a bigger amount. For these people, a negative long term outcome does not mean they will choose to avoid it, indicating that they are not even considering the long term negative consequences. Similarly, Rivalan et al.'s (2009) rat version of the IGT revealed that some rats systematically chose disadvantageously, regardless of the difficulty of the task. The authors suggested that their poor decision making did not occur through failure to learn how to make an advantageous decision, but rather through a hypersensitivity to reward and higher risk taking. The findings from the present study support this notion, as shown through the young reward sensitive males demonstrating a clear and consistent preference for Deck B throughout the course of the task. Whilst young females demonstrated a learning curve early on in the task, presumably realising the high risk associated with Deck B and thus selecting fewer cards from it, the reward sensitive young males continued to choose more cards from this deck throughout the 100 trials.

The findings are in line with other research evidence related to decision making and reward sensitivity. For example Penolazzi et al. (2012) found that high reward sensitive individuals were more likely to underestimate loss when high gains could be achieved; and Buelow and Suhr (2013) found that individuals chose more cards from Deck B in the IGT when they also scored high on BAS-Drive, the continued desire to pursue a course of action for an end goal.

The results also add to the body of literature relating to reward sensitivity and risky health-related behaviours. Previously, greater sensitivity to reward has been found to relate to increased substance use (Genovese & Wallace, 2007); binge drinking and dysfunctional eating amongst young women (Loxton & Dawe, 2001). These studies have found reward sensitivity to be related to various risky health behaviours, and the findings from the present study suggest that for young males, reward sensitivity may underpin risky decision making.

Research conducted into the concept of a 'teenage brain' provides some explanation as to why the young reward sensitive males in this study may have based their decisions on immediate gratification rather than long-term outcomes. Siegel (2014) identified several changes that occur in the brain as an individual develops through adolescence and up to their mid-twenties. One of these changes is known as novelty-seeking, in which adolescents develop an increasing desire to seek out new and exciting experiences. Siegel (2014) suggested that novelty-seeking emerges from an increased desire for rewards in the circuits of the adolescent brain, motivating them to want to experience exciting, but often dangerous, events. Whilst this change does enable adolescents to have the courage to try new experiences, this is also accompanied by a strong desire to take risks. In this way, adolescents may engage in more risk-taking behaviours because the prospect of thrills is overemphasized and consideration of risks is minimised. Young males are known to be great sensation-seekers than females (Turner & McClure, 2003) and there is also evidence to suggest that male adolescents engage in some forms of real-world risk-taking more frequently than females (Harris, Jenkins & Glaser, 2006). Therefore taken together these findings lend further support to the idea that young males may be especially likely to engage in risk-taking behaviour over and above their female peers.

The concept of the ‘teenage brain’ combined with the findings from this study adds further support to the idea that heightened reward sensitivity may underpin the risky driving behaviour of young males, showing how young males may be more likely to behave recklessly in order to satisfy their desire for reward. Previous research has found that heightened reward sensitivity is related to more self-reported errors, attention lapses and aggressive driving violations amongst young drivers (Constantinou et al, 2011). However the relationship between reward sensitivity, risky decision making and gender has not yet been investigated. By doing so here it has been shown that it is specifically the young male risk takers that make decisions based on immediate gratification and acceptance of risk, and do not consider the more advantageous long term outcomes. Young females and older males on the other hand are presumably more adept at considering the consequences and are thus less likely to be negatively affected by their desire for reward.

It should be noted that this was an exploratory study, considering the potential relationship between reward sensitivity and risky decision making. The IGT does not test decision making in the driving context and so it cannot necessarily be implied that reward sensitive young males will inevitably make risky decisions when driving just because they chose a certain deck in a computer game. However the relationship found here regarding young males’ reward sensitivity and their risky behaviour may also explain their heightened risk whilst on the road. So in order to provide further clarification about the role of reward sensitivity in young drivers’ risky driving behaviour study three considers this further, making use of a measurement tool relevant to the driving environment.

3.5 Study Three: The Relationship between Reward Sensitivity, Gender and Risky Driving

3.5.1 Introduction

As discussed previously study two examined the relationship between behavioural inhibition/ behavioural activation (BIS/BAS) and risky behaviour by exploring how BIS/BAS scores related to scores on the Iowa Gambling Task. This was done to explore whether young people highly sensitive to reward would accept a high level of risk in order to try and win a reward. Results showed that card selections from 'risky' Deck B were made most frequently by males scoring high on reward sensitivity (BAS), and their preference for this deck increased throughout the duration of the task. The males less sensitive to reward, all females and older males, chose much fewer risky selections.

The findings indicated that for young males higher levels of BAS are associated with riskier decisions on the IGT, where they prefer an option that offers high immediate gain even when it is accompanied by the risk of large loss. In the context of driving, this may mean that the riskiest young drivers may also be highly sensitive to reward, and this drives their desire to engage in risky thrill-seeking driving. The results from study two suggest that reward sensitivity may be a potential personality characteristic that underpins young drivers' risky behaviour. As Seigel (2014) found in his study of the teenage brain, the sensation-seeking risk-taking behaviour of young people may occur because of their desire to find novel, rewarding and thrilling experiences. In this way the reckless driving of young people, in particular young males, may be explained by their adolescent motivation to satisfy a desire for reward. However study two did not include a measure of risk taking relevant to the driving context so it cannot be implied from this that high reward sensitive young males will inevitably be risky drivers. Therefore the present study sought to explore whether reward seeking also underpins risk-taking behaviour in the driving context.

Some previous evidence supports the notion of a 'teenage brain', by comparing the risk-taking behaviour of young versus older drivers. Hatfield and Fernandes (2009) had young drivers (16 – 25 years) and older drivers (35 years +) complete a series of measures related to their risk perception, risk propensity and self-reported risky driving; and they found that compared to older drivers, young drivers tended to have lower risk-aversion and a higher propensity for taking risks that may lead to a collision. In addition, they found that younger drivers demonstrated stronger motives for risky driving in their desire for experience-seeking situations, sensation-seeking, prestige seeking, "letting off steam", and "getting there quicker"; and further to this, these variables were associated with risky driving. These findings illustrate that specifically young drivers have lower risk-aversion and higher propensity for risk than older drivers. They also contradict the view that the reason young drivers engage in more risky driving is because they are less able to recognise risk than older drivers. This is shown by the fact that young drivers actually demonstrated higher perceived risk of negative outcomes from risky driving than the older drivers in the study (Hatfield & Fernandes, 2009). Therefore it appears that young drivers recognise the risk they face when engaging in risky driving behaviours, but contrary to older drivers, choose to accept or even seek out this risk in order to satisfy their adolescent desire for excitement.

As discussed earlier, Gray's reward sensitivity theory (Franken & Muris, 2005) suggests that the behavioural activation system (BAS) and behavioural inhibition system (BIS) mediate an individual's response to any given event (Genovese & Wallace, 2007). For studies investigating the relationship between BAS, BIS and risky driving, a common measure of self-reported risky driving behaviour is the Driver Behaviour Questionnaire (DBQ) (Reason et al, 1990). The original 50-item DBQ was split into three subscales: "errors", "violations" or "lapses". Errors referred to potentially dangerous failures in observation or judgement, violations refer to behaviours deliberately breaking the law; and lapses refer to mistakes that cause embarrassment and inconvenience rather than risk. Participants indicate how often they have committed each of the 50 behaviours on a five-point scale (1 = never, 5 = almost always). A meta-analysis of

studies investigating the relationship between DBQ responses and subsequent collision involvement found that the errors and violations subscales on the DBQ were both moderately effective in predicting collision rates (de Winter & Dodou, 2010); and the factor-structure of the DBQ has been found to be reliable and replicable cross-culturally (e.g. Lajunen et al, 2003).

However as a self-report measure of risky driving, there are still limitations to using the DBQ as an indicator of real-life driving. Although de Winter and Dodou's (2010) meta-analysis found that the DBQ was relatively effective in predicting collision involvement, several studies have actually found insignificant correlations between DBQ scores and collision involvement (e.g. Davey et al, 2007). In addition, self-report measures may be sensitive to various biases such as social desirability or overestimating one's own skills (Aberg, Afram & Nilsson, 2005). Within the context of this study participants may also feel led to respond in a way they perceive the experimenter to want them to, for example a young male driver may expect the experimenter to want them to report engagement in high risk behaviours to further consolidate this view. In addition to this there are specific limitations to some of the DBQ questions, for example asking drivers to report how many times they have had slips or lapses in concentration may prove difficult, when an unconscious error is done without awareness in the first place (Bjomskau & Sagberg, 2005).

Another bias reported by de Winter and Dodou (2010) is the consistency motif, in which the correlations often seen between DBQ scores and self-reported collision involvement may be inflated because they are measured on the same occasion, and thus participants' responding on each measure is likely to be congruent with each other. The authors suggested that one way to reduce the consistency motif is to correlate DBQ scores with an objective criterion instead of another self-reported behaviour, such as driving speeds or lane variability in a driving simulator (Charlton, 2003) in order to provide support for self-report data.

In acknowledgement of the aforementioned limitations to self-report measures such as the DBQ, the present study sought to investigate whether reward sensitivity and punishment sensitivity would be related to young drivers' actual risky driving, in addition to their self-reported engagement in risky driving. As described above, previous studies have found evidence to support a relationship between reward sensitivity and self-reported risky driving amongst young drivers. However to date, these associations have not been investigated in conjunction with a measure of actual risk-taking behaviour whilst driving. Therefore this study made use of a relatively new measure of risky driving, in order to provide further empirical support to self-report measures, that reward sensitivity may be associated with greater risky driving behaviour.

3.5.1.1 Vienna Risk-Taking Test – Traffic

The Vienna Risk-Taking Test was developed on the basis of risk homeostasis theory (Wilde, 1978, 1994). This theory posits that individuals consider subjective and objective elements of risk perception when making decisions related to risk-taking behaviour in a road traffic environment. Wilde (1978, 1994) suggests that individuals' risk-taking behaviour is determined on a cost-benefit ratio, whereby people accept a subjective degree of risk in any given situation, with the expectation of a gain occurring as a result. The theory proposes that individuals compare the level of risk they are willing to accept (a target risk value), with the actual perceived risk of an objective traffic situation. In the driving context, if perceived risk increases during a driving manoeuvre then the individual will adjust their driving behaviour so that their target risk value remains constant. According to Wilde (1978, 1994) this is known as the homeostasis principle, with risky driving occurring from the interplay between the subjectively accepted degree of risk and the perceived risk of an objective traffic situation.

Just as perceived risk in a situation varies between individuals, so does the degree of risk they are willing to accept. Hergovich et al. (2007) suggested that depending on the characteristics of a traffic situation (e.g. speed of vehicles, environmental factors etc) and individuals' target risk values, their responses to particular traffic situations will vary. If an individual perceives the

level of risk to fall below their target risk value, they are more likely to carry out a risky driving behaviour, because they are not concerned about a negative outcome. Conversely if the level of perceived risk in a situation exceeds an individual's accepted degree of risk, they may be more likely to take action to reduce this risk in order to feel safer. Hergovich et al. (2007) proposed that 'subjectively accepted degree of risk' serves as a latent personality trait, manifested behaviourally by the reaction time that elapses before an individual decides to take action in a risky situation. The time it takes for them to decide if a particular risky course of action exceeds their target risk value, serves as an indicator of their willingness to take risks.

Wilde's (1978, 1994) risk homeostasis theory formed the basis of the Vienna Risk-Taking Test – Traffic (Hergovich et al, 2005). This test measures an individual's willingness to take risks in road traffic situations, measured on the basis of reaction times. Participants view a series of videotaped road traffic situations on a computer screen, taking the perspective of a driver in a car. Participants have to indicate by pressing a button, at which point they would no longer carry on with their course of action i.e. when they would consider it to be too risky to carry on. The time that elapses between the start of the sequence and the participants' decision to abandon the manoeuvre, is used as an indication of risk-taking (the longer the reaction time, the higher the risk taking). There are 23 experimental trials involving situations concerned with speeding, overtaking, junctions, and weather conditions. The objective degree of risk inherent in each situation is systematically varied by changing characteristics of situations (e.g. vehicle speed, visibility, number of vehicles etc) known to affect time to collision (Vogel, 2003).

The Vienna Risk-Taking Test- Traffic (Hergovich et al, 2005) has been shown to have good reliability (.92 according to the test developers) and has been used in various traffic psychology studies as a measure of risk-taking behaviour. Compared with traditional measures of risk-taking this test has the advantage of not being based on self-reported behaviour. Instead, risk-taking scores are calculated directly from participants' behaviour in each traffic situation, providing an indirect measure of their real-life risk-taking behaviour (Hergovich et al, 2005). In

line with this the test has been useful in identifying real-world risky drivers. For example Sommer et al. (2005) used participants' vienna test scores to estimate the collision risk of individual drivers. Using these scores they correctly identified 89% of drivers who had never had a collision, versus those who had had multiple collisions (Sommer et al, 2005). Therefore this test appears to be a useful measure of risk-taking behaviour in the driving environment, providing a novel alternative to more traditional self-report forms of risky driving.

3.5.1.2 Present Study

The present study aimed to build on prior research evidence into the relationship between gender, reward sensitivity, punishment sensitivity and self-reported risk taking with actual risk-taking behaviour on a driving game. Drivers ranging in age from 18 – 25 years old completed various questions related to their sensitivity to reward, punishment and risky driving behaviour. They then played a short driving game that involved them viewing a series of potentially dangerous driving situations and deciding when the level of risk reached a point where they would no longer continue with a particular course of action.

Based on previous research (e.g. Genovese & Wallace, 2007) and the results from chapter three, it was expected that young male drivers rated as being highly sensitive to reward would also report engaging in more risky driving behaviours, and would perform more riskily on a driving game, evidenced by longer reaction times and thus greater willingness to take risks in potentially hazardous driving situations. Therefore the hypotheses for the present study were as follows:

1. High BAS scoring males (sensitive to reward) will report more risky driving behaviours than low BAS scorers.
2. High BAS scoring males (sensitive to reward) will demonstrate a greater willingness to take risks on the driving game than low BAS scorers.

3. Young males who score high on BAS (sensitive to reward) will report more risky driving behaviours and show a greater willingness to take risks than all females, and the young males who score low on BAS.
4. High BIS scorers (sensitive to punishment) will report less risky driving behaviour than low BIS scorers.
5. High BIS scorers (sensitive to punishment) will demonstrate less willingness to take risks on the driving game than low BIS scorers.

3.5.2 Method

3.5.2.1 Participants

166 participants (52 males) aged 18-25 years old (Mean age = 20.1 years) completed the study. All participants held a full valid UK driving license and were recruited via opportunity sampling through a variety of means: the University paid participation pool, advertisements around campus, and some participants took part for course credit. Most participants were undergraduate students (88.6%). The others were either employed for wages (3.0%), self-employed (2.4%), looking for work (2.4%), a postgraduate student (1.8%) or not employed and not looking for work (1.8%). Participants had held their driving license for, on average, 2 years and 1 month (range: 1 month to 7 years) and made on average 2-5 trips per week. 43 participants had been involved in a collision as a driver (25.9% of the sample), 7 had been involved in two collisions and 5 participants had been involved in three collisions. In the most recent of these, 13 participants incurred minor damage to the vehicle(s), 21 reported that there was significant damage to the vehicle, 5 reported someone suffered minor injuries and 4 participants reported someone suffered serious injuries resulting in hospital treatment. 12 participants reported that they had received a speeding ticket (1 participant had received two), 1 participant reported that they had been convicted for drunk driving, and no participants had been convicted of using their mobile phone whilst driving.

3.5.2.2 Design

A between-subjects design was implemented. There were 2 independent variables: gender (2 levels – male/female), reward/punishment sensitivity (4 levels – High Reward/Low Punishment, High Reward High Punishment, Low Reward/ High Punishment, Low Reward/ Low Punishment). There were two dependent variables: self-reported risky driving behaviour, and subjectively accepted level of risk as measured by the Vienna Risk-Taking Test-Traffic. The 'Accepted Risk Reaction Time' was the mean response time of all driving situations in which a response was given.

3.5.2.3 Measures

The Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (SPSRQ) (Torrubia et al, 2001)

Participants completed the 48 yes-no response item questionnaire which incorporates two scales – sensitivity to punishment (24 items) and sensitivity to reward (24 items). This was the same measure as used in study two, please see Appendix 3A for the full questionnaire.

Driver Behaviour Questionnaire (Reason et al, 1990)

There has been substantial variation in the number of DBQ items and factors used in different studies. For example, Ozkan et al. (2006) used 19 items and Lajunen and Summala (2003) used 27; whilst Kontogiannis et al. (2002) and Aberg and Rimmo (1998) used 112 and 104 items respectively. Further to this whilst the original questionnaire consisted of three factors: violations, errors and lapses (Reason et al. 1990), they have since been divided into, for example, two (Blockey & Hartley, 1995), five (Parker et al, 2000) or even seven (Kontogiannis et al, 2002) different factors.

The present study used the original 50-item version of the DBQ to measure participants' self-reported engagement in risky driving behaviours. Each of the items belonged to one of three subscales: "errors", "violations" or "lapses" (see Appendix 3C for full list of items).

‘Violations’ are defined as behaviours deliberately breaking the law (e.g. “deliberately disregard the speed limits late at night or very early in the morning”). ‘Errors’ indicate potentially dangerous failures in observation or judgment (e.g. “turn left on to a main road into the path of an oncoming vehicle that you hadn’t seen, or whose speed you had misjudged”). ‘Lapses’ are errors that cause embarrassment and inconvenience rather than risk (e.g. Lock yourself out of your car with the keys still inside). Participants were asked to indicate how often they committed each of the 50 behaviours on a five-point scale (1 = never, 5 = almost always).

Vienna Risk-Taking Test – Traffic (Hergovich, Bognar, Arendasy, & Sommer, 2005)

The 15-minute driving game is an objective personality test, designed to deduce participants’ subjectively accepted level of risk in a variety of traffic situations. For each traffic situation participants first receive a verbal description of the particular driving manoeuvre about to be carried out. Participants then view the video of the traffic scene twice: the first time to observe the scene, and the second to indicate at which point the intended driving manoeuvre would be too risky to carry out. The situations can be categorised as either a) speed choice and overtaking decisions or b) decisions at intersections. Weather conditions also vary between scenes. Participants view 1 practice trial and then complete 23 experimental trials, where each scene is shown twice. A screenshot from the game can be seen in Figure 3.6.

Figure 3.6. Screenshot from the Vienna Risk-Taking Test- Traffic (Hergovich, Bognar, Arendasy, & Sommer, 2005).

3.5.2.4 Procedure

The study consisted of 4 parts. Part A contained a series of demographic questions including gender, date of birth, driving license duration, number of collisions involved in, collision severity, and number of speeding infringements they had had over the last 5 years. Part B contained the Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (Torrubia et al, 2001), a 48 item yes-no response scale. Part C contained the Driver Behaviour Questionnaire (DBQ, Reason et al, 1990), a 50-item scale that measured how often respondents engaged in various risky driving behaviours. The last part of the study is a driving game created by Hergovich et al. (2007) called The Vienna Risk-Taking Test- Traffic. Participants viewed a series of traffic situations and had to indicate for each one, at which point the action that was contingent on the described situation would become too dangerous to carry out. Participants viewed 24 driving situations in total, and each one was described in words before they were shown on-screen. Each driving situation was then shown twice: first for participants to observe,

and then so that they could respond by pressing the 'Ctrl' key. The distance from the moment of danger to the moment that they press the button, measured in hundredths of a second, is taken as a measure of the participants' subjectively accepted level of risk. The 'Accepted Risk Reaction Time' is the mean time of all the driving situations in which a response was given.

3.5.3 Results

3.5.3.1 Reliability of Measures

Reliability analyses were carried out on each of the measures. The alpha scores for each of the measures were as follows: SPSRQ: $\alpha = .80$; DBQ: $\alpha = .93$, indicating that both measures had very good reliability.

3.5.3.2 Analysis

A median split of SPSRQ scores from this sample of participants was used to derive high and low sensitivity to reward and punishment groups. The high reward sensitivity group consisted of scores over 11.7 and the low reward sensitivity group consisted of scores under 11.7. The high punishment sensitivity group consisted of scores over 12.9 and the low punishment sensitivity group consisted of scores under 12.9.

In a recent study exploring the relationship between reward sensitivity, punishment sensitivity and substance use, Genovese and Wallace (2007) investigated interaction effects between the two scales of the SPRSQ. They achieved this by dividing the sample into four groups based on the median split of SP and SR scores. The four groups were (a) high reward, low punishment (HRLP), (b) high reward, high punishment (HRHP), (c) low reward, high punishment (LRHP), (d) low reward, low punishment (LRLP). This method has the advantage of showing how many participants are primarily sensitive to reward, punishment, or both; and provides additional information about the interactions between the variables. To build on the methodology used in study two, and to investigate any potential interactions in this sample, a similar procedure to

that carried out by Genovese & Wallace (2007) was used. Table 3.3 shows the number of males and females assigned to each of the four groups based on their sensitivity to punishment and reward scores. A statistically significant association between group membership and gender was found (Cramer's V = .28, p< .01. Females were underrepresented in the HRLP group whereas males were underrepresented in the LRHP group.

Table 3.3. Number of participants in each SPSRQ group

	Males (N)	Females (N)
High Reward, Low Punishment (HRLP)	16	17
High Reward, High Punishment (HRHP)	18	30
Low Reward, High Punishment (LRHP)	4	35
Low Reward, Low Punishment (LRLP)	14	32
Total (N)	52	114

The data in Table 3.4 shows the mean scores for each reward/ punishment sensitive group on the risky driving measures: the DBQ as a whole and each of its three subscales (errors, slips and lapses, and violations) and the mean accepted risk reaction times. Faster response times represent a lower subjectively accepted level of risk. It can be seen that for each of the risky driving measures (DBQ and accepted risk reaction times) participants from the HRLP group displayed the riskiest behaviour and participants from the LRLP group showed the least risky behaviour.

Table 3.4. Descriptive statistics for participants' self-reported driving behaviour and accepted risk reaction time, split by their sensitivity to punishment and reward.

	HRLP Mean (SD)	HRHP Mean (SD)	LRHP Mean (SD)	LRLP Mean (SD)
DBQ (sum)	91.9 (23.2)	90.4 (14.0)	86.3 (17.4)	81.1 (15.1)
DBQ: Errors	28.8 (8.5)	28.5 (5.3)	27.5 (6.9)	25.3 (5.8)
DBQ: Slips and Lapses	33.3 (7.4)	34.1 (5.8)	33.2 (7.4)	30.1 (6.4)
DBQ: Violations	29.8 (9.8)	27.8 (6.6)	25.6 (5.0)	25.7 (5.8)
Accepted Risk Reaction Time	8.4 (1.5)	8.1 (1.6)	7.7 (1.3)	7.4 (1.7)

3.5.3.3 Correlations

The correlations for the study variables are presented in Table 3.5. The DBQ was correlated with sensitivity to reward $r(166) = .34$, $p < .01$, sensitivity to punishment $r(166) = .16$, $p < .05$, accepted risk reaction time $r(166) = .23$, $p < .01$; and each of the DBQ subscales: errors $r(166) = .92$, $p < .01$, slips and lapses $r(166) = .86$, $p < .01$ and violations $r(166) = .81$, $p < .01$. Here, higher scores on the DBQ - indicating a greater number of risky driving behaviours - was associated with heightened reward sensitivity, heightened punishment sensitivity, and longer reactions on the risky driving game, indicating more accepted risk. Accepted risk reaction time was also correlated with sensitivity to reward $r(166) = .31$, $p < .01$ and the DBQ subscale violations $r(166) = .33$, $p < .01$; suggesting that more accepted risk was related to heightened reward sensitivity and a greater number of reported violations. However accepted risk reaction time was not correlated with the other DBQ subscales, errors $r(166) = .13$, $p > .05$ and slips and lapses $r(166) = .14$, $p > .05$; or with sensitivity to punishment $r(166) = -.00$, $p > .05$.

Sensitivity to punishment was correlated with the errors and slips and lapses subscales of the DBQ, $r(166) = .92$, $p < .01$ and $r(166) = .86$, $p < .01$ respectively; suggesting that heightened punishment sensitivity was associated with more reported errors and slips and lapses; but not with the violations subscale $r(166) = -.03$, $p > .05$, or sensitivity to reward $r(166) = .04$, $p > .05$. Sensitivity to reward was correlated with each of the three DBQ subscales: errors $r(166) = .27$, $p < .01$, slips and lapses $r(166) = .22$, $p < .01$, and violations $r(166) = .40$, $p < .01$; suggesting that heightened reward sensitivity was related to more reported errors, slips and lapses and violations.

*Table 3.5. Correlations among Variables. Note *p< .05. **p< .01.*

Variable	1	2	3	4	5	6	7
1. DBQ (sum)	--						
2. DBQ: Errors	.92**	--					
3. DBQ: Slips and Lapses	.86**	.78**	--				
4. DBQ: Violations	.81**	.62**	.47**	--			
5. Accepted Risk Reaction Time	.23**	0.13	0.14	.33*	--		
6. Sensitivity to Punishment	.16*	.19*	.26**	-0.03	0	--	
7. Sensitivity to Reward	.34**	.27**	.22**	.39**	.31**	0.04	--

The results suggest that when participants scored as highly sensitive to reward they also tended to report committing more road traffic violations and displayed higher levels of risk acceptance, evidenced by slower reaction times. On the other hand participants scoring as more sensitive to punishment tended to report committing more errors, and slips and lapses whilst driving, but not more violations or a greater acceptance of risk.

To examine the interplay between gender, sensitivity to punishment, sensitivity to reward and risky driving, a MANOVA was performed with reward/punishment sensitivity group and gender as independent variables and sum DBQ, DBQ: errors, DBQ: slips and lapses, DBQ: violations, and accepted risk reaction time as dependent variables. The analysis revealed that there was a statistically significant difference in overall risky driving behaviour based on both reward/punishment sensitivity group, ($F(12, 410) = 2.1$, $p < .05$), Wilk's $\Lambda = .854$, partial $n^2 = .05$; and on gender ($F(4,155) = 5.3$, $p < .01$), Wilk's $\Lambda = .879$, partial $n^2 = .12$. There was no interaction found between reward/ punishment sensitivity group and gender on overall risky driving behaviour ($F(12, 410) = 1.3$, $p > .05$).

Reward and Punishment Sensitivity

Given the significance of the overall test, univariate main effects were then examined. They revealed a significant main effect of reward/ punishment sensitivity group on sum DBQ $F(3,158) = 2.9 < p.\ 05$, slips and lapses DBQ subscale $F(3,158) = 3.3$, $p < .05$, and accepted risk reaction time $F(3, 158) = 3.8$, $p < .05$; but not on errors DBQ subscale $F(3,158) = 2.1$, $p > .05$ or violations DBQ subscale $F(3,158) = 2.0$, $p > .05$. To examine the specific nature of these main effects Tukey post-hoc tests were conducted, with the following results:

Sum DBQ: The mean scores for sum DBQ were significantly different between HRLP and LRLP groups ($p < .05$), but not between any of the other groups; although the difference between HRHP and LRLP narrowly missed significance ($p = .052$). HRLP Participants who were highly sensitive to reward but less sensitive to punishment reported more overall risky driving behaviours than participants who were low in both reward and punishment sensitivity.

Errors DBQ: There were no significant differences in mean scores on the errors DBQ subscale for any groups, although the difference between HRLP and LRLP groups, and HRHP and LRLP groups approached significance ($p = .09$ and $p = .09$ respectively). Participants scoring high on reward sensitivity reported more errors than those scoring low on reward sensitivity, irrespective of their punishment sensitivity. However these differences did not quite meet significance.

Slips & Lapses DBQ: The mean scores on the slips and lapses subscale significantly differed between HRHP and LRLP ($p < .05$), but not between any of the other groups. Participants who were highly sensitive to both reward and punishment reported more slips and lapses than participants who were less sensitive to both reward and punishment.

Violations DBQ: Similarly the mean scores on the violations subscale were significantly different between HRLP and LRHP ($p < .05$); and HRLP and LRLP ($p < .05$), but not between the other groups. Here, participants scoring high on reward sensitivity and low on punishment sensitivity reported more violations than participants who were less sensitive to reward, irrespective of their sensitivity to punishment .

Accepted Risk Reaction Time: Finally, mean scores on accepted risk reaction times were significantly different between HRLP and LRLP ($p < .05$) but not between any of the other groups. Participants who were highly sensitive to reward and less sensitive to punishment had longer (i.e. riskier) accepted risk reaction times than participants scoring low on both reward and punishment sensitivity.

Gender

The analysis found a significant main effect of gender for DBQ subscales' slips and lapses $F(1, 158) = 4.3$, $p < .05$, and violations $F(1,158) = 5.0$, $p < .05$. Female participants reported committing more slips and lapses than male participants. Conversely, male participants reported committing more violations than female participants. No main effects of gender were found for sum DBQ $F(1,158) = .02$, $p > .05$, errors DBQ subscale $F(1,158) = .04$, $p > .05$, or accepted risk reaction time $F(1, 158) = 1.3$, $p > .05$.There were no significant interactions found between gender and reward/ punishment sensitivity group for any of the dependent variables; although the interaction between gender and reward/ punishment sensitivity and accepted risk reaction time was approaching significance $F(3, 158) = 2.3$, $p=.08$. This may be due to the disparity in HRHP males' and females' accepted risk reaction times. Males scoring high on both reward and punishment sensitivity had much longer (i.e. riskier) accepted risk reaction times than the females scoring high on both measures. See Figures 3.7 and 3.8 for graphical illustration of how reward/ punishment sensitivity and gender had an effect on participants' mean sum DBQ scores and accepted risk reaction times.

As can be seen, both males and females scoring high on reward sensitivity and punishment sensitivity reported more risky driving behaviours and displayed longer risk reaction times than participants scoring low on reward and punishment sensitivity. For females, it appears that when they are highly sensitive to both reward and to punishment they tend to report fewer risky driving behaviours and much shorter risk reaction times than if they were highly sensitive to reward but less sensitive to punishment. This suggests that when females report being sensitive

to punishment they are less likely to display risky driving behaviour, even if they are also sensitive to reward. On the other hand when males report being sensitive to both reward and to punishment, they are still likely to report high numbers of risky behaviours and display long risk reaction times, similar to those males who report being sensitive to reward but less to punishment. This suggests that for males, reward sensitivity may play a bigger role in determining their risk-taking behaviour than punishment sensitivity.

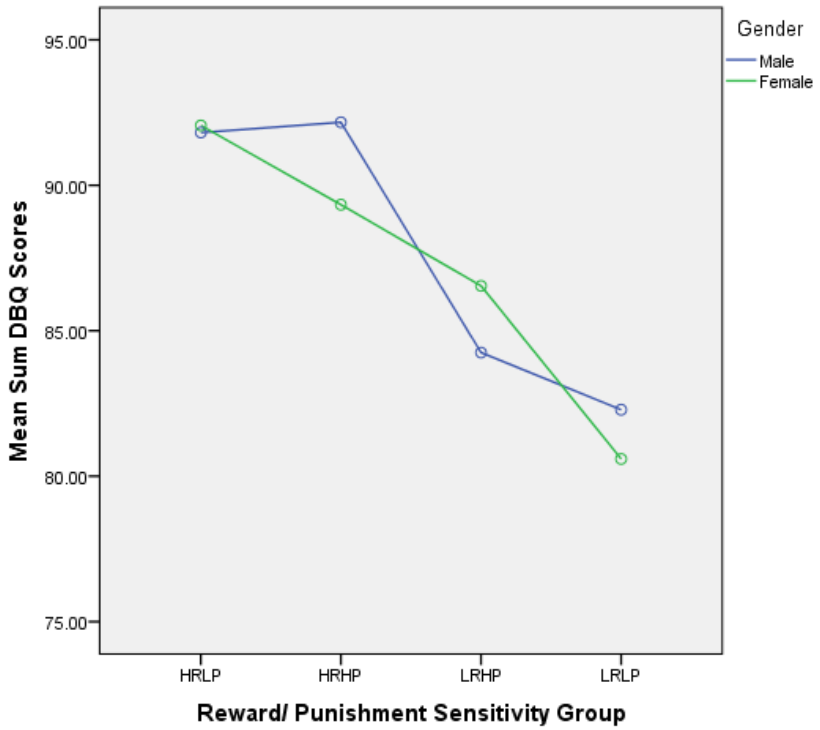

Figure 3.7. Mean sum DBQ scores for males and females, split by reward and punishment sensitivity.

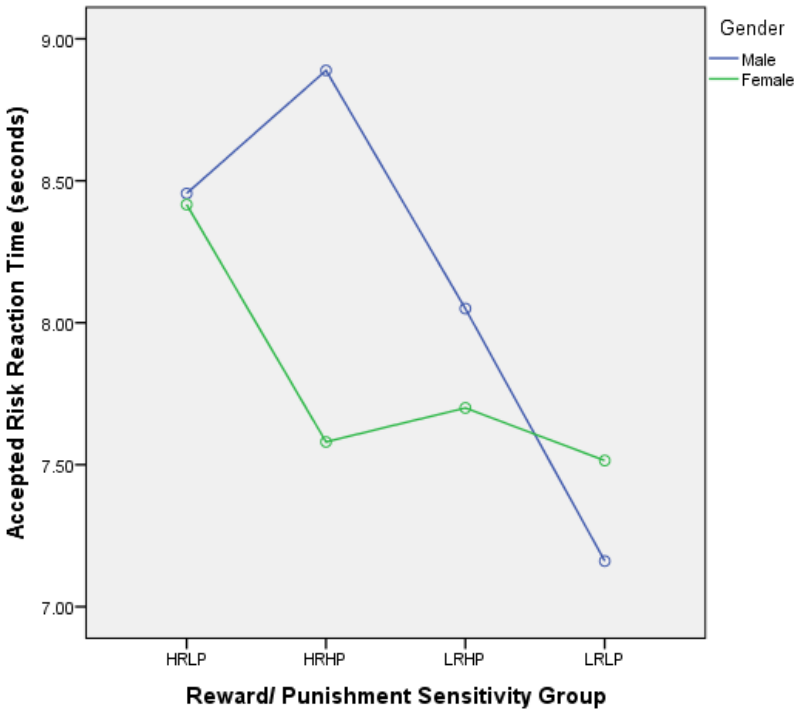

Figure 3.8. Mean scores on accepted risk reaction times for males and females, split by reward and punishment sensitivity.

3.5.4 Discussion

In this study self-reported risky driving and actual risk-taking behaviour were examined in relation to measures of reward sensitivity and punishment sensitivity. It was hypothesized that high reward sensitivity would relate to more self-reported engagement in risky driving behaviours, and greater willingness to take risks as evidenced by longer reaction times on a risky driving game. It was expected that this pattern of results would be particularly evident for young males. The findings support the hypothesis in that overall, higher reward sensitivity was related to more self-reported and actual risky driving. Participants who were more sensitive to reward tended to report more slips and lapses (females) and driving violations (males), and displayed longer accepted risk reaction times, than participants who were less sensitive to reward. The summary diagram of risk factors in Figure 3.9 has been updated to reflect how reward sensitivity may lead to increased risk-taking amongst young drivers. The effect of punishment sensitivity on risky driving was diverse, with participants more sensitive to punishment reporting more slips and lapses but fewer violations than those less sensitive to punishment. Females were more likely to report committing slips and lapses whereas males were more likely to report committing violations. It should also be noted that males were statistically under-represented in the 'Low Reward High Punishment' group whereas females were under-represented in the 'High Reward, Low Punishment' group. This suggests that there might be a general tendency for young males to be less sensitive to punishment than females; and females to be less sensitive to reward than males.

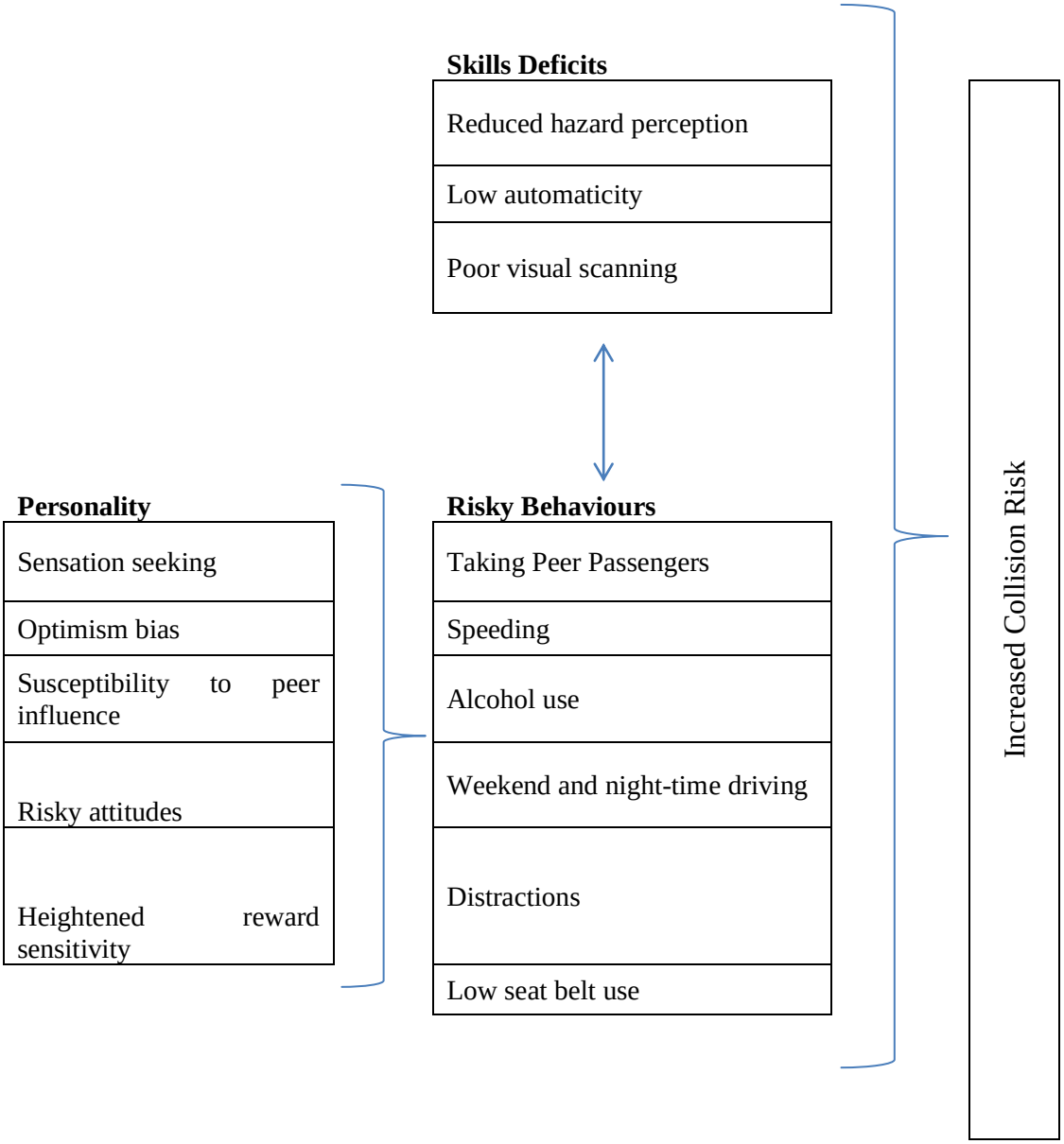

Figure 3.9 Factors thought to underpin young drivers' risky driving.

The findings are in line with those from study two and with other recent research in this area (e.g. Constantinou, 2011; Castella & Perez, 2004); providing further support for the notion that heightened reward sensitivity may underpin the risky driving of some young drivers. However contrary to the findings seen in study two, heightened reward sensitivity was related to more self-reported risky driving and longer accepted risk reaction times for both males and females in this study. It was also found that reward sensitive males were more likely to commit violations than females. Previous research suggests that deliberate violations may be the best predictor of

collision-involvement (e.g. de Winter & Dodou, 2010) and the findings here support this idea, presumably because reward sensitive young drivers accept more risky violations whilst driving in the pursuit of achieving a rewarding feeling (Parker et al, 1995). In addition to this the young reward sensitive males in this study were more likely to report committing violations than the females, providing further support for the idea that for young males in particular, heightened reward sensitivity may lead them to commit more risky driving violations in search of thrills.

Interestingly, punishment sensitivity appeared to mediate the effect of reward sensitivity for young females on their accepted risk reaction times. When young females reported being highly sensitive to reward but less sensitive to punishment they had long risk reaction times. However when they reported being sensitive to both reward and to punishment young females' risk reaction times became much shorter, indicating much safer behaviour. This suggests that when young females are sensitive to punishment they are less likely to display risky driving behaviour, even if they are also sensitive to reward; so punishment sensitivity has an overruling effect for them. On the other hand when males reported being sensitive to both reward and to punishment, they were equally likely to display long risk reaction times, similar to those males who reported being sensitive to reward but less to punishment. This suggests that for males, reward sensitivity may play a bigger role in determining their risk-taking behaviour than punishment sensitivity and provides further explanation as to why the intervention in chapter two was less effective for males than for females. Whilst females may feel motivated by their punishment sensitivity to change their behaviour, males may be much more influenced by their sensitivity to reward.

Similarly, heightened punishment sensitivity was only related to more slips and lapses; and females were much more likely to report slips and lapses than males. This suggests that risk-avoidant young drivers may be less likely to commit deliberate violations but do lose concentration whilst driving, thus still posing a degree of risk. In this sense punishment sensitive young drivers do not deliberating seek risk through dangerous driving, but rather are more likely to make mistakes and misjudgements that may result in heightened risk. This is in

line with the finding that young females were more likely to report slips and lapses than young males, suggesting that young females' heightened risk may be more likely to occur due to lapses in attention rather than from deliberate risky violations, because they are not actively seeking rewarding feelings from risky driving.

Males who were highly sensitive to reward and less sensitive to punishment, tended to report engaging in the most violations and displayed the longest risk reaction times in the sample. This finding provides further explanation for why the intervention in study one was least effective for young males, by showing how young male drivers may be more likely to commit violations and take longer to make safe manoeuvres, in order to satisfy their desire for reward. In this way, heightened reward sensitivity may be one of the underlying factors determining the risky driving behaviour of young males. Teenagers' novelty-seeking behaviour is one of the key changes Siegel (2014) identified that occurs in the brain throughout adolescence. Here, adolescents develop an increasing desire to seek out new and exciting experiences, caused by an increased desire for rewards in the circuits of the adolescent brain, which is often accompanied by less caution when considering associated risks. According to Siegel (2014), adolescents may therefore engage in more risky driving behaviours because the prospect of thrills is overemphasized and consideration of risks is minimised in the adolescent brain. The findings from studies two and three provide further support for this notion, in that the biggest risk-takers - those most likely to choose from risky Deck B on the IGT, have the longest accepted risk reaction times on the Vienna Risk-Taking Test, and report the largest number of violations – were young males who also scored as highly sensitive to reward. If risky driving is a way to achieve thrills, and punishment sensitivity has little effect on determining their behaviour, this might also explain why the intervention in study one was least effective for males.

The Vienna Risk-Taking Test – Traffic (Hergovich et al, 2007) is a relatively unique measure that assesses willingness to take risks in driving situations. Grounded in psychological theory (Wilde, 1978; 1994) the test has been found to reliably predict drivers' real-life collision

involvement (Sommer et al, 2005); and correlates well with various other scale measures of readiness to take risks, e.g. Sensation seeking – danger avoiding, irresponsible – responsible (Bulheller et al, 1998). Contrary to most measures of risky driving this test is based on reaction times rather than traditional self-reported behaviour, providing a more valid approach to studying young drivers' behaviour. The test contains various driving scenarios, with different characteristics and varying degrees of risk in each, making it a useful tool to study holistically how much risk young drivers tend to accept in general. Therefore this test has multiple advantages over basic self-report measures, giving it a higher level of ecological validity when interpreting the results in terms of real-life driving behaviour. To our knowledge this is the first study to compare young drivers' self-reported responses on the DBQ to their risk reaction times on the objective test. We found that responses on the violations subscale of the DBQ were correlated with risk reaction times which suggest that the test is an accurate representation of young drivers' deliberate risky driving. As deliberate violations predict collision involvement (de Winter & Dodou, 2010) it can be plausibly suggested that the Vienna Risk-Taking Test is an appropriate means of assessing young drivers' level of risk. In this way, the use of this test provides further evidence that reward sensitivity is not just related to the self-reported driving behaviour of young people, but also a more objective, realistic form of risky driving assessment.

The findings from the studies reported so far have implications for addressing problems with young male drivers. As discussed previously current road safety campaigns tend to be oriented around punishment (Job, 1988), focusing on educating young people about the negative consequences of risky driving. However the results from study one showed that this method may be less effective for young males, and the results in studies two and three have shown that reward sensitivity may provide some explanation as to why this is. For the most dangerous young drivers (male thrill seekers); the rewarding sensation they anticipate from risky driving outweighs the risk of potential punishment; and so 'fear appeal' interventions focusing on punishment might have little effect on reducing their risky behaviour. In line with this an alternative method for advocating safe driving may prove more effective than fear appeals, such

as by framing messages in terms of rewards rather than punishments. Providing young newly qualified drivers with incentives to drive safely, and in the process replacing the thrilling reward of risky driving with an appropriate alternative, may be more effective in promoting continued safe driving than a punishment-oriented approach.

In conclusion, the findings from studies two and three have shown how reward sensitivity can influence the self-reported and actual risk-taking behaviour of young drivers. Young males who reported being highly sensitive to reward tended to report more violations and displayed longer reaction times on the Vienna Risk-Taking Test, reinforcing earlier findings that reward sensitivity may underpin the risky driving behaviour of young males. The findings regarding females' behaviour were more complex. Reward sensitive young females were found to report more slips and lapses and displayed longer reaction times in risky situations, casting some doubt over whether reward sensitivity only predicts young males' risky driving. However they were unlikely to report committing deliberate violations, suggesting that a desire to engage in purposeful risky driving is not a motivating factor for them. In addition when females were both sensitive to reward and to punishment, they were much less likely to display risky reaction times, suggesting that their punishment sensitivity is an overruling determinant of their behaviour. Therefore it may be that reward sensitivity does underpin risky driving for a small subgroup of young females, but for the majority it is a more complex combination of factors, involving a fear of punishment and more mistakes rather than deliberate dangerous behaviour.

Thus whilst reward sensitivity may underpin young females' behaviour to a certain extent, the relationship between reward sensitivity and deliberate risky driving for young males has been shown to be much more consistent and reliable. The findings suggest that traditional road safety campaigns may be ineffective for those most at risk (high reward sensitive young drivers) because these drivers are relatively unaffected by the threat of punishment. In order to better engage these young drivers to consider their risky driving, the concept of "reward for safe driving", rather than "punishment for risky driving", may prove more effective. Therefore the

study in chapter four was conducted to investigate the potential use of reward-based approaches for improving young drivers' behaviour, in comparison to more traditional punishment-oriented interventions.

Chapter Four

Study Four: The Influence of Message Framing, Punishment Sensitivity, Reward Sensitivity and Age on Drivers' Ratings of Road Safety Messages

4.1 Introduction

The research literature already tells us that drivers who are highly sensitive to reward report engaging in a greater number of traffic violations (Castella & Perez, 2004) and have more driving errors and lapses in attention (Constantinou et al, 2011) than those less sensitive to reward. The results from the studies conducted here so far add to this literature by showing that:

a) a fear appeal road safety intervention was least effective for those most at risk (young males) and suggest that this may be due to the fact that their behaviour is driven by a motivation for reward rather than fear of punishment; and

b) in addition to self-report measures of risk-taking reported above, high-reward sensitive young males display slower reaction times on a driving game indicating that they tend to accept a higher degree of risk than other drivers.

Results such as these suggest that reward sensitive young drivers may be prepared to take risks because they value the rewarding thrill that accompanies high risk situations such as speeding, or driving under the influence of drink/ drugs. Therefore an avenue for interventions that target risky driving might be to replace the perceived rewarding thrill of risky driving with another reward such as a rewarding incentive to drive safely. Such interventions may be particularly effective for the group of drivers most in need – young, reward sensitive males. The concept of financial reward as an incentive to encourage safe driving has been used in the UK by some insurance companies who offer young drivers a discounted premium if they install a GPS device in their car and adhere to prescribed driving restrictions such as not exceeding national speed limits or not driving between 11pm and 5am. Preliminary findings suggest these incentive-

schemes result in some positive behavioural changes, such as reduced speeding violations, over the short term at least (Greaves & Fifer, 2011; Bolderdijk et al, 2011).

As discussed previously most young driver interventions are based on scare techniques, or 'fear appeals' (Williams, 2006). They rely on the viewer experiencing a fearful emotional response to a graphic collision scene that they will then use to motivate them to change their future driving behaviour (Lewis et al, 2007b). Despite their widespread use the efficacy of fear appeals has long been challenged. For example Donovan et al. (1999) examined the self-reported intentions of drivers after being exposed to a range of different types of advertisement for different driving behaviours (i.e., speeding, drink driving, fatigue, inattention). They found that the highly emotive, graphic fear appeals were considered no more effective than the less threatening adverts used. The authors concluded that there was no consistent evidence that fear appeal style adverts with high production costs reduced risky driving to a greater extent than the other types of advert.

Despite this finding more than a decade ago, fear appeals continue to be used now both in mass media campaigns and local young driver interventions. The evaluation conducted in study one found that the fear appeal intervention was less effective for young males than young females and similar findings have also been reported (e.g. Lewis, Watson & Tay, 2007a; Tay, 2002).The findings from studies two and three provided insight into why fear appeals may be less effective for some young males, by showing how those who are particularly sensitive to reward may be motivated to engage in risk-taking behaviour to achieve thrills, and are less affected by threats of punishment. In this way fear appeals, designed to evoke a fear of punishment, are less effective for this group because their behaviour is motivated by the prospect of gains rather than fear of losses.

The studies conducted so far have shown that some young drivers, particularly males, are particularly sensitive to reward rather than punishment; and this group tend to engage in more high-risk behaviour and are less likely to be influenced by fear appeal interventions. If this high-risk group are relatively unaffected by punishment but motivated by a desire for reward, it might be possible to manipulate their perception of reward by framing safe driving measures in terms of gains rather than losses.

As described earlier various theories are used to explain why fear appeals may be less effective for young drivers, and in particular, young males. The EPPM (Witte, 1992) suggests that for a fear appeal to be effective an individual needs to perceive the threat as high, the message as being effective and to have confidence in their own ability to act in the way that's prescribed. Young males tend to perceive risky situations as being less risky than older drivers (Trankle, Gelau & Metker, 1990), so the perceived threat is low, and they often find fear appeal messages relevant for others but not for themselves, the so-called 'third person effect' (Hastings & MacFadyen, 2002; Hastings et al, 1990), so the perceived efficacy may also be low. According to the EPPM it is therefore not surprising that young males may not respond to fear appeals in the way that is hoped.

Similarly, Terror Management Theory (TMT) (Greenberg, Pyszczynski & Solomon, 1986) posits that individuals may use coping mechanisms when they want to continue on with a course of action that they are told will cause them vulnerability. They may ignore the threat or tell themselves that the risk is not relevant to them, in order to convince themselves that they may carry on with their desired behaviour with no repercussion. As we have found in studies reported here, young male drivers with heightened reward sensitivity tend to engage in more risky driving behaviour, presumably because they enjoy the rewarding thrill of it. When told about the risks they face they may use terror management strategies to convince themselves that they are not really at risk of harm.

4.1.1 The Framing Hypothesis

The framing hypothesis of prospect theory suggests that presenting information either in terms of gain or losses will differentially influence decisions (Kahneman & Tversky, 1979). Fear appeals use loss-framed messages to associate risky actions with negative consequences whereas gain-framed messages posit the benefits of a positive course of action, and encourage safer behaviour on the basis of potential gains. Although many road safety campaigns use loss-framed messages to deliver their point, the framing hypothesis suggests that this may not be effective since individuals tend to seek risks when they are focused on losses and avoid risks when they are focused on gains (Millar & Millar, 2000; Tversky & Kahneman, 1981). For example when people view loss-framed messages they tend to make riskier decisions; but when they view gain-framed messages and are focused on the benefits of avoiding a risky behaviour they are more cautious.

Some health-related studies have supported the framing hypothesis, finding that gain-framed messages produce stronger intentions to perform more exercise (Robberson & Rogers, 1988); and result in more early success in smoking cessation (Toll et al, 2007) than loss-framed messages. Others have not been supportive - Lauver & Rubin (1990) found that gain- and loss-framed messages were equally effective at promoting medical tests; and a meta-analysis of 93 studies concerning health-related behaviours and framing, found that gain-framed messages were only more persuasive for advocating dental hygiene behaviour. For many other health behaviours including safer sex, skin cancer prevention, and diet and nutrition, gain-framed messages were no more effective than loss-framed messages (O'Keefe & Jensen, 2007).

The potential use for gain-framed messages in the realm of road safety is still being investigated. A recent naturalistic study by Chaurand, Bossart and Delhomme (2015) involved the use of anti-speeding messages on a busy 8-lane road in France, framed in terms of gains or losses and varying in theme (crash versus fuel consumption). They recorded nearly 6,500

drivers' speeds after they had passed the signs, using this as a measure of compliance, and found that drivers' speeds were lowest after having viewed the gain-framed messages, irrespective of theme. Although this study was not able to control for the age of the driver, and thus it is unclear whether young drivers responded to the messages in the same way as older drivers, it does show how gain-framed messages may result in less speeding, and thus safer driving behaviour, than the traditional loss-framed messages used in road safety interventions.

Studies have also begun to look at the relationship between personality characteristics and how these may influence peoples' responses to messages framed in different ways. For example Shen & Dillard (2007) explored the relationship between message framing, punishment and reward sensitivity, and responses to a variety of health-related messages. They found that gain framing activated the reward system, whereas loss framing activated the punishment system and concluded that both forms of message were persuasive but for different people in different ways. Similarly, Updegraff et al. (2007) looked at how effective health messages were when they were framed either to be congruent or incongruent with individuals' approach/avoidance motivations (reward/ punishment sensitivity). They found that participants who read a message framed in congruence with their reward/ punishment orientation were much more likely to report healthier dental hygiene intentions than participants who read an incongruently framed message. Similarly, Kaye, White & Lewis (2013) investigated the influence of punishment/ reward sensitivity on the processing of words presented in gain-framed and loss-framed anti-speeding messages. They found that individuals more sensitive to reward showed an attention bias towards rewarding stimuli, while those more sensitive to punishment processed loss-framed messages the most.

Research such as this suggests that personality characteristics like reward sensitivity may influence how effective participants perceive gain-framed and loss-framed safe driving messages to be. They suggest that it might not be that fear appeals are universally ineffective, but rather that they are less effective for the riskiest, reward-sensitive group of people because

the messages are framed in a manner incongruent to their personality. But we don't know whether these effects will be the same for young as for older drivers. Reward sensitivity is particularly associated with adolescence (Steinberg, 2007) and so gain-framed messages might be particularly effective for young drivers. If this is the case, and young drivers think that gain-framed messages would be more effective at improving their driving behaviour than loss-framed messages, then this would have implications for the best way to target them. As has been seen previously, fear appeal loss-framed messages may not be very effective for young males. As young males tend to be more reward-sensitive and higher risk takers, it might be that they respond better to gain-framed messages that offer rewards for safe driving rather than punishments for risky driving. If this is the case the design of future interventions aiming to target those most at risk may benefit from using a gain-framed approach. Therefore the present study was conducted to explore whether drivers would rate gain-framed messages as more or less effective than loss-framed messages, and whether ratings would be influenced by age, gender or punishment versus reward sensitivity.

More generally it is unknown whether we can replace a 'bad' reward i.e. the thrill of risky driving, with a 'good' reward such as a financial incentive for safer driving. There is evidence to suggest that financial risk perception and sensation seeking are unrelated, and that risk-taking is domain specific – so that someone can simultaneously be a risk taker in one area, e.g. driving and risk averse in another, e.g. financially (Horvath & Zuckerman, 1993; Weber et al, 2002; Gabe Thomas et al, 2010). There are many different types of rewards that people may find differentially appealing. It might be that young drivers are sensitive to only certain types of reward that are domain-specific to driving. If this is the case, and risk-taking and reward sensitivity are domain sensitive, then replacing the reward of risky driving with another type of reward may not be effective at reducing young drivers' risk. For example Lewis et al. (2007b) reported how individuals are more likely to feel motivated to change their behaviour when they are provided with strategies that they are confident they can carry out when driving. For young drivers this might mean that approaching them with a strategy or reward that they consider

personally relevant, may prove most effective at reducing their high risk behaviour. The potential use of more social or skill-based messages to reduce collision rates is less well researched or implemented, and so in order to investigate whether the type of reward matters to young drivers the influence of message context was also considered in this study. Two different contexts were used: skill and financial, to provide further clarification about whether drivers themselves considered financial incentives or further skill training to be more effective at reducing risky driving.

The evidence reported previously suggests that people may respond better to a health message framed in congruence with their reward/ punishment sensitivity orientation. Further to this the findings from studies two and three suggest that of all individuals, young males may be particularly reward sensitive, and so might respond the most favourably to gain-famed messages. Similarly based on previous evidence that risk-taking might be domain specific (e.g. Gabe-Thomas et al, 2010) it is expected that skill messages, pertinent to the driving context, might be considered more effective than financial messages, which are less contextually relevant to driving. Thus the hypotheses of this study were as follows:

1. Drivers highly sensitive to reward (particularly males) would rate gain-framed messages as being more effective than loss-framed messages.
2. Drivers highly sensitive to punishment would rate loss-framed messages as being more effective than gain-framed messages.
3. Skill framed messages may be rated as more effective than the financially framed messages.

4.2 Method

4.2.1 Participants

107 participants (69 female) aged 19 – 73 years old completed the study. 'Young Drivers' are generally defined as being between the ages of 18 and 25 years old, therefore in this study the participants recruited for the 'young' age category were between these ages. All other participants over the age of 25 were assigned to the 'older' group. The 'young' group consisted of 56 participants (38 female) with a mean age of 21.5 years (SD = 2.2). Participants had held their driving license for, on average, 2.6 years (range: 2 months to 7.8 years) and made on average 2-5 trips per week. 8 participants had been involved in a collision as a driver, of these, 3 incurred vehicle damage only, 2 reported someone suffered minor injuries, 2 participants reported someone suffered serious injuries requiring hospital treatment and 1 participant reported that someone had died. Over the last five years 10 participants had been convicted of a speeding offence (2 participants had been convicted twice), 2 participants had been convicted of using their mobile phone whilst driving and no participants had been convicted of drunk driving.

The 'older' group consisted of 51 participants (31 female) with a mean age of 41.6 years (SD = 12.3). Participants had held their driving license for on average 21.5 years (range: 11 months to 55 years) and made on average 6-10 trips per week. 26 participants had been involved in a collision as a driver, of these 7 reported vehicle damage only; 12 reported that someone suffered minor injuries, 6 reported someone suffered serious injuries requiring hospital treatment and 1 participant reported that someone had died. Over the last five years 12 participants had been convicted of a speeding offence (3 participant had been convicted twice, 2 participants had been convicted three times), 1 participant had been convicted of using their mobile phone whilst driving and no participants had been convicted of drunk driving.

This demographic data shows that whilst young drivers had held their driving license for only 1/10 of the mean duration that the older drivers had (mean length 2.6 years: 21.5 years) they had already been involved in around 1/3 of the number of collisions that older drivers had (mean number of collisions 8: 26); had accrued a similar number of speeding offence convictions (10: 12), and had 1 more mobile phone conviction between them than the older drivers (2:1). This data provides further support for the notion that young newly qualified drivers are more likely to carry out risky behaviours whilst driving (such as speeding and using a mobile phone), and are at an increased risk of collision as a result. Therefore the delivery of effective interventions to reduce this risk is ever more critical, and more consideration is needed regarding how interventions are designed and presented to young drivers.

4.2.2 Design

A 2x2x2x2x2x2 mixed design with gender, age (young: 18 – 25 years, older: 26 – 58 years), punishment sensitivity (high, low) and reward sensitivity (high, low) as between-groups variables; and message framing (gain, loss) and context (financial, skill) as within-groups variables. Factorial combination of the two within-subject independent variables results in 4 experimental conditions: gain financial, gain skill, loss financial, and loss skill. The dependent variable was perceived message effectiveness.

4.2.3 Materials

The Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (SPSRQ) (Torrubia et al, 2001): Participants completed the same 48-item questionnaire as used in studies two and three, which incorporates two scales – sensitivity to punishment (24 items) and sensitivity to reward (24 items). See Appendix 3A for the full scale.

Safe Driving Messages: As reported earlier, the high-risk behaviours that young drivers tend to engage in most include speeding, drink driving and using a mobile phone whilst driving

(Vassallo et al, 2007; Clarke et al, 2002; Begg & Langley, 2001). It is regularly argued that by reducing young drivers' engagement in these key risky behaviours, the collision risk of young drivers would also be much reduced (Rice, Peek-Asa Kraus, 2003; Ferguson,2003). Therefore the present study focused on investigating what methods drivers considered to be most effective at reducing these three key areas of risk. There were 12 safe-driving messages, four focusing on each of three target areas - speeding, night driving and mobile phone use. For each target area two messages were gain-framed and two messages were loss-framed. The context in which each message was presented was either financial or skill-based. The messages are as follows:

*Gain Financial – a) b*y driving at the recommended speed you will maintain a good driving record, and will have the opportunity to obtain discounted insurance premiums; b) by driving only between 5am and 11pm you could receive a £30 fuel voucher each month; c) by turning your mobile phone off each time you get in the car to drive, you could receive £20 cash back each month.

*Gain Skill - a) b*y driving at the recommended speed you will gain needed time for braking in an emergency. You remain in good control of the vehicle and this will show that you are a competent and able driver; b) by driving only between 5am and 11pm you show that you are responsible, and are aware of the increased risk night-time drivers pose to other road users; c) by turning your mobile phone off each time you get in the car to drive you can be totally focused on your driving, meaning you can become highly accomplished and skilled.

*Loss Financial – a) b*y not driving at the recommended limit you will be less likely to maintain a good driving record, and you will lose an opportunity for discounted insurance premiums; b) by driving between 11pm and 5am you lose the opportunity to obtain a £30 fuel voucher once a month; c) by not turning your mobile phone off each time you get in the car to drive, you lose the opportunity to receive £20 cash back each month.

Loss Skill – a) By not driving at the recommended speed, you will lose time needed for braking in an emergency. This will make you look less in control of the vehicle, and more amateur; b)by driving between 11pm and 5am you show that you may be irresponsible, and are not thinking about the risk night-time drivers pose to other road users; c) by not turning your mobile phone off each time you get in the car to drive you can become easily distracted from your driving. This could mean you miss important signs or hazards and your driving skill will suffer as a result.

For each message participants were asked to rate how effective the message would be in reminding them to drive more safely (1 to indicate very effective and 7 to indicate very ineffective).

4.2.4 Procedure

Participants read the information sheet and consent form via a website online. To provide informed consent participants typed in their full name and selected the button that signified that they had read and understood the conditions of participation. Once participants had consented and clicked 'Next' they were directed to complete the 3-part questionnaire: Part A containing a series of demographic questions, Part B containing the Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (Torrubia et al, 2001); and Part C containing the 12 safe-driving messages. Participants read each message and rated whether they thought the messages were effective or not. Before reading the messages participants acknowledged that they understood the instructions. Once participants had completed all the questions they were presented with a debrief form on screen, detailing the objectives of the study and the experimenters' contact details should they have any questions. Participants taking part for course credit were allocated 1 point for their time; participants taking part for money were awarded their payment.

4.3 Results

4.3.1 Reliability of Measures

Reliability analyses were carried out on each of the measures. The alpha scores for each of the measures were as follows: SPSRQ: α = .89; ratings of safety messages: α = .93. , indicating very good reliability for both measures.

4.3.2 Descriptives

The data in Table 4.1 shows the mean sum effectiveness ratings of the safe driving messages, for all participants and also split by age and gender. For each message type e.g. 'gain financial' there were three statements. The scores from these three statements were summed and displayed here. The results suggest that overall the gain-framed and loss-framed financial messages were considered more effective than gain-framed and loss-framed skill messages. This was consistent for young and older participants, although young males in particular perceived the loss-framed skill messages to be particularly ineffective.

Table 4.1. Rated effectiveness of safe driving messages.

	All Participants Mean (SD)	Young Males Mean (SD)	Young Females Mean (SD)	Older Males Mean (SD)	Older Females Mean (SD)
Gain Financial Messages	14.8 (4.6)	14.3 (4.6)	15.9 (3.7)	14.1 (6.1)	14.3 (4.9)
Gain Skill Messages	11.2 (4.0)	10.4 (2.9)	10.8 (3.1)	12.2 (5.5)	11.6 (4.3)
Loss Financial Messages	12.4 (4.6)	10.9 (5.1)	13.6 (4.1)	12.2 (4.9)	11.9 (4.6)
Loss Skill Messages	10.5 (4.5)	8.3 (3.4)	11.0 (3.8)	11.0 (5.4)	10.8 (4.8)

The methodology used by Genovese and Wallace (2007) to investigate interaction effects between the SPSRQ scales was administered here again, as it was in study three. The sample was divided into groups based on the median split of SP and SR scores and the four groups were (a) high reward, low punishment (HRLP), (b) high reward, high punishment (HRHP), (c) low reward, high punishment (LRHP), (d) low reward, low punishment (LRLP). Table 4.2 shows

the number of young males, young females, older males and older females assigned to each of the four groups based on their sensitivity to reward and sensitivity to punishment scores. A statistically significant association between group membership, gender and age group was found (Cramer's V = .38, p< .01). For three cases only 1 participant was found to be assigned to a RS/PS group, i.e. young males in LRHP, older males in HRHP and older females in HRLP. Field (2012) noted how there needs to be more participants than dependent variables when testing for differences in variance between conditions. When only one participant is present in any of the RS/PS groups we would not be able to establish the amount of variance between the groups because only 1 data point is available.

Table 4.2. Total number of participants in each reward and punishment sensitivity group

	Young Males (N=18)	Young Females (N=38)	Older Males (N=20)	Older Females (N=31)
High Reward, Low Punishment (HRLP)	9	4	4	1
High Reward, High Punishment (HRHP)	4	19	1	5
Low Reward, High Punishment (LRHP)	1	9	2	11
Low Reward, Low Punishment (LRLP)	4	6	13	14

On this basis, the original methodology used in study two (and in Lawrence et al, 2014) was implemented here. The median split of SPSRQ scores were used to derive high and low sensitivity to reward and sensitivity to punishment groups. The high punishment sensitivity group consisted of scores over 12.3 and the punishment sensitivity groups of scores less than 12.3. The high sensitivity to reward group consisted of scores over 9.4, and the low sensitivity to reward group of scores less than 9.4. Table 4.3 shows the total number of participants in each group after the median splits had been conducted. A statistically significant association between group membership, gender and age group was found for both punishment sensitivity (Cramer's V = .45, p< .01) and reward sensitivity (Cramer's V = .44, p< .01). Young males were less sensitive to punishment and more sensitive to reward, young females were more likely to be both sensitive to punishment and reward. Older males were less sensitive to both punishment

and reward, whereas older females were equally split in their sensitivity to punishment but were much less sensitive to reward.

Table 4.3. Total number of participants in each reward and punishment sensitivity group

	Young Males (N=18)	Young Females (N=38)	Older Males (N=20)	Older Females (N=31)
High Sensitivity to Punishment	5	28	3	16
Low Sensitivity to Punishment	13	10	17	15
High Sensitivity to Reward	13	23	5	6
Low Sensitivity to Reward	5	25	15	25

4.3.3 Analysis

A 2x2x2x2x2x2 mixed model ANOVA investigated the effects of gender, age, punishment sensitivity and reward sensitivity on ratings of message effectiveness. A significant interaction was found between gender, age, punishment sensitivity, reward sensitivity and message context ($F(1, 91) = 4.7$, $p < .05$). Main effects of framing ($F(1, 91) = 17.2$, $p < .01$) and context ($F(1, 91) = 29.5$, $p < .001$) were found but no main effects were found for gender ($F(1, 91) = 1.0$, $p > .05$), age ($F(1, 91) = .35$, $p > .05$), punishment sensitivity ($F(1,91) = .06$, $p > .05$) or reward sensitivity ($F(1,91) = .20$, $p > .05$). It appears that the overall interaction occurred because a) young, reward sensitive males and females rated financial messages as being most effective and skill-based messages as much less effective; and b) older, punishment sensitive males rated both types of message as being similarly effective whilst older, punishment sensitive females rated both types of message as being much less effective.

There was a significant interaction between message framing and message context ($F(1, 91) = 5.7$, $p < .05$) as well as significant main effects of both framing ($F(1, 91) = 17.2$, $p < .001$) and context ($F(1, 91) = 29.5$, $p < .001$). Figure 4.1 shows that overall gain-framed messages were rated as being more effective – particularly when presented in a financial context. All messages presented in a skill context were rated as less effective than financial context messages, irrespective of framing.

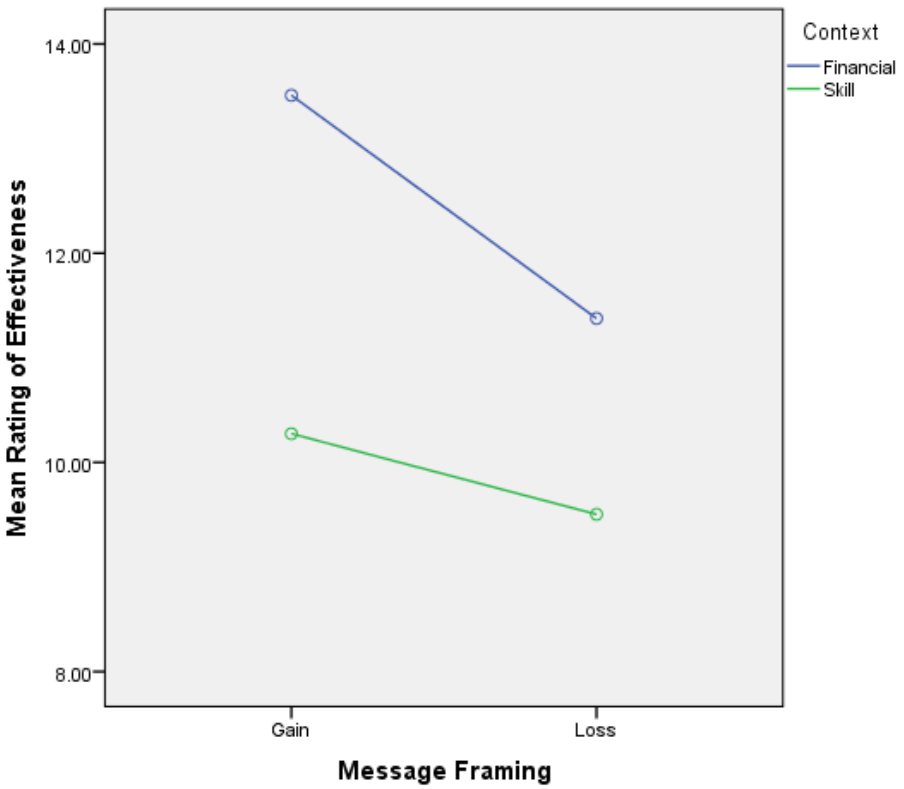

Figure 4.1. Interaction between message framing and context.

There was also an interaction between message framing and punishment sensitivity ($F(1, 91) = 4.3$, $p < .05$), with a main effect of framing ($F(1, 91) = 17.2$, $p < .001$) but not punishment sensitivity ($F(1, 91) = .06$, $p > .05$). Figure 4.2 shows that gain-framed messages were rated as more effective regardless of punishment sensitivity; but participants low in punishment sensitivity tended to rate loss-framed messages as being very ineffective.

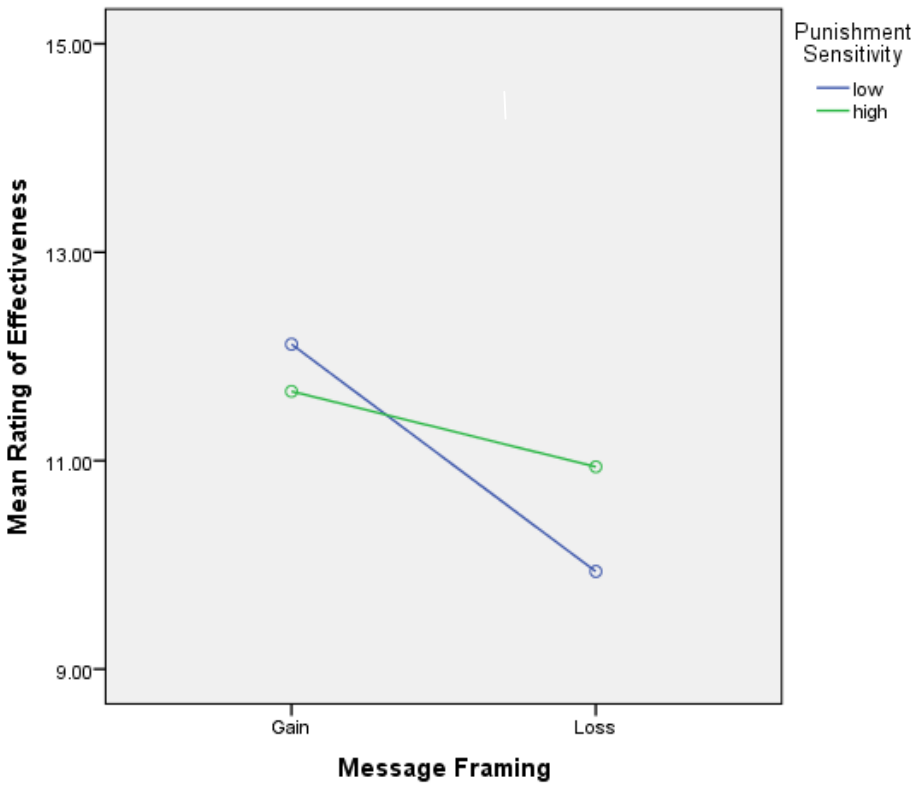

Figure 4.2. Interaction between message framing and punishment sensitivity.

There was a significant interaction found between gender, age, punishment sensitivity, reward sensitivity and message context ($F(1, 91) = 4.7$, $p < .05$). Figures 4.3 and 4.4 show that reward sensitivity had an effect on the ratings young participants gave to financial and skill messages. Figure 4.3 shows that old and young participants scoring low on reward sensitivity tended to rate financial messages as being more effective than skill messages. However Figure 4.4 shows that young participants scoring high on reward sensitivity tended to rate financial messages as being much more effective and skill messages as much less effective than older participants also scoring high on reward sensitivity.

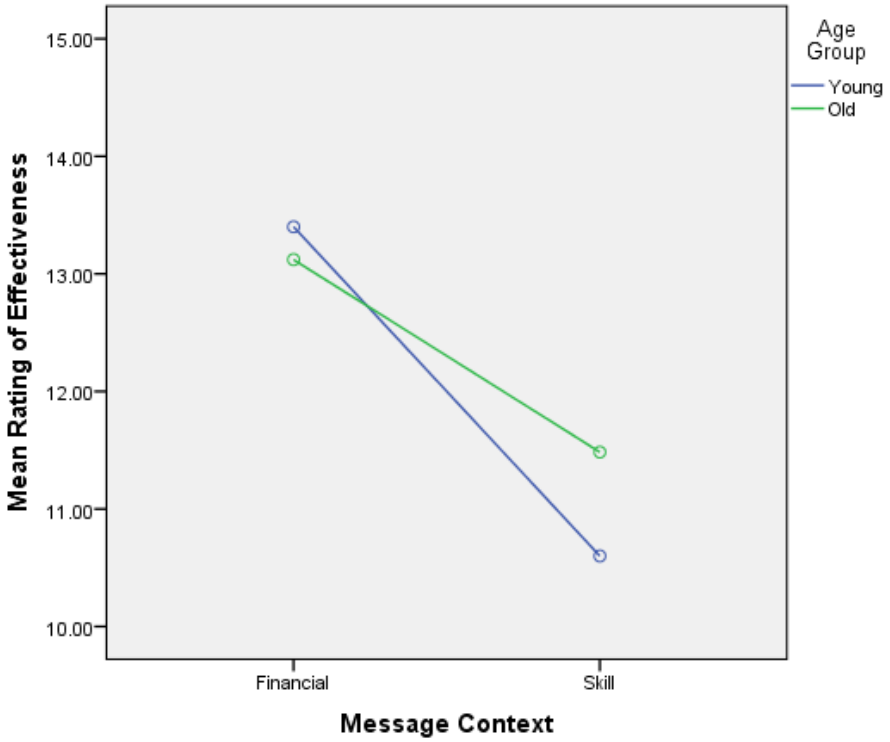

Figure 4.3. Interaction between message context and age for low reward sensitive participants.

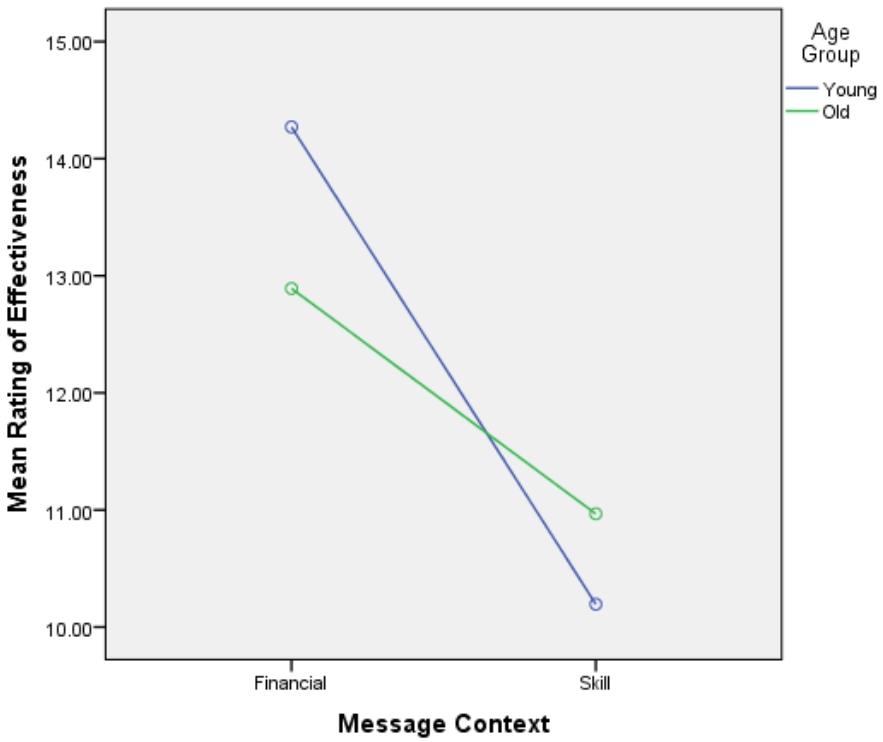

Figure 4.4. Interaction between message context and age for high reward sensitive participants.

Punishment sensitivity had an effect on older participants' message ratings. Figure 4.5 shows that older males who were less sensitive to punishment rated messages as being much more effective than older females also scoring low on this measure. Conversely Figure 4.6 shows that older males who more sensitive to punishment rated messages as being much less effective than older females who were also more sensitive to punishment.

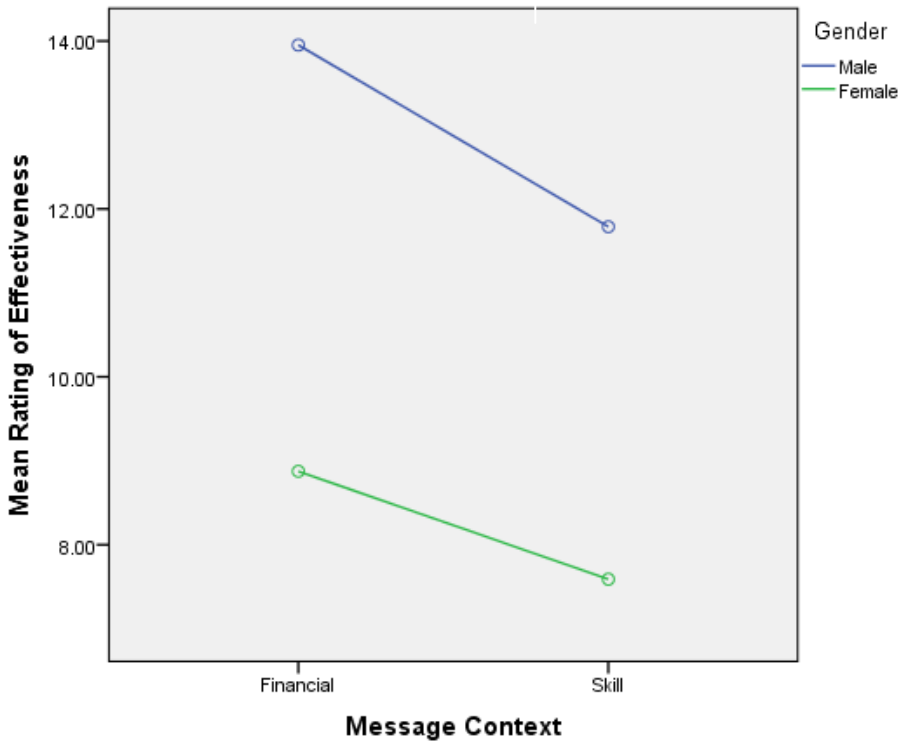

Figure 4.5. Interaction between message context and gender for low punishment sensitive older participants.

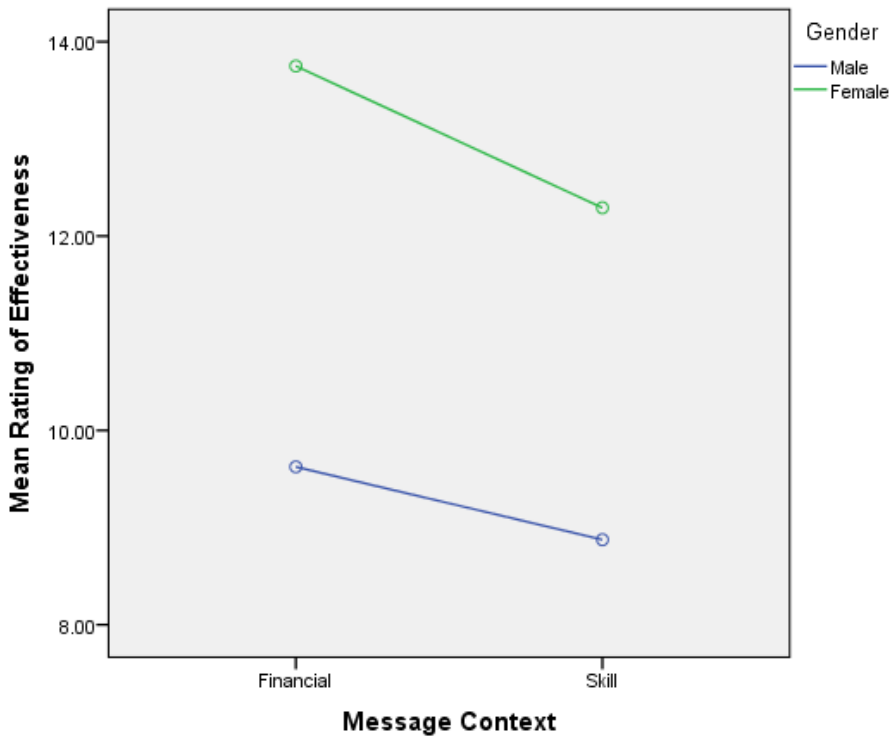

Figure 4.6. Interaction between message context and gender for high punishment sensitive older participants.

4.3.4 Summary

Message framing and message context were found to influence drivers' ratings of the effectiveness of safe driving messages. Gain-framed financial messages were rated as being most effective at improving drivers' own driving behaviour; over and above loss-framed financial messages and all skill messages. Age, gender, punishment sensitivity and reward sensitivity were found to have an effect on how effective drivers rated financial versus skill safe-driving messages to be. All young drivers (male and female), particularly those who were highly sensitive to reward, rated financial messages as being more effective than skill messages. On the other hand all older drivers (male and female) tended to rate financial messages and skill messages as being similarly effective. The exceptions to this were that less punishment sensitive older males rated all messages as being more effective than high punishment sensitive older males. Conversely high punishment sensitive older females rated all messages as being more effective than low punishment sensitive older females.

4.4 Discussion

The findings provide much-needed insight into what young and older drivers perceive to be effective means of targeting risky driving behaviour. Gain-framed messages were rated as more effective than loss-framed messages overall, supporting previous research (e.g. Tversky & Kahneman, 1981; Millar & Millar, 2000) and suggesting that road safety interventions should consider framing messages in terms of potential gains rather than losses. As discussed previously, most young driver initiatives tend to use 'fear appeals', focusing on the potential deadly consequences of dangerous driving (Williams, 2006). However the effectiveness of such methods has long been challenged (e.g. Tay & Watson, 2002; Cohn, 1998) and the results from the evaluation in chapter two highlighted how young males in particular may be least likely to respond to these types of messages. Chapter 3 showed how specifically young males have a heightened sensitivity to reward, and their desire for thrills may underpin their engagement in risky driving. The findings here support the idea that appealing to this reward sensitivity by using a gain-framed approach in road safety interventions may prove more effective than traditional fear appeals. The results suggest that young drivers, including young males, may respond well to a financial-based reward scheme and this could be an effective means of reducing their risky behaviour.

The context of the message was found to be important, particularly for young drivers, who consistently rated financial messages as being more effective than skill messages. This finding is at odds with previous research suggesting that domain-incongruent safety messages may not be effective at improving behaviour (e.g. Gabe-Thomas, 2010; Horvath & Zuckerman, 1993). However given that adolescence is also a time associated with increased financial independence and a greater understanding of the value and necessity of money, it may be intuitive that young drivers feel financial rewards would be an appropriate way to encourage them to drive safely.

The findings also support the notion that financial-based incentive schemes may be an appropriate way to reduce young drivers' risk (Greaves & Fifer, 2011). The participants rating financial messages as being most effective were those young drivers who were more sensitive to reward. Recent research suggests that young drivers who are highly sensitive to reward report committing more traffic violations and driving errors (Castella & Perez, 2004; Constantinou et al, 2011). If these individuals consider financial incentives to be an effective way of improving their driving behaviour, replacing the rewarding thrill of risky driving with a rewarding incentive to drive safely may be an appropriate way to reduce young drivers' risk.

By contrast older participants were much less likely to report being highly sensitive to reward, suggesting that reward sensitivity may be a personality trait particularly associated with adolescence. This supports the work of Siegel (2014) who suggested that reduced inhibitions and enhanced reward sensitivity are particularly present throughout the teenage and young adult years, explaining young peoples' increased desire for exciting and rewarding situations. Teenagers and young adults may consider financial rewards to be very important, and thus this would explain their higher ratings of effectiveness for these messages. However it should be noted that although young drivers rated financial messages as more effective than skill ones it is unclear whether this result is specific to the messages described in this study, or for financial rewards in general. For example in the context of gambling, Choliz (2010) found that the immediacy of financial reward is critical for participants' continued play. When the result appeared immediately (after 2 seconds), gamblers were much more likely to continue playing than when the result was delayed by up to 10 seconds. It was suggested that immediate rewards maintain and increase the behaviour, whereas delayed rewards result in reduced engagement in the behaviour. For young drivers it might be that delayed financial rewards, e.g. reduced yearly insurance premiums, are insufficient to override the immediate thrilling sensation that accompanies risky driving. How the immediacy and type of reward affects young drivers' engagement in risky behaviour has yet to be investigated. Therefore more research is now needed into the nature of financial rewards as a concept for reducing young drivers' risk; and

whether its efficacy is affected by other factors such as the temporal environment and immediacy of reward.

Older participants who were rated as being reward sensitive were still less likely to report the financial messages as being effective despite their sensitivity to reward, suggesting that reward sensitivity may differentially affect younger and older individuals. McCaul, Johnson and Rothman (2002) examined the effect of message framing on older adults' likelihood to obtain a flu immunization. They found that gain-framed appeals did not result in more people receiving a flu vaccine than loss-framed ones, instead finding that messages conveying instructional information about how to get vaccines resulted in more flu vaccines being administered. In the context of this study, it may be that the older participants were less likely to be influenced by financial incentives because small financial gains are less relevant for them, and they would not be directly helpful at improving their driving behaviour.

There were also differences found in older participants' sensitivity to punishment and their ratings of message effectiveness. Older females were much more likely than older males to score as highly sensitive to punishment, supporting previous literature that suggests women are more risk-averse than men (Croson & Gneezy, 2009). The messages were rated as most effective by older males low in punishment sensitivity and older females high in punishment sensitivity, suggesting that sensitivity to punishment differentially affects how effective older drivers consider road safety messages to be. It might be that older females felt motivated to reduce their risky driving because of their fear of punishment; whereas older males were motivated to change for some other reason. Whilst the influence of punishment sensitivity on message ratings was diverse for older drivers, the influence of reward sensitivity followed a similar pattern for young drivers: they consistently rated financial messages as being most effective at improving their behaviour. Thus there may actually be an effective, universal approach to targeting young drivers' risky behaviour, and in particular for those most at risk: young and highly sensitive to reward.

Contrary to the findings from chapter three, there were few gender differences observed between young males' and females' sensitivity to reward and their ratings of message effectiveness. The results in study two showed that only young males who were highly sensitive to reward consistently chose cards from the high-risk deck, even though the chances of loss were greater than the likelihood of reward. By contrast, here both males and females tended to rate the financial messages as being similarly effective, regardless of their sensitivity to reward. Siegel's (2014) research suggests that adolescents in general have heightened reward sensitivity throughout their teenage years. When this is considered in conjunction with the notion of a financial incentive, financial freedom being a crucial aspect of young adulthood, it may be less surprising that the prospect of financial gains would be similarly attractive to all young people, regardless of their intrinsic, generalised reward sensitivity. Similarly, a key aspect of the study described in chapter three was that there was a tangible risk of immediate financial loss to the participant should he/ she choose from the wrong deck. By contrast, in this study the safety messages did not refer to any immediate financial loss, meaning there was not so much risk versus reward to consider. This might explain why all young people, regardless of gender, perceived the financial messages to be most effective.

The findings from this study are based on hypothetical safety messages, so it is unknown whether perceived effectiveness will translate into real-life safer driving. However behavioural intentions have been seen as valid and reliable predictors of future behaviours (Ajzen & Fishbein, 1980) so it would be worthwhile to incorporate the results from this study in the design of future young driver interventions. With some insurance companies already offering financial incentives for young drivers' proven safe driving behaviour there appears to be more scope to further engage with young drivers through their enthusiasm for rewarding safe driving.

Although insurance companies are increasingly offering financial-based incentive schemes to young drivers there are few evaluations published evaluating their efficacy. One such evaluation

conducted by Lahrmann et al. (2012), evaluated the effect of anti-speeding campaign launched in Denmark which was based on Pay as You Drive principles specifically for young drivers. The campaign used ISA (Intelligent Speed Adaptation) equipment which informed the driver of the speed limit, warned the driver when they were speeding and calculated penalty points on this basis. Each penalty point represented a reduction of a 30% discount on the driver's car insurance premium. Following early problems with participant recruitment the project was then terminated before it was due to complete. The researchers found that young drivers were reluctant to relinquish the option to speed, even for substantial economic gain, and the authors suggested that psychological barriers such as these must be overcome before young drivers will accept ISA equipment that limit their driving speed options.

However it should be noted that the nature of the financial scheme described in Lahrmann et al.'s (2012) study tended to focus on financial losses – reduced discounts - rather than on what young drivers could gain from safer driving. Thus it may be that financial incentives considered in isolation of the way they are framed, may be insufficient. The results from the study described here suggests that the way in which financial gains and losses are framed may be crucial to their efficacy for young drivers. Thus it might be that financial incentives need to be framed as a 'gain' in order to be effective.

The findings from chapter three suggested that young drivers scoring high on reward sensitivity may be more likely to engage in more high-risk driving behaviour. They reinforced the notion that traditional 'fear appeal' style road safety interventions may be ineffective at reducing risky young driver's behaviour and so the present study was conducted to explore how effective drivers would consider gain-framed and loss-framed messages, set in different contexts, to be. The findings support the idea that offering tangible rewards for safe driving may be an effective approach for improving young drivers' behaviour, and in particular offering financial incentives may prove the most effective. The findings did not uncover any gender preferences for certain messages, but did reinforce the notion that adolescents may be in general more reward sensitive

than older adults, and that by replacing a sensation-seeking reward with another age-appropriate reward, such as financial aid, may be a potential avenue to consider.

This study was the first of its kind to investigate age-and-personality-related differences between young and older drivers' ratings of message effectiveness. The findings suggest that the context of road safety messages appeal differently to drivers of different ages, with different personality characteristics. For young drivers, especially those high in reward sensitivity, the context of the incentive offered need not be domain-congruent to improve their intentions to drive safely. Whilst some older drivers may consider skill-based safety messages to be effective at improving their driving behaviour, young drivers do not concur. In fact, financial gain-framed messages were consistently rated most effective by young drivers. Future interventions targeting young drivers may prove effective when framed in terms of the potential financial gains young drivers may acquire if they adopt safer driving behaviours.

Chapter Five

Young Drivers, Peer Influence and Risky Driving

5.1 Study Five: The relationship between different forms of peer influence and young drivers' self-reported engagement in risky driving

5.1.1 Introduction

The findings thus far have revealed that: fear appeal interventions may be less effective for young males, reward sensitivity may be one of the factors underpinning the risky driving behaviour of some young people; and framing safety messages in terms of potential gains, rather than losses, may be a more effective method to reduce their collision risk. In addition to reward sensitivity, another factor implicated in young drivers' high collision rates is the presence of peer passengers. So in this chapter we explored how peers influence young drivers in order to better understand why they increase their risk and to inform the design of new interventions targeting them. As discussed previously, when accompanied by their peers young drivers are more likely to engage in various high-risk behaviours (e.g. Rhodes, Pivick & Sutton, 2015) and are also more likely to be involved in a collision (e.g. Rice, Peek-Asa & Kraus, 2003). It is crucial to understand why peer passengers have such a negative effect on young drivers' collision risk in order to be able to develop effective methods to reduce this risk.

For teenage drivers, driving is often perceived as a means of socializing, and young drivers are more likely than older drivers to a) have passengers and b) have a greater number of passengers per trip (Shope & Bingham, 2008). The presence of passengers is a key factor implicated in the crash rate of drivers under 21 years old (Bedard & Meyers, 2004), and it appears to be the presence of same-age passengers that is most risky (Doherty, Andrey & MacGregor, 1998). Mirman et al. (2012) found that young drivers who reported driving often with multiple

passengers, also tended to report greater sensation seeking tendencies and greater engagement in risky driving behaviours.

By analysing police crash reports for collisions involving 16 and 17 year olds, Rice, Peek-Asa and Kraus (2003) found that driving with passengers was one of the most common predictors of a crash resulting in the driver being seriously or fatally injured. Young drivers were least at risk when accompanied by an older adult but most at risk when accompanied by a male teenage passenger. These findings were echoed by Ouimet et al. (2010) who found that young drivers' crash risk was lowest when accompanied by an adult passenger aged 30 years or over but highest when accompanied by similar-aged teenage passengers, and in particular teenage males (Ouimet et al, 2010). Similarly Williams and Tefft (2014) analysed police crash report data for the years 2005 – 2010. They found that more than 40% of 16 and 17 year old drivers involved in fatal crashes had teenage passengers at the time; and when teen drivers were accompanied by teen passengers they were much more likely to be responsible for the crash than lone teen drivers. The presence of peer passengers is now known to be a risk factor in the crash rates of young drivers, but more recently researchers have focused on understanding why they pose such a risk.

5.1.1.1 Peer Influence

We know that adolescents tend to be more susceptible to peer influence than other age groups (Steinberg, 2004) and it might be that young drivers are influenced by their peers to drive in a certain way. Allen and Brown (2008) suggested that factors such as trying to please one's peers and divided attention between driving and entertaining friends may influence young drivers' propensity to engage in risky driving when accompanied by peer passengers. Peers can also "egg on" dangerous action, knowing they will not incur any legal responsibility for the consequences. Viewed holistically Allen and Brown (2008) identified these concepts as being

‘social risk factors’ for the young driver, as their driving behaviour is being affected by influences derived from the social environment.

Horvath et al. (2012) suggested that these social risk factors can exert their influence on young drivers’ behaviour directly through verbal encouragement, or indirectly, through the drivers’ perceptions of how others think they should drive. Passengers that verbally encourage the driver to perform risky behaviours are considered to be a direct ‘active’ form of influence, as it involves action on the part of the passenger and occurs within the driving context at specific moments in time. In comparison, indirect forms of passenger influence originate from outside the driving context and occur through the driver’s own perceptions of pressure from the passenger. Allen and Brown (2008) suggest that this perceived pressure is likely to stem from group norms that specify appropriate behaviour for members, developed through relationships within a group, and on which identity as a member of that group is sought (Tajfel, 1982). In this way “active” peer influence can be understood to mean direct and observable verbal (or otherwise) encouragement from passengers; whereas “passive” peer influence refers to more indirect unobservable instances where in the driver’s own perceptions about their passengers’ attitudes or feelings influences their driving behaviour. Social Identity Theory (SIT) suggests that individuals base their identity on group membership. To strengthen their feeling of in-group membership they are motivated to behave in accordance with the group’s norms even when not explicitly instructed to (Tajfel, 1982). Thus it could be that young drivers are affected by passive peer influence as the mere presence of the passengers enforces the group norms and implicitly encourages them to behave in accordance with them, without active persuasion from the passenger (Allen & Brown, 2008).

Having peer passengers in the car is well known to be a risk factor in general for young drivers. However relatively little research has attempted to uncover whether it is primarily active peer influence, where the passengers actively encourage risky driving; or primarily passive peer influence, where the drivers themselves feel they have to drive in a certain way to impress their

peers, that increases young drivers' propensity to drive in a risky way when accompanied by peer passengers. It is important that this be known in order for us to understand the specific factors that underpin young drivers' engagement in risky behaviour. This knowledge will then be used to design evidence-based interventions better equipped to reduce the risk of future young drivers.

Of the research that has been conducted, there is evidence from various sources to support the idea that it is more passive forms of peer influence that correlate with young drivers' use of certain risky driving behaviours. For example Conner et al. (2003) investigated the influence of peers on drivers' speeding behaviour and found that both male and female drivers reported feeling normative pressure to speed when with peer passengers. This in turn was associated with increased speeding intentions for these drivers. Further to this, males also reported normative pressure to speed even when driving alone. This suggests that passive peer influence can exert its effect on drivers' behaviour even in the absence of passengers.

Also using self-report measures, Moller and Haustein (2014) found that young males' perceptions of their friends' speeding behaviour were the biggest predictor of their own speeding behaviour and they suggested that adolescent males are vulnerable to being coerced into driving more dangerously via the social norms prescribed by their peer group. Similarly Guggenheim and Taubman-Ben-Ari (2015) found that young drivers whose friendships were based on aspects of pleasure (rather than concern, practical interactions etc) were more likely to report engaging in risky and distracted driving; and this was particularly evident among male teenagers. Further research by Taubman-Ben-Ari et al. (2015) found that perceived popularity of risky driving among peers was associated with higher levels of self-reported risky driving; providing more support for the notion that young drivers may engage in high risk driving to be in accordance with the perceived norms of their peer group.

Evidence from other sources concurs. For example in a driving simulator study Ouimet et al. (2013) found that the mere presence of a male teenage passenger in the vehicle with a male teenage driver was enough to reduce the drivers' attention to the road. Even without overt pressure or encouragement to drive dangerously, when young male drivers were accompanied by a similar-aged male passenger they were more likely to make less eye glances at hazards. There is also some evidence supporting a neural basis for susceptibility to peer influence and risk taking in adolescence (Falk et al, 2014). Here, young drivers' neural responses to social exclusion predicted an increase in simulated risk taking behaviour in the presence of a peer one week later. It may be that young drivers consider risky driving an appropriate way to reassert their position within a social group if they are feeling marginalised and thus act in a way that will strengthen their in-group membership.

Although there appears to be much support for the idea that passive peer influence underlies young drivers' risky behaviour, few studies have actually explored the relative contribution of active versus passive peer influence. Thus Sela-Shayovitz' (2008) study was the first known exploration into the relationship between four types of influence (two passive, two active) on young drivers' risky behaviour. The two passive forms of influence were apprehension about friend's evaluations and attaining social prestige, whereas the two active forms of influence were peers intervening in decisions and pressure to make traffic violations. Young drivers aged between 17 and 21 years old completed self-report questionnaires and it was found that only the passive forms of influence were highly correlated with many driving violations, including speeding, tailgating, going through a red light and failing to yield the right of way; as well as also being associated with crash involvement. In comparison, no correlations between these driving violations and the active forms of influence were found (Sela-Shayovitz, 2008).

Despite these clearly diverse findings Sela-Shayovitz (2008) failed to explicitly differentiate passive from active peer influence (Horvath et al, 2012) and until recently this differentiation had not yet been applied overtly to the road safety context. Horvath et al. (2012) thus provided

one of the first explicit investigations into this notion. They had young drivers on an Australian provisional or full license complete a scenario- based questionnaire, measuring their intentions to speed when accompanied by passengers in various situations. Contrary to expectation a protective effect of passenger presence was observed in that the young drivers' intentions to speed were found to be higher when alone than when with passengers (Horvath et al, 2012). Similarly, although Sela-Shayovitz (2008) found that passive peer influence was correlated with more driving violations than active forms, Horvath et al. (2012) failed to replicate this finding. Similar levels of reported speeding intentions were observed for both active and passive peer influence conditions, illustrating that there is still uncertainty about the relative impact of passive vs. active influence on risky behaviours in young drivers.

Gheorghiu, Delhomme and Felonneau (2015) employed a different approach to exploring the relative influence of active versus passive peer pressure. They created six driving scenarios involving a fictional young male driver and a group of his peer passengers under different conditions of peer influence. The peer passengers were either high risk-takers or low-risk takers and exerted either direct active pressure, indirect active pressure (through storytelling) or passive pressure. The participants' task was to estimate the fictional drivers' speeding behaviour and intentions to speed when under these different conditions of peer influence. Gheorghiu et al. (2015) found that only the two types of active pressure had an effect on the estimated speeding behaviour of the fictional driver, and reported that only more speeding behaviour was reported when the fictional driver experienced active pressure from his peer passengers rather than when he experienced passive pressure. These findings suggest that active peer pressure may play a substantial role in young peoples' risky speeding behaviour, but the study design using fictional scenarios and only a male driver limits the generalisation of the results to real-life behaviour.

The research into how passive and active peer influence affects young drivers is still in its infancy. But the findings related to how peers influence other teenage health behaviours, such as starting smoking, is well established. Although peers are understood to influence young people

taking up smoking it appears that this rarely happens through direct persuasion, and rather occurs as the result of the teenager wanting to conform to the perceived norms of the peer group with which they identify (Stewart-Knox et al, 2005; Michell and West, 1996). Findings such as these are in line with social identity theory as their engagement in smoking appears to be a channel through which young people can define their social group, identify with their in-group members, and emphasize their commitment to the group's norms (Stewart-Knox et al, 2005).

The findings into teen smoking demonstrate how peer influence is a complex and multi-dimensional concept that can exert effects in different ways. Sela-Shayovitz' (2008) and Horvath et al.'s (2012) findings illustrate the limited understanding we have about the relative impact of passive versus active peer influence in the engagement of risky driving behaviours among young drivers. Therefore the present study aimed to develop our understanding of how peers influence young drivers' risky driving, using a relatively new measure of risky driving behaviour. By having a clearer understanding of how peers influence young drivers' risky behaviour, we can then use this information to design interventions and more effectively reduce the risk of future young drivers.

Therefore we predicted that:

1. Participants who reported more risky driving behaviours would also report being influenced by their peers.
2. Passive influence would be a bigger predictor of risky driving than active influence.
3. Participants who report high resistance to peer influence would report fewer risky driving behaviours.

5.1.2 Method

5.1.2.1 Participants

163 drivers aged 18 – 25 years old (Mean = 19.74 years) completed the study. There were 137 females, 26 males. Paid participants were recruited via the University of Plymouth participant pool and from advertisements around campus; undergraduate psychology students also participated for course credit. The length of time participants had held their driving license varied from just 3 months to 8 years 8 months (Mean = 2 years 2 months). Participants made on average 2 – 5 trips per week. 33 participants had been involved in a collision as a driver. Of these, 11 collisions involved no injuries, and only minor damage to the vehicle(s); 13 collisions involved no injuries and some damage to the vehicle(s), 7 collisions involved someone suffering minor injuries; 2 collisions involved someone suffered quite serious injuries (i.e. required hospital treatment). 8 participants had been in more than 1 collision since obtaining their driving license.

5.1.2.2 Materials

Susceptibility to Peer Influence (SPI) (Sela-Shayovitz et al, 2008).

Active and Passive Peer Influence were measured with items from Sela-Shayovitz' (2008) self report questionnaire for young drivers. We used four subscales, each of five items: attaining social prestige (ASP) e.g. 'driving allows me to impress others'; apprehension about friends' evaluations (AFE) e.g. 'what my friends think about my driving is important to me'; peer intervention in decisions (PID) e.g. 'when I'm driving my friends sometimes encourage me to speed to have fun'; and pressure to make traffic violations (PTV) e.g. 'my friends pressure me to drive after I've had an alcoholic drink'. See Appendix 5A for the full scale.

Resistance to Peer Influence (RPI) (Steinberg & Monahan, 2007).

RPI consists of 10 pairs of opposing statements about inter-individual interactions, e.g. "some people go along with their friends just to keep their friends happy, BUT, other people refuse to

go along with what their friends want to do, even though they know it will make their friends unhappy". Respondents answered whether each statement sounded 'really true for them' or just 'sort of true for them'. It is designed for specifically adolescents, higher scores indicate greater resistance to peer influence. See Appendix 5B for the full scale.

Behaviour of Young Novice Drivers Scale (BYNDS) (Scott-Parker et al, 2012).

BYNDS measures the risky driving behaviour of specifically young drivers and comprises five subscales: transient violations, fixed violations, misjudgement, risky driving exposure, and driving in response to mood. The survey uses a Likert scale ranging from 1 (never) to 5 (almost always). Higher scores indicate more risky driving, see Appendix 5C for the full scale.

5.1.2.3 Procedure

Participants read the information sheet and consent form via a website online. To provide informed consent participants typed in their full name and selected the button that signified that they had read and understood the conditions of participation. Participants then read instructions for completion of the study and proceeded to complete a set of questionnaires comprised from the following tools: The Behaviour of Young Novice Drivers Scale (BYNDS) (Scott-Parker, Watson, King & Hyde, 2012), Peer Influence questions taken from a self-report questionnaire devised by Sela-Shayovitz (2008) which was based on the Driver Behaviour Questionnaire (DBQ) (Lawton, Parker, Stradling and Manstead, 1997) and the Resistance to Peer Influence scale (Steinberg and Monahan, 2007). The presentation order of the measures was the same for all participants. Once participants had completed all the questions they were presented with a debrief form on screen, detailing the objectives of the study and the experimenters' contact details should they have any questions. Participants taking part for course credit were allocated 1 point for their time; paid participants were awarded £4 for their time.

5.1.2 Results

5.1.2.1 Reliability of Measures

Reliability analyses were conducted on each of the measures. The alpha scores indicate good/very good reliability for all measures: SPI (Sela-Shayovitz, 2008) $\alpha = .83$, RPI (Steinberg & Monahan, 2007) $\alpha = .74$ and BYNDS (Scott-Parker et al, 2012) $\alpha = .92$.

5.1.2.2 Analysis

The lowest possible score on the behaviour of young novice drivers scale (BYNDS) (Scott-Parker et al, 2012) is 44, indicating very few and infrequent traffic violations; the highest possible score is 220. Participants' mean road traffic violation score for this study was 94, with scores ranging from 56 to 160. Table 5.1 provides the descriptive information for participants' responses on all measures. Total road traffic violation scores were calculated by summing the responses from each item. Higher scores equated to more risky driving behaviour. One-way ANOVAs revealed no statistically significant differences between males and females on measures of passive peer influence ($F(1, 152) = .97$, $p > .05$), active peer influence ($F(1,152) = .1.6$, $p > .05$); RPI ($F(1, 152) = 2.6$, $p > .05$) or road traffic violations ($F(1, 152) = .18$, $p > .05$). Similarly, no significant differences were found between males and females on any of the susceptibility to peer influence subscales: ASP ($F(1, 152) = .67$, $p > .05$), AFE ($F(1, 152) = .84$, $p > .05$), PID ($F(1, 152) = .15$, $p > .05$) or PTV ($F(1, 152) = 3.5$, $p > .05$). As males' and females' scores did not differ the data was collapsed across gender.

Table 5.1. Self-reported susceptibility to passive peer influence, active peer influence, resistance to peer influence and prior road traffic violations

	All Participants Mean (SD)
Passive Peer Influence (sum)	28.7 (6.6)
Passive: Attaining Social Prestige	15.1 (4.6)
Passive: Apprehension of Friend's Evaluations	13.6 (3.0)
Active Peer Influence (sum)	23.6 (6.1)
Active: Peer Intervention in Decisions	12.6 (3.4)
Active: Pressure to make Traffic Violations	13.7 (3.5)
Resistance to Peer Influence	30.8 (4.1)
Road Traffic Violations (sum)	94.1 (18.7)

5.1.2.3 Correlations

Correlations between the study variables are presented in Table 5.2. The results suggest that when young drivers report feeling influenced by their peers they also report higher rates of various road traffic violations. The results also indicate that susceptibility to both active peer influence and passive peer influence is associated with self-reported driving violations. Young drivers reporting high resistance to peer influence did not report significantly fewer road traffic violations.

As the peer influence measures were correlated with each other, variance inflation factors (VIF) were used to assess the degree of collinearity between variables. There are various recommendations in the literature regarding acceptable levels of VIF. Most commonly, a value of 10 has been regarded as the maximum level of VIF to accept (e.g. Hair et al, 1995; Kennedy, 1992; Marquardt, 1970; Neter et al, 1989); and this corresponds to the tolerance recommendation of .10. The VIFs for each of the variables in the present study (*ASP, AFE, PID, and PTV*) were 2.5, 1.7, 1.9, and 2.8 respectively. These VIF levels indicate that the degree of collinearity between the variables is low and they are suitable for use within a multiple regression analysis.

*Table 5.2. Correlations among Variables. Note *p<0.5. **p<.01*

Variable	1	2	3	4	5	6	7	8
1. Passive Peer Influence	-							
2. Passive: Attaining Social Prestige	.93**	-						
3. Passive: Apprehension of Friend's Evaluations	.81**	.53**	-					
4. Active Peer Influence	.80**	.78**	.59**	-				
5. Active: Peer Intervention in Decisions	.64**	.66**	.41**	.89**	-			
6. Active: Pressure to make Traffic Violations	.79**	.73**	.64**	.90**	.60**	-		
7. Resistance to Peer Influence	-.35**	-.37**	-.20**	-.35**	-.28**	-.34**	-	
8. Road Traffic Violations	.53**	.56**	.32**	.57**	.59**	.43**	-.12	-

5.1.2.4 Regression Analyses

Hierarchical regression analysis were conducted to assess relations between the four forms of peer influence (passive: ASP & AFE; active: PID & PTV) and reported road traffic violations. The first model incorporated all four variables and found that reported road traffic violations was predicted by ASP $\beta = .32$, $t(149) = 3.1$, $p < .01$) and by PID $\beta = .40$, $t(149) = 4.6$, $p < .01$, but not by AFE $\beta = .03$, ($t(149) = .35$, $p > .05$, or PTV $\beta = -.15$, $t(149) = -.05$ $p > .05$). ASP and PID also explained a significant proportion of the variance in reported road traffic violations, Adjusted $R^2 = .38$, $F(4, 149) = 24.5$.

The two non-significant measures of peer influence were removed from the model (AFE & PTV) to see whether this affected the amount of variance accounted for by the two remaining variables in the model. Adjusted R Square increased from .38 to .39, with an R Square change of -.001. This change was non-significant $F(2, 149) = .14$, $p > .05$; and therefore it can be

assumed that AFE and PTV do not explain any additional variance. Figure 5.1 shows the adjusted model, whereby attaining social prestige and peer intervention in decisions explained a significant proportion of the variance in reported road traffic violations, Adjusted $R^2 = .39$, $F(2, 149) = 24.5$.

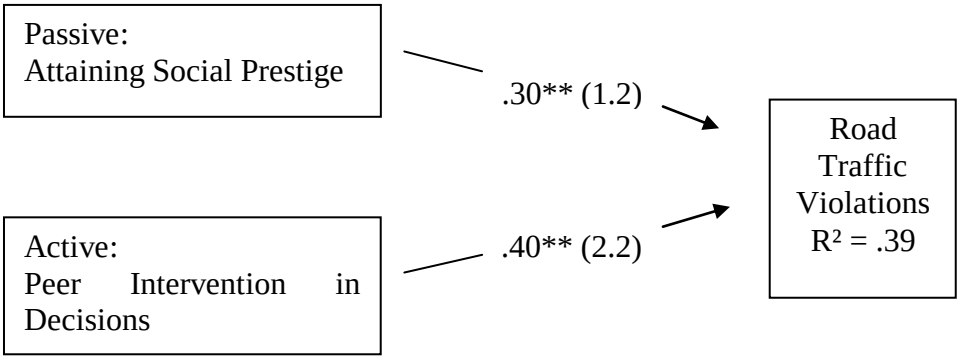

*Figure 5.1. Attaining social prestige, peer intervention in decisions and road traffic violations. Values represent standardized estimates with unstandardized estimates in parentheses. **p< .01.*

5.1.3 Discussion

This study was conducted to explore how peer passengers influence young drivers' risk-taking behaviour, in order to better understand how to reduce this risk. Young drivers are more likely to engage in various high-risk behaviours when with peer passengers (e.g. Rhodes, Pivick & Sutton, 2015) and are also more likely to be involved in a collision in these circumstances (e.g. Rice, Peek-Asa & Kraus, 2003). Thus addressing this issue, and understanding precisely why peer passengers pose such a risk, is critical in order to improve the safety of future young drivers and their peers. To this end young drivers' self-reported risky driving violations were examined in relation to measures of susceptibility to active and passive peer influence, and resistance to peer influence. It was found that high susceptibility to peer influence was related to more self-reported risky driving behaviours and that attaining social prestige (Passive) and peers intervening in decisions (Active) were significant predictors of more violations; rather than apprehension of friends evaluations or through drivers feeling pressure to make traffic violations. Resistance to peer influence was not associated with road traffic violations.

The findings are consistent with previous research (Sela-Shayovitz, 2008; Allen & Brown, 2008) and support the notion that young people may perform risky behaviours to be in accordance with the social norms of their peer group (Stewart-Knox et al, 2005). The findings also support the idea that young drivers do not need active persuasion from their peer passengers to drive dangerously, but rather they feel implicitly required to drive in a certain way in order to gain a higher social status within their peer group. SIT (Tajfel, 1982) posits that members of social groups seek to strengthen their in-group membership by acting in ways to enhance their in-group similarity. The results from this study showed that young drivers who felt susceptible to their peers' influence in terms of attaining social prestige within their peer group, were also more likely to report engaging in more road traffic violations. The summary diagram of risk factors in Figure 5.2 illustrates how susceptibility to peer influence may contribute to young drivers' enthusiasm for engaging in risky driving behaviours, and the findings here lend further support to this notion.

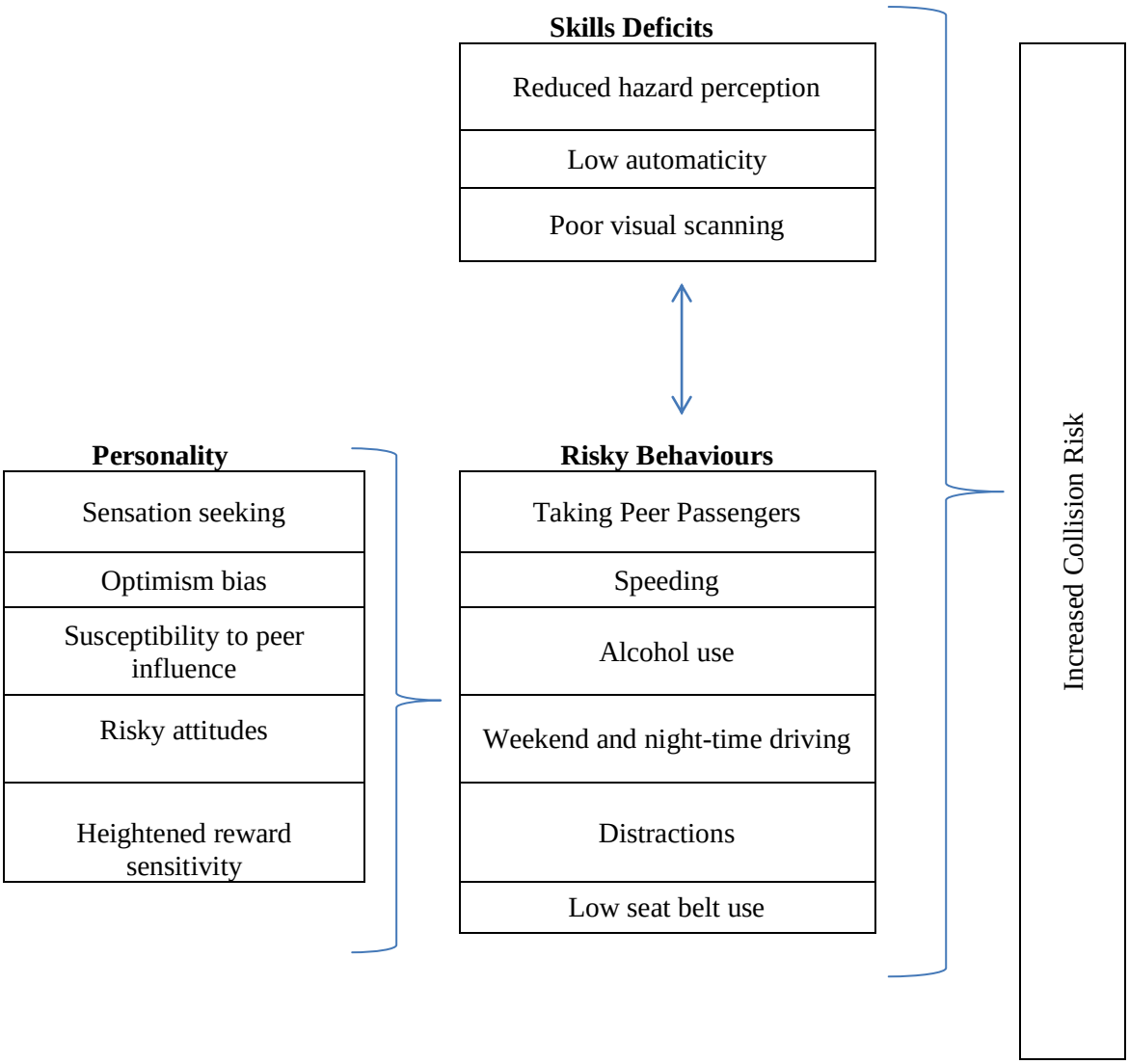

Figure 5.2. Factors thought to underpin young drivers' risky driving.

For young drivers, driving is a part of their identity and a mode with which to transmit their norms and beliefs. If performing a risky driving behaviour is considered an appropriate way to sustain a good position within their social group, those susceptible to peer influence are likely to do it (Stewart-Knox et al, 2005). Indeed, Allen and Brown (2008) suggested that young drivers may engage in more risky driving when they are trying to please their peers; and Horvath et al. (2012) found that when drivers reported identifying with their peer passengers, their intended speeding behaviour reflected this connection to their social group: young drivers who felt their

peers endorsed speeding, were more likely to do it. Thus it appears that enhancing in-group similarity and acting in ways that strengthen their social bond is a key determinant of some young drivers' risky behaviour.

There is also some evidence to suggest that peer passengers do not even need to be present in the car with a young driver for them to feel implicitly required to drive in a certain way. Conner et al. (2003) found that some male drivers reported feeling normative pressure to speed even when they were driving alone, suggesting that there might be an embedded culture of expectation amongst the young driver population to drive in a certain risky way, even when not accompanied by their peers in the car. This has implications for targeting young drivers, as interventions may need to address the wider social norms that young people subscribe to, in order to be more effective at reducing their risk-taking behaviour.

In terms of the non-significant predictors, 'apprehension of friends evaluations' and 'pressure to make violations' were not associated with more risky driving. This suggests that young drivers perceive the input of their peer passengers to be collaborative, rather than coercive. This further supports SIT, with risky driving likely to be considered a shared interest between some young drivers' and their peers, and may form part of a wider social norm amongst young people that risky driving is appropriate. Interventions confronting the issue should therefore focus on changing the perception that driving in a risky way is a means to attain social prestige. These findings can be used to help inform interventions designed to reduce young drivers' risk, and should focus on two primary avenues - providing young drivers with strategies to resist peer influence, and challenging the perception that driving in a risky way is a means to attain social prestige. If the social group as a whole no longer perceives risky driving to be "cool", then individual drivers won't feel the need to engage in dangerous behaviour.

The study was not able to explore potential gender differences between susceptibility to peer influence and risky driving as very few males took part. Previous research has found that the

presence of young male passengers has a much greater negative impact on the risky driving behaviour of young drivers than female passengers (Simons-Morton et al, 2005); and so further investigation is still needed to understand how males and females are differentially influenced by their peers. Future research should therefore focus on identifying the mechanisms by which peer influence differentially affects males and females, in order to better understand how to reduce their risk.

The findings from the present study are in line with research into peer influence and teenage health behaviours (Stewart-Knox et al, 2005); and provides further evidence that when young adults report being highly susceptible to peer influence, they also tend to report engaging in more risky driving behaviours. The results are important in terms of identifying risk factors for young drivers, and designing appropriate interventions to tackle this issue. Peer influence has been shown to be a critical factor in the risky driving behaviour of young drivers; and thus the next study aimed to address this issue, by devising a way in which to counteract young people's desire to use driving as a means to attain social prestige within their peer group.

5.2 Study Six: Investigating the efficacy of a pilot peer-to-peer road safety intervention

5.2.1 Introduction

The results from study five suggest that young drivers who are susceptible to peer influence are more likely to report engaging in more traffic violations. Specifically, attaining social prestige and peers intervening in decisions were the forms of peer influence associated with most violations. This suggests that young drivers use their passengers to help them decide their driving behaviour (be it safe or dangerous); and use their driving behaviour as a means to attain a higher social standing within their peer group. These findings provide insight into what underpins the risky driving behaviour of some young drivers, in that if risky driving is sanctioned by their peer group, those young drivers who are influenced by their peers are more likely to comply. The findings also suggest that if interventions are able to break down the perception that risky driving is an appropriate way to attain social prestige within a peer group, then young drivers' engagement in risky driving, and subsequent collision risk, might be substantially reduced.

The evidence discussed in chapter two showed how the efficacy of young driver interventions is still unclear, with literature reviews and meta-analyses having failed to find a clear and substantive link between current interventions and long-term improvements to young driver collision rates (e.g. McKenna, 2010). Possible reasons for this lack of efficacy were discussed, including most notably the over-reliance on 'fear appeal' style techniques that may not apply to the most risky, reward-sensitive young drivers. In chapter four a possible alternative to fear appeal loss-framed interventions was considered; the key finding being that young drivers considered gain-framed financial rewards as a possible avenue through which to improve their behaviour.

However whilst young drivers may consider financial incentives to be an ideal way to improve their behaviour, monetary reward may not solve all the factors associated with young drivers' engagement in risky behaviour. The findings from study five showed that young drivers who reported committing the most road traffic violations were also more likely to report feeling influenced by their peers in two specific ways: as a means to attain prestige within their social group and by accepting their peers' intervention in their driving. This provides some explanation about why some young drivers are so at risk as it shows how they might be choosing to drive dangerously to be in line with the risky expectations of their social group. It also provides an opportunity to try and reduce this risk, by using the influence that peers have on young drivers in a positive way. If peers themselves challenged the perception that risky driving is an appropriate way to act, this might lessen young drivers' engagement in risky driving because the need to do it to attain prestige will have been eliminated.

This is in line with the idea that by removing the "rewarding" part of risky driving it will no longer be considered novel and exciting, and adolescents may be then less likely to want to engage in it (Siegel, 2014). Therefore in this study a peer-to-peer intervention was designed, piloted and evaluated, in order to investigate whether a peer-led intervention involving an entire peer group would be successful in reducing young drivers' intentions to drive dangerously.

5.2.1.1 Peer-to-Peer Education

Peer Health Education can be defined as "the teaching or sharing of health information, values and behaviours by members of similar age or status group" (Sciacca, 1987). The rationale for using peer education is informed by social learning theory (Bandura, 1976; 1986), social inoculation (McGuire, 1964) and social norms (Baric, 1977). Together these theories posit that friends look for advice from their friends, and are also influenced by the expectations, attitudes and behaviour of the social group to which they belong (Lindsey, 1996). Thus peer education is used because it is thought that adolescents may be more likely to respond to the teachings of a peer as they try to enhance their in-group similarity by conforming to the norms of their social

group. This is in comparison to the teachings of teachers, older adults, or “experts”, whom they have no affiliation to, and are less influenced by.

Peer education has been used as a tool to improve young peoples’ wellbeing in many realms of risky health behaviour, such as nutrition, sexual health and alcohol consumption. For example, Story et al. (2002) reported an evaluation of a school-based nutrition peer education intervention. Around 1,000 students from eight schools participated in the year-long intervention, with around 250 of them trained by nutrition experts to become ‘peer leaders’. These students were responsible for delivering activities, reinforcing nutrition messages, and delivering the intervention throughout the year. The evaluation incorporated peer leader and classroom student feedback, classroom observations and teacher interviews; and it was found that peer-led nutrition education was highly endorsed by both peer leaders and classroom students themselves, and there was an overall consensus that peer education should be used more in promoting good health (Story et al, 2002).

Similarly, White et al. (2009) conducted a 3-year longitudinal evaluation of a university campus peer health education programme. They found that students who had contact with peer health educators reported less alcohol consumption and healthier weight management behaviour by their third year, compared to students who did not have any contact with peer educators. They did find, however, that peer health education had little effect on students’ reported sexual health behaviours, a finding echoed by Tolli’s (2012) systematic review into the effectiveness of peer education for HIV prevention, adolescent pregnancy prevention and sexual health promotion for young people. Peer education interventions for sexual health in the European Union published between January 1999 and May 2010 were collated, and the results analysed. Overall there was no clear evidence that peer education was more effective when compared to standard practice or no intervention; however it should be noted that only 5 studies were deemed appropriate to be included in the review, showing how the use of peer education for improving the sexual health

behaviour of young people is still relatively underdeveloped, in Europe at least, and in need of further expansion.

Aside from sexual health interventions, peer education has been used in various other domains of risky health behaviour and there is some suggestion that peer leaders are as effective, if not more, than adult educators (Mellanby, Rees & Tripp, 2000). However despite these positive findings, the prevalence of peer education for improving specifically young drivers' risky behaviour is limited. There are very few published evaluations investigating the potential for peer education to reduce young drivers' risk, and in the UK in particular this concept is relatively undeveloped.

However despite its limited presence in the UK, peer education is becoming increasingly popular in the US due to its apparent success. In an early investigation into its potential for teaching young people how to drive, Bell et al. (1991) found that peer tutoring resulted in immediate improvements to learners' correct responding and a corresponding rapid deceleration of errors; compared to learners who went without peer support. More recently, a state-wide peer-to-peer safety programme has been developed called 'Teens in the Driver Seat'. Launched in 2002, the programme focuses solely on traffic safety and addresses the major risks associated with young drivers. School-age students are provided with access to statistics, safe driving tips and "how-to" guides that promote awareness of the risks young drivers face; and then the students themselves devise and deliver an intervention. The Texas A&M Transportation Institute (TTI) provide the resources and guidance where necessary, but it is the teens that primarily create the programme and are responsible for its delivery and implementation.

An evaluation of the programme (Geedipally, Henk & Fette, 2012), conducted using multiple methods including self-report and observation, found that the programme was effective in various ways, such as by a 200% improvement in awareness of teen driving risks, 14% increase in teen drivers and passengers using their seat belt, and a 30% decrease in teens using their

mobile phones while driving. In addition, two of the most significant changes made in 2002 were the introduction of Graduated Driving Licensing (GDL) and the launch of the Teens in the Driver Seat programme. Since then the state of Texas has seen a 45% reduction in fatal teen crashes; and year-on-year this declines further. McCart et al. (2009) suggested that GDL laws similar to those introduced in Texas should expect on average an 11% reduction in fatal crashes involving 16 year old drivers. So although the introduction of GDL may explain some of the reduction in fatal teen collisions in Texas, it is unlikely that GDL can account for all of it. In addition, the regions where both GDL and the Teens in the Driver Seat programme have been implemented, they have seen a 14.6% greater reduction in teen collision fatalities than in regions with only GDL in place. This suggests that a substantial, and significant, proportion of the reductions in teen crashes may be due to the efficacy of the programme (Geedipally et al, 2012).

Encouraged by the success of the Teens in the Driver Seat programme, the creators have devised a newer version 'U in the Driver Seat', dedicated to improving the risk awareness of University-age young drivers. The initiative follows much the same structure as its predecessor and continues the theme of peer-to-peer education; recruiting University students to act as a Collegiate Advisory Board, who then help design and implement the programme with the support and guidance of the TTI.

There are a small number of initiatives in the UK that implement the notion of peer-to-peer education, but they are presented as one-day events and do not involve any continued influence from the peer educators after the event has concluded. The 'Wasted Lives' programme is one such initiative currently running here in the UK that uses an interactive, informative layout to challenge young drivers attitudes toward road safety. Whilst the one-day event is organised and delivered by road safety professionals, they use peer-to-peer learning throughout the event and one evaluation suggests that up to 73% participants took fewer risks because they understood the potential consequences (Fylan, 2009). However, despite initial improvements immediately

after the event in attitudes towards risky driving, these improvements had lessened at the 3-month follow up, and previous research suggests that a continual decline in attitudinal improvement would be seen the more time that had lapsed post-event (Soames, 1988). The efficacy of one-day events on changing long-term attitudes has long been challenged, and though this initiative uses peer-to-peer education somewhat effectively there is still a need for an intervention that reinforces the message over time.

Similarly, some evaluations have failed to find consistently positive effects of peer education on risky driving. Cristini et al. (2005) evaluated the effects of a peer education intervention on young peoples' alcohol use and driving after drinking. Three months after the conclusion of the intervention, they found that peer education participants had increased their knowledge on the risks of driving after drinking, but they didn't report any improvements on their attitudes toward drink driving or actual drink driving behaviour. The authors concluded that peer education had an impact on participants' knowledge, but this didn't translate into improved behaviour, and they suggested this might have been impacted by the fact that the intervention was a one-off event, providing an inadequate "dose of intervention".

To our knowledge there are currently no peer-to-peer education programmes in the UK that mirror 'Teens in the Driver Seat' or 'U in the Driver Seat'. The findings from study five showed that young drivers who report being influenced by their peers also reported engaging in more road traffic violations and risky driving behaviours than those who were less susceptible to peer influence. Therefore in order to improve young drivers' behaviour on the road, it appears logical to address the issue of peer passengers and try to use peer influence in a positive way. Thus the present study sought to run a pilot peer education intervention for University-age students based on the resources and peer-to-peer education format used in the US. Previous peer education interventions have highlighted the need to provide sustained influence rather than just a one-off event (Soames, 1988; Cristini et al, 2005) and so the intervention used various methods to reinforce the safety message.

The purposes of the present study were as follows:

1) To design a pilot peer-to-peer intervention aiming to improve young drivers' attitudes towards risky driving and its consequences.
2) To evaluate the effectiveness of this pilot peer-to-peer intervention; exploring the effect it has on attitudes and intentions to drive safely.

The hypotheses for the study were:

1. Participants in the peer-to-peer group would report safer behaviour, attitudes and intentions about risky driving 6 weeks after the conclusion of the initiative.
2. Participants who viewed standard Department for Transport (DfT) road safety fear appeal videos but who did not participate in the peer to peer initiative would report less safe behaviour, attitudes and intentions about risky driving than the peer to peer group 6 weeks later.
3. Participants who did not view any road safety videos and did not participate in the peer to peer initiative would not demonstrate any safer behaviour, attitudes and intentions about risky driving 6 weeks after responding the first time.

5.2.2 Method

5.2.2.1 Participants

72 participants aged 18 – 25 years old (Mean age = 20.6 years) completed the present study. 56 females and 16 males participated, all were drivers. Participants were recruited through a variety of means: social media, advertisements around campus, and the University of Plymouth payment & course credit participation pool.

The length of time participants had held their driving license for varied from just 1 month to 7 years 6 months (Mean length = 2 years 9 months). 12 participants (10 females) had been involved in a collision as a driver and 12 participants (9 females) had previously received a traffic ticket. While some participants chose not to disclose the reason for their ticket, the causes of some included speeding (N=6), running a red light (N=1) and not having a tax disc displayed (N=1).

In addition to the study participants, five undergraduate students (aged 18 – 21 years old) were recruited to become peer leaders (PLs) through the undergraduate apprenticeship scheme. The scheme offers students the opportunity to get first-hand experience of carrying out research - from literature searching through experimental design and data collection to analysis and even publishing papers. Typically students work the equivalent of one afternoon a week for a term (ten weeks). As a voluntary scheme, apprenticeships are entirely about gaining experience and skills - there is no money or course credit to get.

5.2.2.2 Design

The present study was a longitudinal, within- and- between subjects design, comparing the effectiveness of a peer-to-peer intervention (PE), to that of standard fear appeal videos (FE) and a control condition with no intervention (CO). The between-subjects variable ‘group’ had three levels: peer-to-peer intervention (PE), fear appeal videos (FE), and control (CO). The within-

group variable 'time' had two levels: pre-intervention and follow-up. There were three dependent variables: attitudes towards risky driving, self-reported engagement in risky driving, and intentions to reduce risk.

5.2.2.3 Materials

Pre- and- post intervention questionnaire of risky driving behaviour, adapted from Tisdale (2013).

Participants were asked a series of questions regarding how often they had committed certain risky driving behaviours over the past month. Participants indicated on a five-point scale how often they had committed each type of behaviour over the past month, where 1 is "never" and 5 is "frequently: more than five times". Example behaviours included: "text-messaged (read or sent) whilst driving", "driven 10mph or more over the posted speed limit". These measures were used as they are much quicker to complete than the DBQ and the risk of losing opportunity-sampled participants through boredom were minimised. For the full list of questions please see Appendix 5D.

Pre- and- post intervention questionnaire of attitudes and intentions towards risky driving, adapted from Burgess (2011).

A series of statements were posed to participants, regarding their attitudes towards risky driving. Participants were asked to indicate on a five-point scale the extent to which they agreed or disagreed with the statement, where 1 is "strongly disagree" and 5 is "strongly agree. Example attitude statements include: "It's ok if you don't wear a seatbelt on short journeys", "some drivers can be perfectly safe overtaking in situations which would be risky for others". Example intention statements include: "In the future I will drive faster than the speed limit", "In the future I will use my mobile phone to send or receive text messages whilst driving". Please see Appendix 5E for a full list of statements.

Intervention materials

First Event: young driver quiz

The first event designed and run by peer leaders (PLs) was an interactive road safety quiz with multiple choice answers and a quick-fire round. The PLs designed the quiz to engage participants with the idea that young drivers can encourage each other to be safer, using a relaxed but informative approach. Example questions included: "how much slower are your reaction times when driving and using a mobile phone at the same time?", "In a 2013 study, what percentage of young, new drivers made an average of three mistakes when listening to their preferred type of music?" See Appendix 5F for the full script and PowerPoint presentation used by PLs.

Second Event: games with beer goggles

PLs ran the second event using special lenses, or 'beer goggles', which can replicate the visual impairment effects of excessive drinking. Throughout the event a PowerPoint presentation was played on continuous loop, displaying facts and statistics on young drivers and drink driving (see Appendix 5G for the presentation). The PLs led participants through a series of 5 games designed to highlight how drink driving and distractions can impair a driver's ability to drive safely. These games were based on sobriety tests and divided attention tasks and participants played these games whilst wearing the beer goggles:

- Walking in a straight line, heel to toe with each step
- Picking out a driving license card from a set of irrelevant cards on the floor
- Throwing a tennis ball into a bucket
- Writing out a legible text message whilst walking through a series of obstacles

Please see Appendix 5H for the script written by PLs for use during this event. In addition to these games, participants also took part in a 'morning after calculator' game, a public drink driving tool designed by Brake and accessed from a web link (see Figure 5.3 for a still image

from the online tool). The calculator provides an approximate indication of how long it would take to sober up after a night out and be safe to drive again, based on the number and type of drinks an individual has consumed. The calculator provided a crude, rough estimate of when it would be safe to drive again, based on the average time it takes for different units of alcohol to be consumed and to enter the bloodstream. The tool used in this study is no longer available but similar resources are available elsewhere, such as the 'Morning After' app, created by Stennik and free to obtain, which helps drivers to calculate when they are likely be completely sober after drinking.

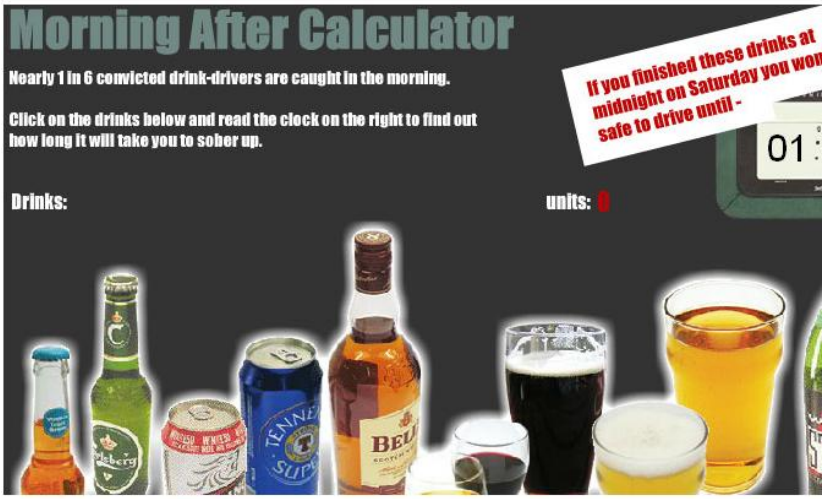

Figure 5.3. Screenshot from the 'Morning After Calculator' (Brake, 2014)

Additional Communication

During the course of the one-month intervention period PLs sent out regular email and text reminders encouraging participants to be a safe and responsible driver. Reminders focused on the key areas known to increase young drivers' risk, including speeding, drink driving, using a mobile phone and carrying peer passengers. An example of one of the email reminders can be seen below. Please see Appendix 5I for the full list of emails sent out.

"We, as young adults, underestimate the risk of dangerous driving. We are less likely than older drivers to rate speeding as high risk. But excessive or inappropriate speed is a key contributory factor in our crashes, with a third of fatal young driver crashes being speed-related. Do you

really need to speed? How many seconds will it save you? That can't be worth the risk can it? Let us know your thoughts, is speeding inevitable?

In the meantime, have a go at this driving challenge. Only 19% of people pass, will you be one of them? http://think.direct.gov.uk/drivingchallenge/"

5.2.2.4 Procedure

The lead researcher (LR) sent out an advert to recruit five peer leaders (PLs) through the undergraduate student apprenticeship scheme. Under the supervision of the LR the PLs were in charge of delivering the peer-to-peer intervention (PE) part of the study. They assisted in designing materials, organizing the event schedule and running the peer intervention events together. Participants in the fear appeal (FE) group viewed fear appeal road safety videos designed by DfT (see Appendix 5J for the instructions and web URLs), and participants in the control (CO) group did not view any road safety videos and did not attend a peer intervention. Throughout the course of the study participants from each group (PE, FE and CO) were not aware that there were other groups of participants carrying out different procedures at the same time. See Table 5.3 for the data collection schedule used for participants in each condition.

At each data collection point participants from all conditions were asked to read the information sheet and sign a consent form agreeing to the parameters of the study. Participants were assured they were under no obligation to attend any event, involvement in the intervention was voluntary, and they may cease their involvement at any point with no repercussions. Once participants from all conditions had completed all the activities and/ or questions they were presented with a debrief form detailing the objectives of the study and the contact details for the LR and each PL.

Table 5.3. Data collection schedule

Time-Frame	Peer-to-Peer Group	Fear Appeal Group	Control Group	Data Collection
Week 1	PLs recruited participants via opportunity sampling around campus. PLs staged first event, approved by LR, aimed at improving risk awareness of young drivers (see above for details).	After completion of the questionnaire participants viewed a series of three DfT videos embedded into the study website (see Appendix 5J for web URLs and full instructions provided).	Participants completed the questionnaire online and signed up for a second study timeslot for 6 weeks' time.	Pre-Intervention Data
Weeks 2 - 3	PLs sent out tips and reminders to participants via email/ mobile phones, encouraging them to be a responsible driver, provide feedback they have; and to offer their own experiences and advice (see above for details).			
Week 4	PLs staged second event approved by LR (see below for more details).			
Week 5	PLs contacted participants via email and invited them to complete the follow-up questionnaire.	Participants were sent an automated email from the participation pool 6 weeks after they had completed the first part of the study where they were invited to complete the follow-up questionnaire.	Participants were prompted via the participation pool automated service to complete the 2nd questionnaire. To establish the validity of the control condition participants were also asked if they had attended any road safety events/ seen road safety advertisements in the past 8 weeks.	Follow-Up Data

5.2.3 Results

5.2.3.1 Reliability of Measures

Reliability analyses were carried out on each of the measures and the Cronbach alpha values are detailed below. Each of the values indicate reasonable internal consistency; although only one achieves the optimal value of α = .70; which was suggested by Nunnally (1978) as indicating strong internal consistency. However Cortina (1993) suggested that the number of items used in a scale should be considered – a reasonable alpha with a small number of items may actually represent better internal consistency than a larger alpha with more items. As each of the measures detailed here contained only 10, 12 and 6 items respectively the Cronbach alpha values were considered adequate. The alpha values for each of the measures are shown in Table 5.4.

Table 5.4 Cronbach alpha values for all measures

	Pre-Intervention	Follow-Up
Risky Driving Behaviour	α = .56	α = .70
Attitudes	α = .54	α = .54
Behavioural Intentions	α = .54	α = .62

5.2.3.2 Analysis

The mean scores for each of the measures were calculated and Table 5.5 provides the descriptive information for participants' responses from each of the three groups (Peer to Peer, Fear Appeals, or Control) on each measure at each of the two time points. The data shows that pre-intervention, participants from all groups started with similar self-reported risky driving, attitudes and intentions scores. At follow-up all participants reported slightly less risky driving behaviour, but participants in the peer-to-peer group reported the least risky driving. Participants in the peer-to-peer group also reported the biggest improvement in attitudes and

intentions at follow-up. Control participants showed the least improvement on each of the measures at follow-up.

Table 5.5. Descriptive statistics for participants' mean scores on each of the measures at each time point. Lower scores indicate safer behaviour, attitudes and intentions. The scores are split by the type of intervention received.

	Peer-to-Peer			Fear Appeals			Control		
Variable	T1 mean (SD)	T2 mean (SD)	N	T1 mean (SD)	T2 mean (SD)	N	T1 mean (SD)	T2 mean (SD)	N
Risky Driving Behaviour	15.2 (2.7)	13.2 (2.4)	21	15.6 (3.1)	14.4 (3.2)	20	15.3 (3.5)	14.4 (3.7)	31
Risky Driving Attitudes	24.3 (3.3)	22.4 (3.7)	21	24.5 (4.2)	24.4 (5.0)	20	25.9 (5.3)	25.6 (4.3)	31
Risky Driving Intentions	11.3 (2.9)	9.1 (2.0)	21	10.9 (3.1)	11.0 (2.9)	20	12.5 (3.8)	12.6 (3.9)	31

A series of 3x2 mixed model ANOVAs were then used to investigate the effect of initiative type on change to mean risky driving, attitudes and intentions scores. For each ANOVA the between-subjects variable 'group' had three levels: peer-to-peer, fear appeals and control. The within-group variable 'time' had two levels: pre-intervention and follow-up. For self-reported risky driving behaviour there was a non-significant interaction found between group and time $F(2, 69) = 1.2$, $p>0.5$. There was a significant main effect found for time $F(1, 69) = 17.0$, $p< .001$ but not group $F(2, 69) = .41$, $p>.05$. Figure 5.4 indicates that these effects may have occurred because for each group the risky driving scores were lower at follow-up than pre-intervention. Analyses of variance (ANOVAs) confirmed that there was no significant difference between the three groups' behaviour scores pre-intervention $F(2, 69) = .10$, $p> .05$ or at follow-up $F(2, 69) = .98$, $p> .05$. However despite this non-significant result, there was a trend indicating that out of all the groups, the peer-to-peer group reported the least risky driving at follow-up.

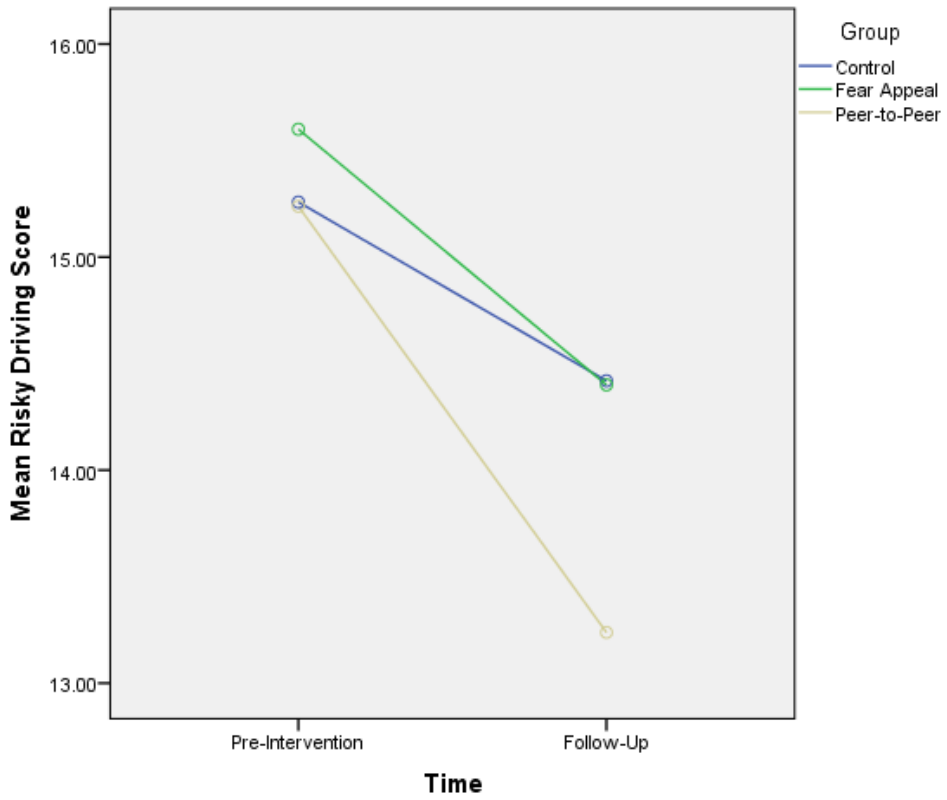

Figure 5.4. Mean self-reported risky driving scores for participants in each group: peer to peer, fear appeals, and control.

For risky driving attitudes there was a non-significant interaction found between group and time $F(2, 69) = 1.2$, $p > .05$. There were also non-significant main effects found for both group $F(2, 69) = 2.5$, $p > .05$ and time $F(1, 69) = 2.2$, $p > .05$. Despite the non-significant results, Figure 5.5 illustrates that the peer to peer group showed an improvement in their risky driving attitudes, whereas the fear appeal and control groups' attitudes had not changed from pre-intervention to follow-up. Analyses of variance (ANOVAs) confirmed that whilst there was no significant difference between the three groups' attitudes pre-intervention $F(2, 69) = 1.0$, $p > .05$, a significant difference was found at follow-up $F(2, 69) = 3.4$, $p < .05$. This appears to be as a result of the peer-to-peer group reporting much safer attitudes at follow-up than the other two groups. Post hoc Tukey tests showed that the peer-to-peer group's attitude scores at follow-up were significantly different from the control group ($p < .05$), but not the fear appeal group ($p > .05$). The control group's follow-up scores were not significantly different from the fear appeal group ($p > .05$).

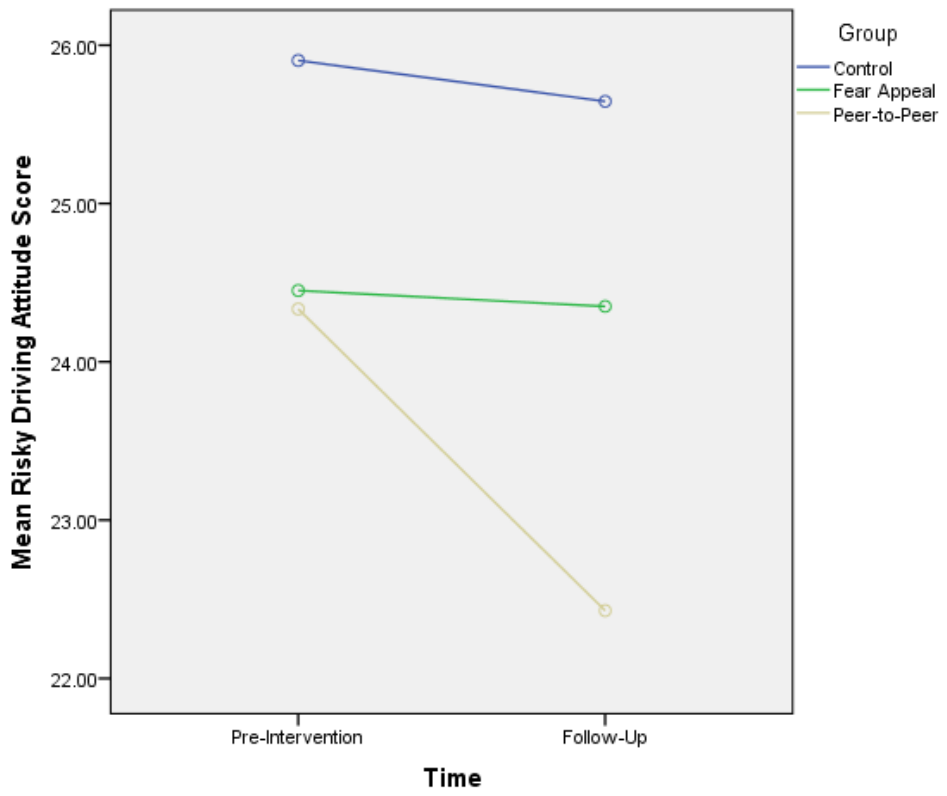

Figure 5.5. Mean risky driving attitude scores for participants in each group: peer to peer, fear appeals, and control.

For risky driving intentions there was a significant interaction found between group and time $F(2, 69) = 9.4$, $p < .001$; and main effects for both group $F(2, 69) = 4.1$, $p < .05$ and time $F(1, 69) = 6.7$, $p < .05$. Figure 5.6 illustrates that the peer-to-peer group was the only one to show an improvement in risky driving intentions from pre-intervention to follow-up. The fear appeal group and control group showed no such improvement. Simple main effects analyses confirmed that whilst there was no significant difference between the three groups' intentions scores pre-intervention $F(2, 69) = 1.6$, $p > .05$; at follow-up a significant difference was found $F(2, 69) = 8.1$, $p < .01$. This appears to result from the peer-to-peer group being the only group to report safer intentions at follow-up. Post hoc Tukey tests showed that the peer to peer group was significantly different from the control group at time 2 ($p < .001$) but not the fear appeal group ($p > .05$). The difference between time 2 scores for the control group and fear appeal group were also non-significant ($p > .05$).

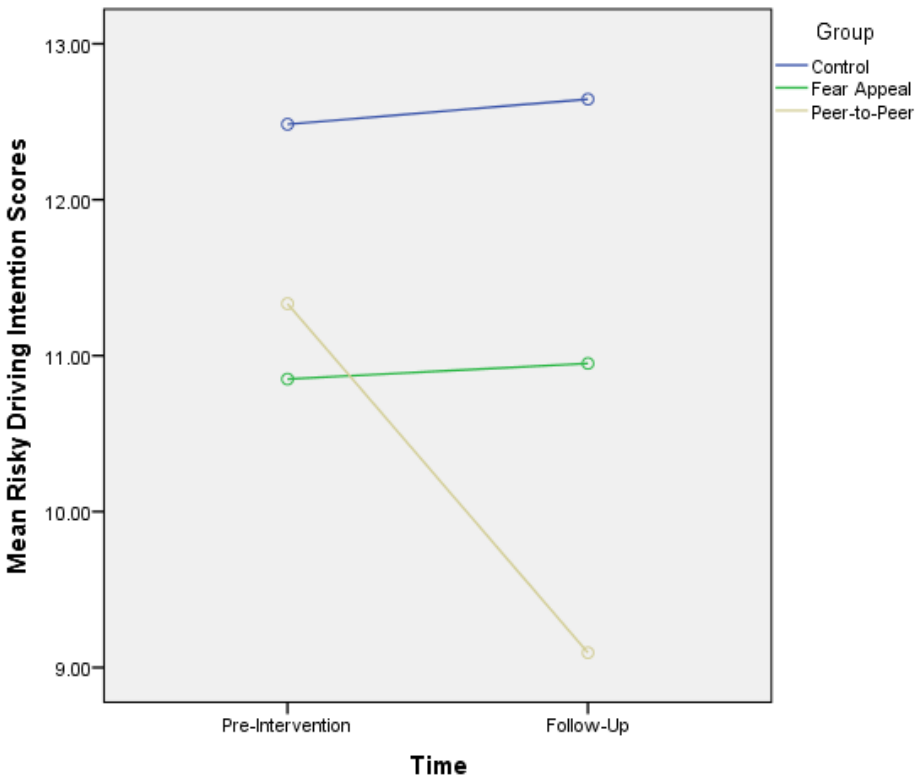

Figure 5.6. Mean risky driving intention scores for participants in each group: peer to peer, fear appeals, and control.

5.2.4 Discussion

In this study a novel peer-to-peer road safety intervention was designed and piloted on a sample of undergraduate university students. The efficacy of the intervention was assessed using participants' self-reported risky driving behaviour, attitudes and intentions; and this was measured pre-intervention and again at follow-up, six weeks after the intervention. We hypothesised that participants in the peer-to-peer group would report the safest behaviour, attitudes and intentions about risky driving 6 weeks after the conclusion of the intervention; when compared to participants who only viewed standard Department for Transport (DfT) road safety fear appeal videos and participants who did not take part in any intervention. The findings were in line with the hypotheses of the study, with the peer-to-peer group reporting significantly safer attitudes and intentions at follow-up, compared to pre-intervention. The peer-to-peer group also reported the least risky driving behaviour at follow up, although this did not quite reach significance.

The findings are in line with those from previous evaluations of peer-to-peer interventions (e.g. Geedipally, Henke & Teffe, 2012) and they lend support to the notion that peer-to-peer education might be a useful way to reduce the risky driving behaviour of young adults. In their evaluation of the Teens in the Driver Seat programme, Geedipally et al. (2012) found that teenagers reported much improved risk awareness, seat belt use, and reductions in mobile use while driving, following the peer-to-peer intervention. Similarly the results from this study shows that these forms of peer education interventions are not limited to teenagers, but may also be effective for young people in their early twenties, who are still very much influenced by their peer group.

Some evaluations have failed to find consistently positive effects of peer education on risky driving. Cristini et al. (2005) evaluated the effects of a peer education intervention on young peoples' alcohol use and driving after drinking. Three months after the conclusion of the intervention, they found that peer education participants had increased their knowledge on the

risks of driving after drinking, but they didn't report any improvements on their attitudes toward drink driving or actual drink driving behaviour. The authors concluded that peer education had an impact on participants' knowledge, but this didn't translate into improved behaviour, and they suggested this might have been impacted by the fact that the intervention was a one-off event, providing an inadequate "dose of intervention".

The peer-to-peer intervention administered in this study was not a one-off event and so it may be that the positive effects reported here continue to be effective as more time elapses following its conclusion. Fylan (2009) found that the Wasted Lives intervention had limited long-term success due to the nature of it being a one-off event; and Cristini et al. (2005) noted how peer education might need multiple "doses of intervention" in order to produce long-term changes to behaviour. The peer-to-peer intervention described in this study was active for a period of four weeks, and so was of a much longer duration than those described in other evaluations. Peer-to-peer participants had multiple opportunities throughout the course of the intervention to have the safe driving message reinforced, for example through multiple events, email reminders and interactive social media sessions. Therefore it is hoped that the positive results seen in this study may lend themselves to a longer-term effect; although this would need to be investigated using further time points, the scope of which was not possible here.

Peer-to-peer interventions tend to differ from more traditional forms of young driver interventions as they rely much less heavily on the use of fear appeal techniques. The evidence reported in chapter two showed how fear appeal interventions have limited efficacy, despite their substantial cost and continued use (e.g. McKenna, 2010). The evidence from chapter three provided some insight as to why these interventions may not be effective, in that it was shown how risky, reward–sensitive young drivers are not motivated to change their behaviour by threats of punishment, but rather by the rewarding feelings of potential gains. The results from study five showed how young drivers who reported feeling more susceptible to peer influence were also more likely to report committing more road traffic violations; meaning that some

young drivers are more at risk of a collision when with their peers because they use driving as a means to attain prestige within their social group and accept their peers' intervention in their driving.

Therefore the peer-to-peer intervention described here provided an alternative to traditional fear appeal techniques, using peers themselves to challenge the perception that risky driving is a means to gain high social standing within their peer group. By doing this it was hoped that young drivers would not feel the need to engage in such high-risk behaviour and thus would report lower intentions to drive dangerously. Siegel's (2014) research supports this idea, wherein he suggested that by removing the "rewarding" part of risky driving adolescents would no longer consider it to be novel and exciting, and then would be less likely to want to engage in it (Siegel, 2014). In this way if a young driver's social group no longer considers risky driving to be acceptable, then they will have nothing to gain by engaging in it, and this may then lead to safer driving behaviour.

The findings are also in line with those of social learning theory (SLT, Bandura, 1976; 1986). SLT suggests that an individual's behaviour is influenced by others in their social group, as they seek to align their behaviour with those around them. So if the peer group as a whole challenges the concept of risky driving as an acceptable behaviour, this might then reduce young drivers' propensity for risk because the need to behave in accordance with this social norm is no more.

The results showed that the intervention positively influenced the risky attitudes and intentions of young drivers; over and above the efficacy shown by standard fear appeal DfT videos. This supports the idea that peer education might be a useful way to reduce young drivers' risk and provides a starting-point to further develop peer-to-peer education as a means to reduce young drivers' risk. The intervention evaluated in this study was a pilot programme, and thus with further development to the design and delivery of such an intervention, the potential for using peer-to-peer education to reduce young drivers' risk is promising.

The use of peer education for improving young drivers' risky behaviour is in its infancy. Despite endorsements from various sources advocating the development of this form of intervention in road safety (e.g. Cristini et al, 2005) few studies have yet to be published documenting their existence and evaluating their efficacy. Whilst the use of peer education for reducing young drivers' risk has thus far been limited, it has been used in various other adolescent risky health domains with some evidence of success. These include such areas as improved nutrition (Story et al, 2002), less alcohol consumption (White et al, 2009) and less smoking (Mellanby et al, 2000). Evidence such as this suggests that peer education may be an appropriate way to target young people and improve health outcomes. The findings from this study concur with prior literature, and provide further support for the development of peer education tools in the realm of young driver safety.

Chapter Six

General Discussion

There were two overarching aims of the present research: to better understand the age-related factors underpinning why young drivers are so at risk of a collision, and to evaluate current approaches aimed at reducing young drivers' risk. We wanted to identify which interventions do and don't work in order to use this information to inform our knowledge of the factors putting young drivers at risk. We would then be able to use this knowledge to design future interventions more likely to yield success.

The findings of the six studies will first be synthesised, discussed and evaluated in terms of their theoretical implications. This will be followed by a discussion of the methodological limitations of the present work, followed by some suggested directions for future research.

6.1 Summary of findings and theoretical implications

An overview of the studies conducted in preparation for this thesis and their main findings can be seen in Table 6.1. The findings of the present research will be discussed in relation to the available literature and structured according to the two overarching aims underpinning the programme of research.

Table 6.1. Summary of findings from all studies

Study	Measures	Main findings	Conclusions
1.Longitudinal Evaluation of L2L	Attitudes and Intentions based on components of the Theory of Planned Behaviour (Ajzen & Fishbein, 1980).	Females reported much safer attitudes and scores on all TPB measures after attending the intervention. Males reported smaller improvements on their attitudes and intentions. Males and females in the control group reported similarly risky attitudes and TPB scores at both time points.	The intervention was effective in improving young females' intentions to be safe but the young males were less affected by fear appeal threats. An alternative approach may be necessary to better engage young males. Their desire to engage in risk-taking behaviour may over-ride consideration of negative outcomes, and this may be driven by the rewarding feeling that accompanies high-risk, sensation-seeking activities.
2.Reward Sensitivity and Risky Decision Making	The Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (SPSRQ) (Torrubia et al, 2001). The Iowa Gambling Task (Bechara et al, 1994).	Greater deck B selections were made throughout the task only by reward sensitive young males. The effect of reward sensitivity was unique to young males, with reward sensitive young females and older males making fewer risky deck B selections by comparison. Fewer Deck C selections were not related to higher scores for punishment sensitivity.	Higher levels of reward sensitivity are associated with riskier decisions on the IGT, for young males at least. The relationship between reward sensitivity and risky decision making was unique to young males. This might be what differentiates young males and underpins their risky driving.
3.Reward Sensitivity and Risky Driving	SPSRQ (Torrubia et al, 2001). Driver Behaviour Questionnaire (Reason et al, 1990). Vienna Risk-Taking Test – Traffic (Hergovich, Bognar, Arendasy, & Sommer, 2005).	Higher reward sensitivity was related to more self-reported and actual risky driving. Participants who were more sensitive to reward reported more slips and lapses (females) and driving violations (males), and displayed longer accepted risk reaction times, than participants who were less sensitive to reward. Participants more sensitive to punishment reported more slips and lapses but fewer violations than those less sensitive to punishment. Females were more likely to report committing slips and lapses whereas males were more likely to report committing violations.	Findings support the notion that heightened reward sensitivity may underpin the risky driving of some young drivers. Reward sensitive males were more likely to commit violations supporting the idea that reward sensitive young drivers accept more risky violations whilst driving in the pursuit of achieving a rewarding feeling. Punishment sensitivity appeared to overrule females' reward sensitivity; with them displaying shorter (safer) risk reaction times when they were both sensitive to reward and to punishment.

4.Message Framing	The Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (SPSRQ) (Torrubia et al, 2001). Safe Driving Measures	Message framing and message context influenced drivers' ratings of the effectiveness of safe driving messages. Reward sensitive young drivers rated gain-framed financial messages as being most effective. Older drivers (male and female) tended to rate financial messages and skill messages as being similarly effective.	Road safety interventions should consider framing messages in terms of potential gains rather than losses. The findings support the notion that financial-based incentive schemes may be an appropriate way to reduce young drivers' risk, particularly for those who are highly sensitive to reward.
5.Peer Influence	Susceptibility to Peer Influence (SPI), (Sela-Shayovitz et al, 2008). Resistance to Peer Influence (RPI), (Steinberg & Monahan, 2007). Behaviour of Young Novice Drivers Scale (BYNDS), (Scott-Parker et al, 2012).	High susceptibility to peer influence was related to more self-reported risky driving behaviours. Specifically, attaining social prestige (Passive) and peers intervening in decisions (Active) were significant predictors of more violations; rather than apprehension of friends evaluations or through drivers feeling pressure to make traffic violations. Resistance to peer influence was not associated with road traffic violations.	The results support the notion that young people may driving riskily to be in accordance with the social norms of their peer group. Young drivers may not need active persuasion from their peer passengers to drive dangerously, but rather they feel implicitly required to drive in a certain way in order to gain a higher social status within their peer group.
6.Peer-to-Peer Intervention Evaluation	Pre- and- post intervention questionnaire of risky driving behaviour, adapted from Tisdale (2013). Pre- and- post intervention questionnaire of attitudes and intentions towards risky driving, adapted from Burgess (2011).	The peer-to-peer group reported the safest attitudes and intentions at follow-up, compared to pre-intervention. The peer-to-peer group also reported the least risky driving behaviour at follow up, although this did not quite reach significance. The other two groups did not report safer attitudes, intentions and risky behaviour from pre-intervention to follow-up.	The findings support the notion that peer-to-peer education might be a useful way to reduce the risky driving behaviour of young adults. Peer-to-peer education may be more effective than traditional fear appeal techniques, particularly when presented as more than a one-off event.

6.1.1 Research aim one:

"To better understand the age-related factors underpinning why young drivers are so at risk of a collision"

The findings from each of the studies provide insight into why young drivers may engage in high-risk behaviour and thus be more at risk of a collision. A picture has emerged of the 'at-risk' young driver; with particularly young, male, reward sensitive drivers found to engage in the most high-risk driving behaviour, presumably because they find the nature of risky driving thrilling and rewarding. For this group their behaviour is motivated by reward and not punishment, and thus fear appeals that try to press upon them the threat of injury or other loss are not effective at reducing their risk. We have also seen how risky driving may be a shared interest between some young people and their peer groups, with young drivers often perceiving their friends' input in their risky driving to be helpful rather than pressuring. They may use their risky driving as a channel through which to establish their social standing and strengthen their in-group membership with their peers; and thus their driving provides them with multiple rewarding feelings: through both adrenaline-filled thrills and the social benefits reaped through engaging in behaviours that are sanctioned by their peers.

Study one results showed that whilst young females reported much safer attitudes and TPB scores after attending the RSI, young males showed only a modest improvement. The results suggested that young males may be more at risk than females and that the fear appeal nature of the intervention was particularly ineffective for young males. It was considered that this may be due to various defence mechanisms used unconsciously to provide justification for their high-risk behaviour (e.g. the third-person effect, rebound effect and terror management principles). There is some empirical evidence supporting the existence of these mechanisms, for example Glendon and Walker (2013) found that young males are more likely to perceive safe-driving messages as being effective for others rather than for themselves. It was posited that young males may be especially likely to use defence mechanisms because they may have a heightened

desire to engage in sensation-seeking behaviour in general (Zuckerman, 1994). In this context, young males' risky, thrill-seeking driving behaviour may be an adolescent manifestation of a heightened sensitivity to reward.

This notion was supported by the findings from study two wherein only young males who were highly sensitive to reward consistently chose the risky deck B in the Iowa Gambling Task. Other studies have observed a general relationship between reward sensitivity and deck choices on the IGT, for example Buelow and Suhr (2013) found that individuals chose more cards from risky deck B when they were also more likely to score highly on BAS-Drive, but gender differences in reward sensitivity and risky behaviour had been less well studied until now. This was the first known study to show that only young males were more likely to display risk-seeking behaviour when they were also highly sensitive to reward. Females and older males did not show this pattern of behaviour, suggesting that reward sensitivity might be a particular motivating factor in the decision making of specifically younger males.

The findings from study three showed that when highly sensitive to both reward and to punishment, females were less likely to display risky behaviour whereas males were more likely to. This suggests that for young males, unlike young females, their reward sensitivity tends to overrule any punishment sensitivity they have, leading to an increased engagement in risky behaviour. This may also explain why young males were less likely to respond to the fear appeal RSI in chapter one, because reward sensitivity may be a more dominant characteristic for this demographic. This is in line with research conducted concerning the notion of a teenage brain. Siegel (2014) identified how adolescents have a heightened desire to seek rewards and are less concerned about risks or exhibiting caution. The findings from study three showed that young males who were highly sensitive to reward were the group most likely to display longer (i.e. riskier) reaction times in dangerous roadway situations. According to Siegel (2014) adolescents tend to be more reward sensitive in general than the rest of the population. Therefore it may be that reward sensitivity does underpin the risky driving behaviour of young

people most at risk, because they are not only more reward sensitive than their peers but also more so than all other age groups.

We considered that if reward sensitivity underpins young drivers' risky driving then young drivers themselves may perceive gain-framed messages framed in terms of rewards to be the most effective way to reduce their risk. In study four we found evidence to support this, in that young drivers perceived gain-framed messages, particularly in a financial context, to be the most effective way of targeting their risky behaviour. Financial incentive schemes for young drivers are gaining momentum both within the UK and beyond. For example, Bolderdijk et al. (2011) found that a sample of Dutch young drivers who took part in a pay-as-you-drive car insurance displayed significantly fewer driving violations than those in a control group. However attempts to evaluate this method of risk-reduction show that it is not without its issues. Lahrmann et al.'s (2012) attempted evaluation of a financial-based reward scheme in Denmark revealed that young drivers were reluctant to relinquish the option to speed, even for substantial economic gain. However despite the authors marketing the scheme as being reward-based, the process they used involve financial penalties in response to speed violations. Thus the drivers themselves were actually participating in a financial loss-framed speed management scheme. It may be that financial incentives considered in isolation of the way they are framed may be insufficient to engage young drivers. The findings from study four suggest that the way in which RSIs are framed may be crucial to their efficacy and Lahrmann et al.'s (2012) findings further support the notion that even framing financial schemes in terms of losses may still result in limited efficacy.

Another risk factor implicated in young drivers' collision risk is the presence and influence of their peer passengers. The findings from study five showed that young drivers more susceptible to peer influence were more likely to report engaging in risky driving; and specifically that attaining social prestige and peers intervening in their decisions were the forms of peer influence associated with most violations. These findings extend previous research suggesting

that young drivers' behaviour is influenced by their peers (e.g. Rhodes, Pivick & Sutton, 2015; Allen & Brown, 2008) providing insight into the precise mechanisms that may be at play resulting in this relationship. Study five adds to the limited research base concerning peer influence and risky driving, by providing evidence that young drivers do not necessarily need active persuasion from their peers to drive dangerously. Previous research has found that peer passengers need not even be present to exert a normative influence (Conner et al, 2003) and so the findings from study five highlight that young drivers may drive in a risky manner in order to increase their social standing within their peer group, because risky driving is considered a revered in-group norm.

Taken together, the findings from these six studies suggest that a desire to achieve a reward; whether it be a sensation seeking thrill, financial gains or perceived social status, might underpin young drivers' engagement in high risk behaviour. Next it will be considered how these findings can inform the design of future young driver RSIs in order to better engage the target demographic that they seek to protect.

6.1.2 Research aim two:

"To evaluate current approaches aimed at reducing young drivers' risk and to consider alternative designs for future interventions"

As described above, the studies presented here suggest that young, reward sensitive males and those who affiliate with risk-taking peers are most likely to engage in high-risk driving behaviour. Young males were least likely to report safer attitudes and intentions after the RSI in study one, showing how they are particularly unaffected by the use of fear appeals and threats of long-term negative consequences. Young males are often reported to be involved in more high-risk driving behaviour than females (e.g. Lonczak et al, 2007) and so more effective ways to reduce their risk is critical. In addition to the existing evidence base that shows how young drivers recognise that fear appeals are trying to scare them (Crohn, 1998) and find their

messages irrelevant (Hastings & Macfadyen, 2002) these findings show how young driver RSIs need to be sensitive to the audience they are presented to and those delivering them need to better consider how males and females may require differential approaches.

If reward sensitivity underpins the risky driving behaviour of young males, as seen in studies two and three, it might be that a reward-based approach may be more effective at reducing their risky behaviour. Traditional RSIs consistently use fear appeal techniques that try to evoke a sense of fear from the viewer. If young males are not intrinsically affected by threats or punishments, these approaches are very unlikely to have any impact on their driving behaviour. By contrast if their sensitivity to reward could be effectively tapped into using an incentive scheme of some sort, then this may effectively override their inclination to take risks whilst driving, because their motivation for reward is being satisfied by another stimulus. Research findings suggest that young males are more likely to be sensation seekers (Zuckerman, 1994) and less likely to respond to fear appeal persuasion techniques (Lewis, Watson & Tay, 2007) and thus we considered how young drivers' intrinsic desire for reward can be used to make them safer in study four.

Young drivers, particularly those more sensitive to reward, tended to rate gain-framed road safety messages as being most effective at improving their risky driving. Although hypothetical in nature, there is some evidence supporting the efficacy of financial incentive schemes, such as pay-as-you-drive car insurance (Bolderdijk et al, 2011). However the type of incentive offered in these schemes and the frequency with which rewards occur need to be considered. It may be that yearly insurance premiums do not have sufficient impact to override the instant rewarding thrill that young drivers experience when engaging in risky driving. For example given that in any one car journey there may be several opportunities for a driver to drive dangerously (e.g. speed, run a red light, encounter distractions, conduct a risky manoeuvre) an incentive scheme must provide the driver with a worthwhile alternative to their multiple opportunities for risky behaviour. The immediacy and type of reward that can effectively replace an immediate thrill

needs to be investigated further, including how to keep young drivers engaged with the incentive scheme over long periods of time. The findings from these studies suggest the need for a more considered, evidence-based approach to RSI design that incorporates an understanding of adolescents' behavioural motivations with a form of incentive that can override the immediate rewarding sensation of risky driving.

We found that young drivers' risky behaviour is often driven by a desire to please their peers, and their risky driving decisions are often based on collaborative input from their peer passengers. The peer-to-peer RSI designed in study six was informed by these findings, and the results showed how young people may respond better to peer-to-peer education than to traditional approaches, because they are naturally inclined to try and enhance their in-group similarity by conforming to the norms of their social group. If the social group prescribes safer driving, they may be more likely to drive more safely as a result.

These findings provide a form of empirical support to those observed in study five, in that it has been demonstrated how peer leaders can effectively alter a social norm amongst young people to reduce risky driving. Peer social groups are incredibly important to young people, and study five showed how they exert their influence even in the absence of overt pressure. Thus it is imperative to consider how we can use young drivers' social groups to modify the perception that risky driving is a means to attain social prestige.

Despite its novelty and relative simplicity in terms of content and delivery style, the peer-to-peer intervention evaluated in study six was shown to be effective at improving young drivers' intentions to drive safely. The findings appear to be in line with the existing limited evidence base concerning the efficacy of peer-to-peer education (e.g. White et al, 2009; Geedipally, Henk & Teffe, 2012) and provide further support for the potential use of this form of intervention in improving young drivers behaviour. However despite the notion of peer-to-peer education being advocated as a potential means of improving young driver's safety the number of interventions

promoted or academically evaluated remains limited. Reasons for this remain unclear but it may be due to a reluctance to deviate from traditional methods that, despite being largely ineffective, appear to be based on intuitive methodology linking fear with compliance to change. However the findings from this research show that there is not a one-size-fits-all approach to targeting young drivers' risky behaviour. RSIs need to consider the temporal and environmental context in which a young driver resides, and the individual personality characteristics that motivate young people to behave in the way that they do, in order to more effectively reduce young drivers' collision rates.

While there are some skill-based deficits that all new drivers face and eventually overcome with driving experience (irrespective of age) there are various additional factors, illustrated through this research, that specifically young drivers have to contend with. These are not strictly 'driving-related' but are displayed through their driving behaviour and increase their risk nonetheless. These include a heightened sensitivity to reward and susceptibility to peer influence in order to attain social standing within their peer group; both of which tend to lead to increased risk-taking. These characteristics are particularly evident among young people, displayed in their driving behaviour as a way to assert their personality, and they lead to an increased risk amongst young people.

In addition to these research findings having implications for post-license young driver interventions, they also lend support to the notion that the structure of driver training in itself may require updating. Many of the risk factors that young drivers need protection from may not be specific to the driving environment but rather are manifestations of personality characteristics particularly heightened during adolescence (Siegel, 2014). Therefore to protect young drivers it may be more effective to increase their driving freedom gradually, minimising the extent to which their adolescent reward-seeking nature can influence their driving behaviour. Thus the next section considers some of the broader implications the research findings have for the use of graduated driver licensing in the UK.

6.1.3 Implications for GDL

Graduated driver licensing (GDL) is a phase-in system providing inexperienced drivers with a set of clearly defined, structured stages to build up their driving skills and experience gradually (Williams et al, 2012). The 'provisional' licensing stage prescribes various restrictions that limit the novice driver's exposure to the most risky driving situations. These vary between country but tend to include a minimum-length supervised learning period, no driving permitted between certain night-time hours and restrictions on the number of peer passengers they are allowed to transport (Begg et al, 1995).

Various forms of GDL have been in place in countries around the world for the past two decades, including countries such as Northern Ireland, Israel, Australia, New Zealand and many states in the USA (Zhu et al, 2013). Impact studies consistently show that GDL is effective at reducing young drivers' crash rates, particularly for 16-and-17-year-olds who are those most likely to be affected by the restrictions (e.g. Williams, Tefft & Grabowski, 2012, Shults & Ali, 2010; Ferguson et al, 2007). For example, a Cochrane review including 34 studies of U.S. and Canadian GDL systems found a 15.5% median decrease in collisions involving 16 year olds (Russell, Vandermeer & Hartling, 2011); and a meta-analysis of 11 studies looking at GDL effects in 11 U.S. states found a 22% reduction in collisions for 16 year olds (Zhu, Cummings, Chu, Coben & Li, 2012).

Specifically, the greatest fatality reductions appear to occur when GDL programmes incorporate the strongest restrictions, including passenger restrictions and night-time curfews of a longer duration (Russell et al, 2011). For example McCartt et al. (2010) analysed US collision data from the years 1996 – 2007, finding that in regions where GDL laws were rated as good (and were thus more comprehensive), there was on average a 30% reduction in fatal collisions involving 15-17 year olds. The authors concluded that where GDL laws include strong night-time and passenger restrictions and delay the full licensing age, fewer teenage fatal collisions occur.

A recent study concurring with these findings explored the interactive association of age at licensure (17-21 years), length of driving experience and GDL license phase on young driver crash rates in New Jersey. Curry et al. (2015) found that teenage novices on the intermediate (restricted) license experienced a steady decline in crash risk with each month of driving experience that they gained. However their crash risk increased substantially (regardless of the age at licensure or the length of driving experience) at the point where they transitioned from an intermediate license to a full license. By contrast drivers of a similar age who remained in the intermediate phase for longer continued to experience a decline in crash rates. The authors suggested many possible reasons for this sharp increase in crash risk, including a sudden increase in the number of miles driven, and/ or increased exposure to previously restricted risky driving situations, e.g. night-time driving and carrying peer passengers. Although it is unclear precisely why this heightened crash risk occurs, the findings support the notion of a prolonged intermediate phase providing further guidance and structure to young drivers as they build on their driving experience. For countries that do not yet have GDL in place, such as the UK, the findings suggest that even following a graduated licensing system, young drivers face heightened risk upon full licensure. They lend support to the notion that the current UK licensing system may provide insufficient support to young, newly qualified drivers and an extended learner period might be necessary in order to better protect them.

Researchers are now attempting to estimate the potential benefits of GDL for countries that do not have a form of it already in place, such as the UK. For example Jones, Begg and Palmer (2013) analysed police crash data from the years 2000 – 2009 to identify young driver crashes occurring at night and/ or while carrying passengers and used this data to estimate the number of lives that could have been saved had a form of GDL been in place. They found that even with a ‘less strict’ form of GDL (night-time restriction from 10pm – 5am and maximum of one 15-19 year old passenger) and with only 50% compliance, 81 deaths and 538 serious injuries could have been prevented each year. These numbers increased to 114 deaths and 872 serious

casualties each year if 50% complied with a stricter form of GDL (i.e. no driving between 9pm – 6am and with no adolescent passengers present).

A recent article published by Jones et al. (2015) has highlighted how the potential implementation of GDL in the UK has support from various sources, including road safety experts and the general public. For example in a recent public attitudes survey 68% of the British public reported that they support the introduction of GDL for newly qualified drivers and only 15% directly opposed its implementation (RAC, 2014 as cited in Jones et al, 2015). The findings from this body of research provide further support for a need to implement GDL in the UK. The findings support the notion that the adolescent brain is naturally inclined to seek out rewards and young people tend to enjoy novel, thrilling, sensation-seeking activities such as high-risk driving to a greater extent than the rest of the population. Therefore greater support in the form of guided licensing is needed, in order to protect a group who tend to give less consideration to risks in their search for novel experiences. Given that the licensing age for driving in the UK coincides with other forms of independence it is not so surprising that young drivers are at a greater risk than their older counterparts. In addition to this, the findings support the notion that peer passengers are a risk to young drivers. It was found that young drivers often feel influenced by their peers to drive dangerously in both active and passive ways. Social group norms often prescribe risky driving as an ideal and GDL would provide an effective means of combating this normative influence by reducing (or in some cases eliminating) young drivers' opportunity to drive with their peers.

The limited efficacy of young driver RSIs to date suggests that young drivers cannot be motivated to change through persuasive fear appeal techniques (e.g. Lewis, Watson & Tay, 2007). By comparison, GDL provides a structured timeline of support that simultaneously provides greater driving experience and negotiation through the adolescent years when young people are most likely to seek risks without considering the consequences (Siegel, 2014). Therefore GDL would produce older fully-licensed drivers who have passed through the

‘adolescent brain’ years and resemble the general population of drivers to a much greater extent than newly qualified drivers do now.

6.2 Methodological Limitations

Many of the specific methodological issues that may limit the generalisation of the findings reported here have been discussed within each chapter. However there are some broader issues which affect several of the studies and these are discussed here.

6.2.1 Evaluations of young driver interventions

The critical need for more methodologically-robust evaluations of young driver interventions has been discussed throughout this body of work. Despite a wide array of pre-driver, learner and post-license interventions being implemented throughout the UK and worldwide, there are very few published evaluations available, investigating and reporting their efficacy (Launchbury, 2007; Glendon, 2011; ROSPA, 2012). Future interventions need to be grounded in sound theoretical evidence, such as the Theory of Planned Behaviour (Ajzen, 1991) and evaluated using appropriate scientific methods. This includes the use of randomised-controlled-trials, matched-sample comparison groups, longitudinal monitoring of their effect, and corroborative sources of collision data to support conclusions drawn.

Fylan and Stradling (2014) noted how various behavioural change techniques are not being utilised to their full effect in road safety interventions, and in particular young drivers need to be supported more when attempting behavioural change and how to manage this process. The pilot use of implementation intentions in the L2L evaluation highlighted some of the issues associated with trying to engage young people to drive more safely, including the need to provide a more personalised discursive approach. Therefore in addition to being grounded in theoretical evidence, future young driver interventions need to consider more than imparting

knowledge, but also giving consideration as to how young drivers are going to implement and sustain safe-driving practices.

Effectively targeting this high-risk group means understanding the complex and multi-faceted system that makes up the young driver environment. This requires a much more comprehensive evidence base to establish the methods that work from those which don't. The only way to accomplish this is to conduct regular, methodologically-sound evaluations, which are published and publicised, in order to inform the development of the next generation of young driver interventions.

6.2.2 Self-report data

One of the key methodological implications arising from the findings of this research programme pertains to the self-reported measurement of behaviour. Worldwide, the vast majority of evidence collected regarding young drivers involves the use of self-report data (Lajunen & Summala, 2003) There are several reasons for this including most importantly that it is not possible to obtain information about attitudes, past experiences, personal characteristics and psychosocial influences any other way. Self-report measures also provide a relatively simple means of obtaining data from a large number of individuals that would otherwise have been inaccessible.

A common critique of self-report measures concerns the fact that respondents may be influenced to respond in certain ways depending on the research questions asked and the position of the participant. They may respond using a self-enhancement bias, seeking social desirability or indeed living up to a self-fulfilling prophecy, for example young males know that they are perceived as risky drivers so they may embellish their responses to appear more risky in order to be in line with those expected by the researcher. Conversely, young drivers' optimism bias may affect their responses because they may view themselves as particularly

skilful and therefore less likely to notice or admit to their mistakes when reporting their behaviour (McKenna, Stanier & Lewis, 1991).

These criticisms may lead researchers to consider other forms of assessing young driver behaviour, such as using naturalistic observation and driving simulators as measures of 'real-life driving'. However as these forms of measurement have to contend with informed consent and avoiding deception they also tend to be overt in nature, meaning that participants know they are being observed, and so may be subject to the same biases as seen in self-reports. Thus the validity of these forms of measurement can similarly be questioned. Naturalistic observation and simulator studies often rely on relatively small sample sizes (e.g. Simons-Morton, Lerner & Singer, 2005; Godley et al, 2002) and involve substantial commitments of both time and money that would not have been easily possible given the timeline of this research programme. Despite some evidence that self-report respondents often underestimate the frequency of their real-life collisions, for example Chapman & Underwood (2000) found that up to 80% of near-misses were forgotten when their reports were delayed by up to 2 weeks, there is also evidence that self-reported collisions and offences have been found to be accurate compared to official collision and offence records (Boufous et al, 2010) and thus the use of self-report measures are considered appropriate given the realms of this research.

Another limitation of using self-report measures concerns whether respondents' intentions to drive safely will actually result in safer driving in real-life. This research used various measures of self-reported behaviour, beliefs and intentions and there is some concern about whether participants respond accurately using these measures. The theory of planned behaviour recognises the intention-behaviour gap (e.g. Godin, Conner & Sheeran, 2005) and particularly in the context of driving there are multiple factors that may prevent an individuals' intentions from translating into actual safer behaviour. The longitudinal evaluations of RSIs described in studies two and six attempted to overcome this issue by providing a gap between the delivery of the RSI and then subsequent reporting of driving intentions. It was hoped that by providing this

space between data collection points that any changes to reported intentions would be seen at follow-up. However this does not completely overcome the problem and more generally there needs to be consideration about how the findings can be used to influence real-world collision risk.

We considered the design of a study involving the use of telematics technology, i.e. black box insurance, to investigate whether this type of reward-based scheme would be effective in improving young drivers' risky behaviour. Because of the limited timeframe available to complete the research, and the associated time-consuming issues related to participant recruitment and retention, appropriate rewards and engagement from external organisations, we were unable to complete this planned study. However the potential to use black box telematics and other types of on-road monitoring data to gain a more rounded understanding of young drivers' risk has been relatively untapped until now. Intentions have been found to be a reliable predictor of future behaviour but to supplement this there needs to be more longitudinal evidence from a variety of sources recording whether young drivers' good intentions do translate into safer future behaviour.

A related limitation concerns the fact that in study four participants were rating the efficacy of hypothetical road safety messages. Participants did not go on to experience the proposed schemes in real-life and so this could have affected how seriously they took the decision-making process and subsequent ratings of efficacy that they awarded each message. They knew that there would be no actual direct consequences, in terms of how their ratings would be used or how their choices would affect their own driving behaviour, and so this may have influenced how they responded. However it should also be noted that participants did not 'lose out' in any way by participating and they knew their answers would not have a direct negative impact on them, so in this way there would not have been a reasonable cause for them to respond untruthfully.

6.2.3 Gender Differences

There was an under-representation of males in the studies conducted in the research, with a larger proportion of female young novice drivers choosing to participate. In response to this limitation separate analyses were conducted for each of the behaviour measures and personal characteristics. Where there were no significant differences the data was collapsed across gender and the limited number of males in the sample was taken into account when discussing the findings. Although this might mean that the observed effects for males may be considered stronger as they were based on fewer participants, consideration needs to be given both to why fewer males chose to take part and the implications this has for interpreting the data.

Participants voluntarily chose to take part in the studies and so it should be noted that even with reimbursements offered for time (in the form of both course credit and financial awards) males were less likely to want to take part. As it is widely referenced that young males tend to be the demographic most at risk of a collision they may have been reluctant to address their own risky driving or be questioned on their behaviour in the context of psychological research. There were also fewer males available within the population from which the majority of participants were drawn (undergraduate psychology students). With fewer males available in this population generally, this may contribute to explaining why there tended to be fewer males volunteering to participate. Gender differences in young drivers' collision risk are pervasive and the findings from study one showed that males and females respond differently to existing RSIs, even with uneven sample sizes. Had more males responded it may have been found that young males were affected by the intervention to an even lesser extent than what was reported. Therefore there needs to be continued efforts to engage young males in research of this nature, and future research may need to consider innovative ways to increase recruitment of this at-risk demographic.

6.2.4 Repeating tests and type 1 error

Many of the studies conducted here involved the simultaneous testing of many hypotheses within one analysis, for example study four investigated the relationship between message

framing, reward/ punishment sensitivity, age and gender in a mixed design that involved the use of multiple between-group and within-group variables. When conducting multiple comparisons there is an increased risk of committing a type 1 error, i.e. wrongly concluding that there is at significant effect when there is not one (Gelman, Hill & Yajima, 2012). The probability of this occurring increases with each additional comparison that is made (Hsu, 1996) and so there is some concern that may result in some 'false positive' results.

There are strategies that have been proposed to address and overcome this issue (see Westfall & Young, 1993 for a review) but this is common for psychological research, particularly when exploring for possible novel relationships, and more recently researchers have argued that it would actually be rare for 'the null hypothesis to be strictly true' (Gelman, Hill & Yajima, 2012). It is important to acknowledge that this is a possibility and future research should be sensitive to the number of multiple comparisons made in a research design; however several of the studies reported here concern the same areas of study (e.g. reward sensitivity and risk-taking) and with similar findings found throughout, the likelihood of a type 1 error having been committed is minimal. Similarly, when studies are exploratory in nature and are investigating possible relationships between variables that have previously been unstudied, it may be considered less of a concern than in situations where causal relationships are being asserted.

More generally, the studies reported here have made use of a variety of research methods, designs and statistical analyses in order to provide better understanding about what underpins young drivers' risky driving. We have made use of both new and established measures of risky driving behaviour (DBQ, BYNDS, Vienna Risk-Taking Test- Traffic); and have shown how these findings can be used to inform the design of future, effective young driver interventions.

6.3 Future Directions

The findings from this programme of research have highlighted the importance of understanding what underpins the risky behaviour of young drivers in order to more effectively reduce their risk in future. In particular, the findings have shown that current young driver RSIs are not fulfilling their role for the most at-risk young drivers and the number of robust evaluations conducted concerning their efficacy are far too few. For each RSI developed and run there needs to be systematic longitudinal evaluations conducted evaluating their efficacy, based on sound psychological evidence and using robust methodology. Self-report measures of attitudes, intentions and behaviour are important but there also need to be other forms of corroborative data such as observations, collision records and tracking participants long past the conclusion of the intervention to investigate real-world impact. Only then will a strong evidence base begin to emerge concerning the efficacy of different types of RSIs and how best to protect young drivers.

Interventions also need to consider the continuity of the messages given and how best to target young people at different stages of licensure, i.e. pre-drivers, learner drivers and novice newly-qualified drivers. Greater understanding is needed about when young drivers develop their risky driving attitudes, how wider social influences including peers, parents and the media affect these beliefs; and the precise nature, extent and mechanisms through which these influences contribute towards young drivers' propensity for risk-taking. The external social factors need to be considered in conjunction with personality characteristics associated with adolescence (e.g. sensation-seeking, reward seeking tendencies and reduced inhibition) in order to provide a more rounded understanding of the young driver and their temporal environment.

Although GDL is not due to be introduced to driving laws in the UK, the restrictions they place on young drivers reflect some of the biggest risk factors known to affect this demographic. One of the key findings from this research was that young drivers' behaviour may be influenced by

their sensitivity to reward and that young drivers themselves believe that a financial gain-framed road safety message may be effective at increasing their compliance with the law. It may be that we can use this evidence to pilot incentive-based schemes, mimicking aspects of the GDL system using intelligent speed adaptation devices (e.g. Lahrmann et al, 2012) in order to explore whether this might be an avenue for reducing young drivers' risk.

More generally, the prevalence of fear appeal style RSIs needs to be addressed. As discussed previously, it may seem intuitive to try and influence young drivers' behaviour by evoking fear. But findings from various sources suggest that this is not an effective way of changing their behaviour, not least because despite their longstanding and widespread use young driver collision rates remain high. Instead, a more considered approach should be taken in the development of contemporary RSIs, using what we now know about adolescent brains and their search for novel thrills and social prestige. Rather than try to force a notion of fear onto a group of individuals who are developmentally less likely to be influenced by fear at this age, it would perhaps be more intuitive to use their natural inclinations towards rewards to incentivise them to be safer.

6.4 Conclusions

Taken together the findings from this thesis demonstrate that personality and social factors have a clear impact on young drivers' engagement in risky driving. Young, reward sensitive male drivers may engage in the most high-risk driving behaviour because they find risky driving thrilling and rewarding. When risky driving is a shared interest between young people and their peers, they perceive their peer passengers' input as an endorsement of their high-risk driving, and in this way are able to use their risky driving as a channel through which to achieve social prestige within their peer group. We know that young males are those most likely to engage in high-risk driving behaviour (e.g. Lonczak et al, 2007) and so finding an effective method of targeting them is imperative. However the limited success of young driver RSIs to date suggests that punishment-oriented fear appeal techniques may not be the most effective way to target them (e.g. Lewis et al, 2007). The findings here show that RSIs need to consider the temporal and social environment that young drivers exist in and support the idea that approaches to target young drivers should consider individual personality characteristics that underpin young drivers' behaviour, such as reward sensitivity. In this way young peoples' natural inclination to seek rewards may be used to improve their driving behaviour. Siegel (2014) identified how adolescents tend to have a heightened desire to seek rewards and are less concerned about the potential risks of a course of action. Therefore it may be more effective to use this intrinsic sensitivity to reward to try and reduce young peoples' engagement in risky behaviour, rather than try to induce a fear of punishment onto a group who are, by nature of their age, less likely to be affected by this.

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Appendices

All appendices are numbered in line with the chapter to which their contents refer

Chapter 2 Appendices

Appendix 2A The list of attitudes statements

Please indicate to what extent you agree or disagree with the following statements:

It's okay if you don't wear a seatbelt on short journeys
It's alright if a passenger fails to wear a seatbelt
I think drink driving is one of the leading causes of road accidents
It is completely acceptable for people to drive after only one or two drinks
I think speed limits are often set too low
I feel it is safer if the speed limits on 30mph roads are strictly enforced
I think distracting the driver in any way could result in a serious crash
It is acceptable to distract the driver whilst he/she is driving
It is acceptable for people to use a mobile phone while driving
I think mobile phone usage is one of the leading causes of road accidents
Some drivers can be perfectly safe overtaking in situations which would be risky for others
People stopped by the police for dangerous overtaking are unlucky because lots of people do it

Appendix 2B The list of TBP scenarios and statements

You are in a car with your friend driving down a country road. The speed limit is 60mph but the car in front is doing about 50mph. You are about to approach a bend in the road and the driver cannot see traffic coming in the opposite direction. Your friend decides to overtake the car in front.

Please tell us to what extent you agree or disagree with the following statements:

I would try to discourage my friend from overtaking the car in front on a bend

I would find it difficult asking my friend not to overtake on a bend

My close friends would think I was stupid asking my friend not to overtake on a bend

If I asked my friend not to overtake on a bend, he/she would listen to me and do what I asked

My family would approve of me asking my friend not to overtake on a bend

I would regret it if I didn't ask my friend not to overtake on a bend

It's Friday evening and your friend picks you up to go to a house party. While driving down a quiet country road their phone starts to vibrate. Incoming call: Dad. "He'll want to know what time I'm coming home" your friend says sighing and reaches to answer the phone.

Please tell us to what extent you agree or disagree with the following statements:

I would ask my friend not to answer their phone while driving

My family would approve of me asking my friend not to answer their phone while driving

I would regret not asking my friend to ignore their mobile phone whilst driving

It would be difficult for me to ask my friend not to answer their phone whilst driving

If I asked my friend not to answer their phone, he/she would listen to me and do what I asked

My close friends would approve of me asking my friend not to answer their phone while driving

Your friend is driving you and three other friends home. You are sitting in the back seat behind the driver. You really cannot stand the song playing on the CD player and decide you want to skip it.

Please tell us to what extent you agree or disagree with the following statements:

I would lean forward to change the track myself, even if it meant distracting the driver

My family would disapprove of me distracting the driver to change the track

It would be easy for me to leave the track playing

If I were to reach over my friend's shoulder whilst they were driving then we are more likely to have an accident

I would regret distracting my friend by leaning over their shoulder to change the track

My close friends would disapprove of me distracting the driver to change the track

Appendix 2B continued

Your friend has picked you up from the train station and is driving you home. It is late at night and there are very few cars on the road. Your friend decides that as the road is quiet, it's OK to drive above the speed limit. You notice that the speed is continuing to increase, and spot that they are driving at 50mph through a 30mph zone.
Please tell us to what extent you agree or disagree with the following statements:

I would ask my friend to slow down

It would be easy for me to ask my friend to slow down

My family would approve of me asking my friend to slow down

If I asked my friend to slow down, then he/she would listen to me and do as I asked

My close friends would think I was wrong to ask my friend to slow down

I would regret not asking my friend to slow down

It's Saturday night and you and a few of your friends are going to a party. You agree on a designated driver, but when it comes to the end of the evening you discover your designated driver has been drinking. You're not sure how much they've had, they're not staggering or slurring their words, but they are probably over the drink-drive limit. They tell you, "Home is only just down the road so I'm fine to drive."
Please tell us to what extent you agree or disagree with the following statements:

I would get into the car with my friend, even though he/she had been drinking

I would find it hard not to get into the car

My close friends would think I was stupid to get into the car

I would regret getting into the car

If my friend is over the legal drink driving limit we are more likely to have an accident

My family would approve of me if I refused to get in the car

After the party, you suspect that your friend is over the drink-drive limit. Your friend tells you, "I only live just down the road, so it'll be okay". You decide not to get into your friend's car, but your friend is still keen to drive home without you.
Please tell us to what extent you agree or disagree with the following statements:

I would ask my friend not to drive if he/she had been drinking

It would be easy for me to ask my friend not to drive home

My family would disapprove if I let my friend drive home without trying to talk him/her out of it

If I asked my friend not to drive home he/she would listen to me and do what I asked

I would regret not asking my friend to leave the car and walk home

My close friends would think I was stupid if I asked my friend not to drive home

Appendix 2B continued

Your friend has come to collect you from home to go shopping in town. It is not far, but it's raining and your friend has offered to drive you. You know that the journey will take less than ten minutes. As you reach for the seatbelt, your friend says, "Don't worry about that, it's only down the road".

Please tell us to what extent you agree or disagree with the following statements:

I would not bother to put my seatbelt on

I would regret not putting my seatbelt on

It would be easy for me to put my seatbelt on

My close friends would disapprove if I did not wear my seatbelt

If I were in a car accident and was not wearing a seatbelt, I would be more seriously injured than if I had worn one

My family would disapprove if I did not wear my seatbelt

Your friend has come to collect you from home to go shopping in town. It is not far, but it's raining and your friend has offered to drive you. You know that the journey will take less than ten minutes. When you get it into the car you notice that your friend is not wearing their seatbelt.

Please tell us to what extent you agree or disagree with the following statements:

I would ask my friend to put his/her seatbelt on

I would find it difficult to ask my friend to put their seatbelt on

My family would approve of me asking mt friend to put his/her seatbelt on

If I asked my friend to wear a seatbelt, he/she would listen to me and do as I asked

My close friends would approve of me asking my friend to put his/her seatbelt on

I would regret not asking my friend to wear his/her seatbelt

Appendix 2B continued

Your friend has driven you up North to see a concert. Your friend wants to get home so you have to travel back after the concert at 1 a.m. The journey will take at least 6 hours and your friend is already complaining that they are tired.

Please tell us to what extent you agree or disagree with the following statements:

I would get into the car, even though my friend is complaining of being tired

I would find it hard not to get into the car with my friend

I would regret it if I didn't get in the car with my friend

My family would approve of me if I did not get in the car

If my friend is tired we are more likely to have an accident

My other close friends would think I was stupid if I did get into the car

Your friend has driven you up North to see a concert. Your friend wants to get home so you have to travel back after the concert at 1 a.m. The journey will take at least 6 hours and your friend is already complaining that they are tired. You decide not to get into your friend's car and to get a cheap room in a hotel for the night, but your friend is still keen to drive home without you.

Please tell us to what extent you agree or disagree with the following statements:

I would ask my friend not to drive home

It would be easy for me to ask my friend not to drive home

My close friends would think I was stupid to ask my friend not to drive home

If I asked my friend not to drive home he/she would listen to me and do what I asked

I would regret not asking my friend to drive home the next day

My family would approve of me if I tried to talk my friend out of driving home

Appendix 2C Post-Intervention, DE+II condition script

Think back to the Learn2Live event you attended recently. You were told about how to be a safe passenger when your friends are driving. You were told several things to keep you safe - wear your seatbelt, don't get in a car with a drunk driver, don't distract the driver, and try to discourage speeding and the use of mobile phones whilst driving. Now we would like you to make a plan that will help you to become a safer passenger in the future.

First, think of something you currently do as a passenger that you would like to change so that it is safer. *E.g. not wearing a seatbelt*

……

How many times they currently do this behaviour:
each week ……
each month …….

	Not at all				*Very much*
How much do you want to make your chosen behaviour safer? (Please tick the relevant circle):	○	○	○	○	○

Now think about how you are going to make this **behaviour safer**. *E.g. put the seatbelt on*

……
……

Of course, if it were that easy you would probably do it all the time. So what might be stopping you? *E.g. you find the seatbelt uncomfortable.*

Write down what stops you from doing this behaviour more safely.

……
……

Now think about the things that could help you overcome this problem.

E.g. you could adjust the seatbelt to make it more comfortable, take your coat off, remove all bags and things in the way, move your seat to a more comfortable position, or think about the victims from the Learn2Live event and accept that a little discomfort is worth being safe.
Write down what you could do to **overcome the problem**.

……
……

You have a behaviour that you want to do more safely and a practical way of achieving it. Next you need to remember to do this every time you are in the car. *E.g. when I sit down I'll remember to put my seatbelt on and make it comfortable*
Write a **reminder** that you can use in the space below.

……
……

Now try to think about the behaviour you want to do safely in an "if-then" way.

For example:
IF *I sit down in the car* ***(reminder), THEN*** *I will put my seatbelt on* ***(safer behaviour)*** *and adjust it to make it comfortable* ***(overcome the problem).***

So now write down the plan for the behaviour that you have chosen to do more safely in the box below:

IF
…..……
……

THEN
……

Please spend a few moments imagining yourself carrying out your plan.

Close your eyes and imagine each part of your plan as vividly as you can. Don't worry if you feel a bit silly doing this, it will really help. Notice how everything looks, sounds and feels. Imagine carrying out each part of your plan in as much detail as you can.

Whenever you get into a car, with your friends or anyone else, remember the plan that you have just made, and try to use it to make your behaviour as a passenger safer.

Appendix 2D Post-Intervention, DE condition script

Think back to the Learn2Live event where you were told about how to be a safe passenger when your friends are driving. If you remember, you were told about several things to keep you safe - wear your seatbelt, don't get in a car with a drunk driver, don't distract the driver, and try to discourage speeding and the use of mobile phones whilst driving.

Please write down a few things that are relevant to you, that you could do to be a safer passenger when you are travelling in a car with friends.
Please write your answers here:

……
……

Now choose <u>one</u> behaviour that you want to change to make yourself a safer passenger. You can choose from your set of examples above or think of a new one.
Please write your answer here:
……

How many times do you think you do this: Each week? .....Each month? .. ..
How much do you want to make your chosen behaviour safer? 1 = Not at all, 5 = very much

Follow-up Implementation Intention Questions
Making a Change

We previously asked you to choose a risky passenger behaviour that you wanted to make safer. Please write down in the space provided what that behaviour was.
.....
.....

How many times do you think you do this behaviour now:

Per Week .....

Per Month .....

Did you find it difficult to make this behaviour safer? If so, why?
Yes ○
Somewhat ○
No ○

Reason _____

Appendix 3A The Sensitivity to Punishment and Sensitivity to Rewards Questionnaire (Torrubia et al, 2001)

Scale has been removed due to Copyright restrictions.

Appendix 3B Screenshot from Iowa Gambling Task (Bechara et al, 1994)

Appendix 3C Driver Behaviour Questionnaire (Reason et al, 1990)

Scale has been removed due to Copyright restrictions.

Chapter 5 Appendices

Appendix 5A Susceptibility to Peer Influence (SPI) scale (Sela-Shayovitz et al, 2008)

Scale has been removed due to Copyright restrictions.

Appendix 5B Resistance to Peer Influence (RPI) scale (Steinberg & Monahan, 2007)

Scale has been removed due to Copyright restrictions.

Appendix 5C Behaviour of Young Novice Drivers Scale (BYNDS) (Scott-Parker et al, 2012).

Scale has been removed due to Copyright restrictions.

Appendix 5D Pre- and- post intervention questionnaire of risky driving behaviour, adapted from Tisdale (2013)

Please read the following statements and indicate how often you have done the following things in the past month. Where 1 = never, 2 = infrequently (once or twice) 3 = sometimes (once a week) 4 = frequently (twice a week) 5 = always (most trips)

a) Talked on a mobile phone while driving
b) Text-messaged (read or sent) while driving
c) Almost fallen asleep while driving
d) Driven a vehicle without a seat belt
e) Ridden in a vehicle as a passenger without a seat belt
f) Driven with passengers who did not wear a seat belt
g) Driven 10 mph or more over the posted speed limit
h) Street-raced anyone
i) Run a red light
j) Driven a vehicle after drinking two or more alcoholic drinks*

* An alcoholic drink means any of the following:
A medium-sized can (or bottle) of beer
A small glass of wine
A shot of liquor straight or in a mixed drink

Appendix 5E Pre- and- post intervention questionnaire of attitudes and intentions towards risky driving, adapted from Burgess (2011)

Please indicate to what extent you agree or disagree with the following statements, where 1 = strongly disagree and 5 = strongly agree.

In the future I will probably overtake in situations which would be risky for others

It's okay if you don't wear a seatbelt on short journeys

It's alright if a passenger fails to wear a seatbelt

In the future I will probably drive faster than the speed limit.

I think drink driving is one of the leading causes of road accidents

It is completely acceptable for people to drive after only one or two drinks

In the future I will probably use my mobile phone to send or receive text messages whilst driving.

I think speed limits are often set too low

I feel it is safer if the speed limits on 30mph roads are strictly enforced

I think distracting the driver in any way could result in a serious crash

It is acceptable to distract the driver whilst he/she is driving

In the future I will probably use my mobile phone to make or receive a phone call whilst driving.

It is acceptable for people to use a mobile phone while driving

I think mobile phone usage is one of the leading causes of road accidents

In the future I will probably drive whilst under the influence of alcohol or drugs.

Some drivers can be perfectly safe overtaking in situations which would be risky for others

People stopped by the police for dangerous overtaking are unlucky because lots of people do it

In the future I will probably drive without wearing a seatbelt.

Appendix 5F The PowerPoint presentation and script used by peer leaders in the first peer-to-peer event

DRIVE: A NEW ROAD SAFETY INITIATIVE

Q1. What is the most common cause of road traffic accident (RTA)?

- a. Mechanical failure
- b. Weather conditions
- c. Road conditions
- d. Human error

Q2. How many people between 18-24 years old crash within 2 years of passing their driving test?

- a. 1/2
- b. 1/4
- c. 1/8
- d. 1/16

Q3. For a male to be over the alcohol limit for driving he must drink 4 units, what does this equate to?

- a. 3 alcopops (275ml, 5.5%)
- b. 2 medium glasses of wine (175ml, 12%)
- c. 2 small (125ml of 12%) glasses of wine & a single shot of spirit (25ml, 40%)
- d. 2 pints of beer/larger/cider (5.2%)

Q4. Taking some drugs are likely to affect your driving. What should you do?

- a. Limit driving to essential journeys
- b. Seek medical advice or don't drive
- c. Only drive if accompanied by a full licence holder
- d. Drive regardless of the risk

Q5. How much slower are your reaction times when driving and using a mobile phone at the same time?

- a. 75%
- b. 25%
- c. 50%
- d. 10%

Q6. How likely are young drivers (17-24) to look at their phone whilst driving if it rings or beeps?

- a. 58%
- b. 12%
- c. 68%
- d. 34%

Q7. In a 2013 study, what percentage of young, new drivers made an average of three mistakes when listening to their preferred type of music?

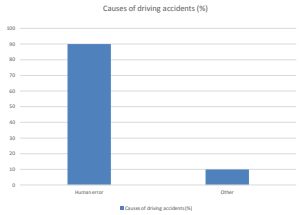
- a. 28%
- b. 51%
- c. 74%
- d. 98%

ANSWERS

A1. What is the most common cause of road traffic accident (RTA)?

a. Mechanical failure	b. Weather conditions
c. Road conditions	d. Human error

"More than 90% of road traffic accidents (RTA) are cause by human error" www.alertdriving.com (2011)



Examples of Human Errors

Speeding	Reckless driving	Drink driving
Running stop signs	Drowsy drivers	Road rage
Wrong-way driving	Improper turns	Running red light
Driving under the influence of drugs	Unsafe lane changes	Distracted driving

A2. How many people between 18-24 years old crash within 2 years of passing their driving test?

a. 1/2	b. 1/4
c. 1/8	d. 1/16

A3. For a male to be over the alcohol limit for driving he must drink 4 units, what does this equal to?

a. 3 alcopops (275ml, 5.5%)	b. 2 medium glasses of wine (175ml, 12%)
c. 2 small (125ml of 12%) glasses of wine & a single shot of spirit (25ml, 40%)	d. 2 pints of beer/larger/cider (5.2%)

NOTE that **all 3** other options would leave you <u>over the limit</u>!

- 3 alcopops (275ml, 5.5%)
- 2 medium glasses of wine (175ml, 12%)
- 2 pints of beer/larger/cider (5.2%)

For females, the advised limit is 3 units of alcohol. So even these examples would be to much!!!

If you get caught drink driving you could face…

- A minimum 12 month driving ban
- A criminal record
- A fine of up to £5,000
- An endorsement on your licence for 11 years

A4. Taking some drugs are likely to affect your driving. What should you do?

a. Limit driving to essential journeys	b. Seek medical advice or don't drive
c. Only drive if accompanied by a full licence holder	d. Drive regardless of the risk

The **criminal consequences** are the same as drink driving!!

The consequences of a drug drive conviction are far reaching and can include:

•Job loss

•Loss of independence

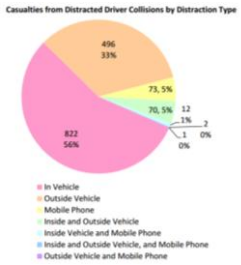
•The shame of having a criminal record

•Increase in car insurance costs

•Trouble getting in to countries like the USA

A5. How much slower are your reaction times when driving and using a mobile phone at the same time?

a. 75%	b. 25%
c. 50%	d. 10%



Casualties from Distracted Driver Collisions by Distraction Type in the North East of the UK in 2012.

A6. How likely are young drivers (17-24) to look at their phone whilst driving if it rings or beeps?

a. 58%	b. 12%
c. 68%	d. 34%

A7. In a 2013 study, what percentage of young, new drivers made an average of three mistakes when listening to their preferred type of music?

a. 28%	b. 51%
c. 74%	d. 98%

32% had to be warned or told to move quickly

20% had to be assisted with steering or breaking

In order to *avoid* a **collision**!

END OF QUESTIONS

In the event of a tie score,
We will go on to a final quick fire round…

QUICK FIRE ROUND

CLOSEST/QUICKEST ANSWER WINS

THANK YOU FOR COMING!

Don't forget to come along to the second event for fun and games with beer goggles!

Hi everyone,
Thank you for coming to the first **DRIVE** event. We have set this initiative up because we want to try a different way of approaching the issue of road safety. We young drivers as a group are still involved in more collisions than anyone else and we want to see this change. We are students ourselves, and we want to get everyone thinking about the issue, and thinking about how we can become safer drivers of our own accord.
So welcome! This first event is a quiz to see how much we all know about young drivers and hopefully learn something new . You will all have your own answer sheet so make sure you write your name at the top – there will be a small prize for the winner, but if you get stuck, you can work together!

When the quiz is finished, we will ask you to swap answer sheets and mark the answers of the person next to you. In the event of a tie, or a mass tie, we will continue to the quick fire round!
So, question 1!

Please switch answer sheets with the person next to you and ask us any questions or fill in any answers you missed. Then we will start going through the answers
Each answer in turn. One point for every correct answer. Ask them to call out if they are unsure of giving any points.

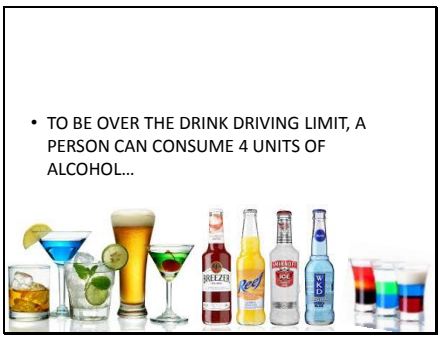
We'll come round now and collect your answer sheets, and then we will call either the person or persons with the highest score up to the front for the quick fire round.

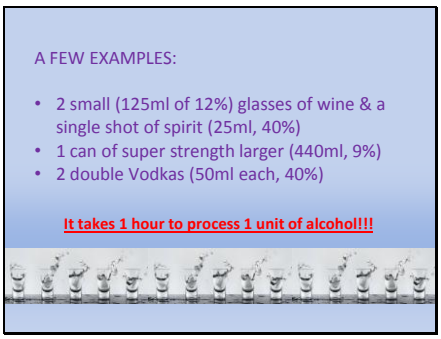
This is how the quick fire round is going to work – please can you pair up with the person next to you.

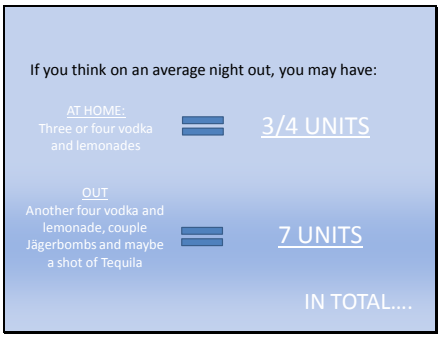
Each pair will now be asked a question, the first person to correctly shout out the question in the quickest amount of time will win the round and pair up with another winner. Answers that are not quite correct but similar to the correct answer will be judge accordingly.
This will keep going until 1 pair is left – who ever answers the question correctly in the quickest time in the final pair will win a prize.
Everyone else listen in closely, you may learn something that might be useful for the next event.

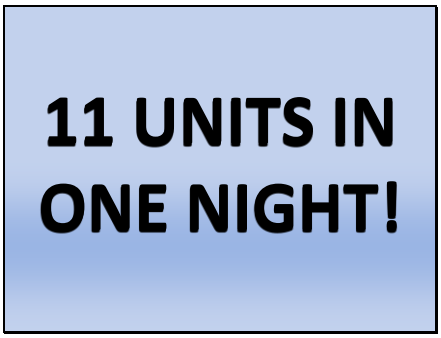
OK, well done (winners name). We hope you all enjoyed the quiz and took something away from it. At the next event we'll be playing games with beer goggles and there will be more of a chance for you to share your own thoughts and experiences as a young driver if you'd like to. In the meantime we'll send over some web links and video clips that you might find interesting, we'd love to hear your feedback.
Thanks again for coming

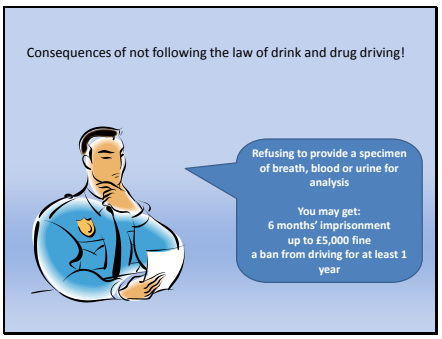
Appendix 5G The PowerPoint presentation used by peer leaders in the second peer-to-peer event









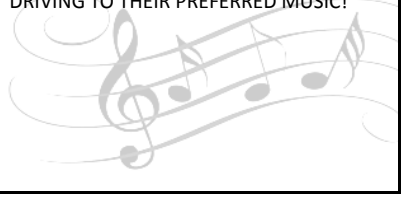


Just as alcohol can stay in your blood stream for up to 24 hours after you've had a drink, drugs can stay in your system for weeks!

Around 18% of people killed in road crashes have traces of illegal drugs in their blood, with cannabis being the most common.

- MUSIC CAN HAVE AN EFFECT ON THE WAY YOU DRIVE TOO…

98% OF YOUNG, NEW DRIVERS MADE AN AVERAGE OF THREE MISTAKES WHEN DRIVING TO THEIR PREFERRED MUSIC!



- THESE MISTAKES INCLUDED:

20%
BEING ASSISTED WITH STEERING OR BREAKING.

32%
BEING TOLD OR WARNED TO MOVE QUICKLY

Divided attention…

Drivers who perform a secondary task at the wheel are 2 or 3 times more likely to crash.

Other more complex tasks, like talking on a mobile phone or texting, can increase crash risk even more.

You can be fined up to £500 if you don't wear a seat belt when you're supposed to.

Studies suggest that drivers using a mobile phone are approximately four times more likely to be involved in a crash than when a driver does not use a phone.

The points…

If caught being **in charge of a vehicle** while your above the alcohol limit you can get **10 points** on your driving licence for **4 years**.

If you **fail to provide a specimen for a breath test** you can receive **4 points** on your driving license for **4 years**.


Think…
Don’t Drink and DRIVE!
Hear your phone?… Ignore it!
Music on… but turn it down!
…SAFETY FIRST!!

Appendix 5H Script used by peer leaders during the second peer-to-peer event

HI EVERYONE, WELCOME BACK TO THE SECOND PART OF THE 'DRIVE'ROAD SAFETY INITIATIVE. AS YOU MAY REMEMBER, LAST TIME YOU ATTENDED YOU TOOK PART IN A QUIZ LOOKING AT NUMEROPUS ASPECTS OF ROAD SAFETY AND YOUNG DRIVERS.
TODAYS SESSION IS GOING TO BE A LITTLE MORE INTERACTIVE AND YOU SHOULD BE READY TO HAVE A BIT OF FUN, HAVING THE FEELING OF BEING INTOXICATED WHILST BEING COMPLETELY SOBER. HAS ANYONE EVER HEARD OF OR USED 'BEER GOGGLES'?
WITH THE USE OF SPECIAL LENSES, THESE GOGGLES CAN REPLICATE THE EFFECTS OF EXCESSIVE DRINKING AND THE VISUAL IMPAIRMENTS THAT ARE ASSOCIATED WITH IT.
TODAY WE HAVE5 5 ACTIVITIES SET OUT:

1. WALKING IN A STRAIGHT LINE: TO BEGIN WITH THE TASK WILL BE COMPLETED WITHOUT THE GOGGLES FOR THE PARTICIPANTS TO SEE HOW EASY IT IS WITHOUT THE GOGGLES. WITH THE USE OF THE BEER GOGGLES, WHICH IS USED BY THE POLICE AS A SOBERITY TEST ON THE ROADSIDE, THE PARTICIPANT MUST WALK IN A STRIGHT LINE, MAKING SURE TO WALK HEEL TO TOE WITH EACH STEP (THERE WILL BE TWO VERSIONS OF THIS ACTIVITY FOR SECOND SESSION)

2. PICK UP DRIVING LICENSE FROM THE FLOOR FROM A SELECTION OF DIFFERENT CARDS (WHO EVER PICKS UP THE CARD FIRST OR THE QUICKEST, CAN WIN BAG OF SWEETS)

3. THROWING A BALL INTO A BUCKET: WHOEVER CAN GET THE FURTHEST AWAY AND STILL GET THE BALL IN THE BUCKET. THIS GAME WILL BE PLAYED IN TEAMS, 2 GROUPS OF 3 (1ST SESSION) EACH TIME THEY GET A BALL IN THE BUCKET THEY MOVE BACK .5 METRES. PLAY AS A RELAY RACE, FIRST PERSON GOES AND GETS TO CERTAIN POINT, TAGS NEXT PERSON AND SO ON UNTIL ALL TEAM MEMBERS HAVE GONE. FASTEST WINS?

4. TEXTING GAME: TAKING IT IN TURN ONE PERSON WILL BE GIVEN A PHRASE IN WHICH THEY WILL HAVE TO WRITE OUT AS A TEXT ON THEIR PHONE (THE TEXT MUST BE LEGIBLE). WHILST THIS IS GOING ON THEY WILL BE ASKED QUESTIONS THAT THEY HAVE TO ANSWER, AS WELL AS KEEPING AN EYE OUT FOR A BALL THAT CAN BE THROWN AT THEM AT ANY MOMENT TO WHICH THEY HAVE TO CATCH. IF THAT WASN'T ENOUGH THE PERSON ALSO HAS TO ALSO DODGE OBSTICLES. THIS TASK LOOKS AT THE EFFECTOF DIVIDED ATTENTION WHICH OCCURS WHEN USING A MOBILE PHONE AND DRIVING.

EACH GROUP WILL STAY ON THE ACTIVITY FOR ROUGHLY 5 MINUTES, ALLOWING TIME FOR EACH PERSON TO HAVE A GO AT ALL AVCTIVITIES. SECOND SESSION EACH GROUP WILL GET A CHANCE TO DO TWO OUT OF THE FOUR ACTIVITIES, EACH TAKING ROUGHLY 10 MINUTES TO ALLOW FOR ALL PARTICIPANTS TO TAKE PART

SO IF YOU COULD GET INTO GROUPS OF __ WE CAN START HAVING SOME FUN WITH THE BEER GOGGLES!!!

Simultaneously three games will play alongside each other. Participants will be split into groups:

Session 1 (6 participants) either groups of 2/3 depending on willingness, possibility for all 6 participating together, roughly 5 minutes per activity depending on numbers (may finish slightly before 3:00 p.m. due to small numbers)

1.WALKING IN A STRAIGHT LINE: TO BEGIN WITH THE TASK WILL BE COMPLETED WITHOUT THE GOGGLES FOR THE PARTICIPANTS TO SEE HOW EASY IT IS WITHOUT THE GOGGLES. WITH THE USE OF THE BEER GOGGLES, WHICH IS USED BY THE POLICE AS A SOBERITY TEST ON THE ROADSIDE, THE PARTICIPANT MUST WALK IN A STRIGHT LINE, MAKING SURE TO WALK HEEL TO TOE WITH EACH STEP.

2.PICK UP DRIVING LICENSE FROM THE FLOOR (WHO EVER PICKS UP THE CARD FIRST OR THE QUICKEST). PARTICIPANTS FACE AWAY AND THE CARD IS PLACED ON THE FLOOR, ALREADY WITH THE BEER GOGGLES ON THEY TURN AROUND TO FIND THE CARD.

3.THROWING A BALL INTO A BUCKET: WHOEVER CAN GET THE FURTHEST AWAY AND STILL GET THE BALL IN THE BUCKET. THIS GAME WILL BE PLAYED IN TEAMS, 2 GROUPS OF 3 (1ST SESSION) EACH TIME THEY GET A BALL IN THE BUCKET THEY MOVE BACK .5 METRES. PLAY AS A RELAY RACE, FIRST PERSON GOES AND GETS TO CERTAIN POINT, TAGS NEXT PERSON AND SO ON UNTIL ALL TEAM MEMBERS HAVE GONE.

4. TEXTING GAME: TAKING IT IN TURN ONE PERSON WILL BE GIVEN A PHRASE IN WHICH THEY WILL HAVE TO WRITE OUT AS A TEXT ON THEIR PHONE (WAIT FOR ME, I WILL BE TEN MINUTES). THE TEXT MUST BE LEGIBLE). WHILST THIS IS GOING ON THEY WILL BE ASKED QUESTIONS THAT THEY HAVE TO ANSWER, AS WELL AS KEEPING AN EYE OUT FOR A BALL THAT CAN BE THROWN AT THEM AT ANY MOMENT TO WHICH THEY HAVE TO CATCH. IF THAT WASN'T ENOUGH THE PERSON ALSO HAS TO ALSO DODGE OBSTICLES (WALK AROUND A CHAIR TWICE AND SIT ON ANOTHER CHAIR PLACED ACROSS THE ROOM). THIS TASK LOOKS AT THE EFFECT OF DIVIDED ATTENTION WHICH OCCURS WHEN USING A MOBILE PHONE AND DRIVING.

5.TWO COMPUTERS WILL BE SET UP WITH THE 'MORNING AFTER CALCULATOR' 3 PARTICIPANTS WILL CROWD ROUND EACH COMPUTER AND HAVE A GO. GIVING THERE MOST ACURATE RECOLECTION OF WHAT THEY MAY DRINK ON A NIGHT OUT.

WE WOULD JUST LIKE TO THANK YOU FOR ALL PARTICIPATING IN THIS STUDY, OUR AIM WAS TO SEE HOW WE, AS YOUR PEERS, COULD HELP TO CHANGE PEOPLE'S ATTITUDES TOWARDS ROAD SAFETY, AND HOPEFULLY ENCOURAGE YOU TO MAKE SAFER DECISIONS WHEN DRIVING IN THE FUTURE. WHEN WE CHOOSE TO SPEED, TO READ THAT QUICK TEXT FROM A FRIEND, TO NOT BOTHER WITH A SEATBELT, WE DON'T THINK ABOUT WHAT COULD REALISTICALLY HAPPEN AS A RESULT. WE HAVE SO MANY NEAR-MISSES, AND PAST EXAMPLES OF

WHERE WE DIDN'T CRASH, WHERE EVERYTHING WAS OK THAT WE THINK IT'LL BE THE SAME NEXT TIME. BY TAKING YOUR ATTENTION OFF THE ROAD FOR EVEN A SPLIT-SECOND YOU INCREASE THE CHANCE OF COLLISON DRAMATICALLY. PLEASE THINK ABOUT DRIVING, ABOUT THE PASSESNGERS WHO YOU ARE RESPONSIBLE FOR, AND THE OTHER INNOCENT ROAD USERS. IN A MONTH YOU WILL RECEIVE AN EMAIL CONTAINING A LINK TO ONE LAST QUESTIONNAIRE THAT WE WILL REQUIRE YOU TO FILL IN. OTHERWISE THAT IS IT FOR TODAY. AGAIN WE HOPE YOU ENJOYED EVERYTHING AND WERE ABLE TO TAKE AWAY SOME INFORMATION FROM THE TWO SESSIONS. ANY QUESTIONS PLEASE JUST ASK ME OR LAUREN, ALTERNATIVELY YOU WILL FIND MY EMAIL ADDRESS ON THE CREDIT SITE OR LAURENS ON THE PAID. THANK YOU AGAIN!

At the end, ask participants what they found the hardest/ best example of being drunk.

Appendix 5I Additional communication sent to peer-to-peer intervention participants

We, as young adults, underestimate the risk of dangerous driving. We are less likely than older drivers to rate speeding as high risk. But excessive or inappropriate speed is a key contributory factor in our crashes, with a third of fatal young driver crashes being speed-related. Do you really need to speed? How many seconds will it save you? That can't be worth the risk can it? Let us know your thoughts, is speeding inevitable?
In the meantime, have a go at this driving challenge. Only 19% of people pass, will you be one of them? http://think.direct.gov.uk/drivingchallenge/

Drivers in their 20s have the highest rates of both drink and drug driving crashes. Young drivers who crash are twice as likely to be impaired by alcohol as older drivers who crash. One study found that almost one in 10 (9%) of 17-24 year olds in the UK admit having driven on drugs. Will you be a statistic? Designate a sober driver, or call a taxi. Star cabs (200020) and Taxifast (222222) are both reasonable!

Mobile phone use while driving is increasing. 80% of young drivers make or receive phone calls while driving and 72% text. The popular craze of creating vines whilst on the road increases the risk of collision hugely. Before you answer the call or check that text, think – can it wait? Put the safety of you and your fellow road users first. What would stop you using your phone while driving? Let us know your ideas. In the meantime have a go at playing this game and see how good your driving is when you're distracted.. http://www.its.umn.edu/DistractionDodger/

Research shows that peer pressure can encourage bad driving and result in drivers 'showing off' to their passengers and taking more risks. And it's not just deliberate risk-taking that has an effect. Young passengers can also cause distraction: teenage drivers are six times more likely to have a serious incident when there is loud conversation in the vehicle. So the next time you're in a car with your friends think beyond the funny chat, or the good song that's turned up loud. Be considerate.

Have a go at one of these driving simulator games and see how your driving fares under distraction from different influences: http://dropitanddrive.com/driving-simulators/

Appendix 5J Web URLs and instructions provided to fear appeal group participants

You will shortly be presented with three short road safety awareness videos. Please watch these videos carefully and consider their content. Please do not close the browser whilst the videos are playing, as you will be required to answer a few questions afterwards.

https://www.youtube.com/watch?v=g-9JR2P4wWI

(31 secs)

https://www.youtube.com/watch?v=aiAn21oa-J0
(2mins2secs)

https://www.youtube.com/watch?v=R0LCmStIw9E
(4mins15secs)